CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833-2937
Tel 916.920.0300
Fax 916.920.8463

CH2MHILL

DOCKET	
09-AFC-4	
DATE	NOV 19 2010
RECD.	NOV 19 2010

November 19, 2010

Mr. Pierre Martinez
Siting Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Subject: Oakley Generating Station Project (09-AFC-4)
Construction Drainage, Erosion, and Sediment Control/ Stormwater Pollution Prevention Plan

Dear Mr. Martinez:

Attached please find three (3) hardcopies and one (1) CDROM of the Construction Drainage, Erosion, and Sediment Control/ Stormwater Pollution Prevention Plan (DESCP/SWPPP) for the Oakley Generating Station (09-AFC-4). The total number of pages in the appendixes exceed 1,000 pages but the only significant change to the DESCP/SWPPP appendixes since the March 2010 submittal is the revised Preliminary Stormwater Management Plan (Appendix E). Therefore, all appendixes have been included on the electronic version but the attached hard copy of the document contains only a printout of the revised Preliminary Stormwater Management Plan.

If you have any questions about this matter, please contact me at (916) 286-0278.

Sincerely,

CH2M HILL

Douglas M. Davy, Ph.D.
AFC Project Manager

cc: POS List
Project File

Draft

Construction Drainage, Erosion, and Sediment Control/ Stormwater Pollution Prevention Plan

for the

Oakley Generation Station

(09-AFC-4)

Submitted to the:

California Energy Commission

Submitted by:

RADBACK ENERGY

With Technical Assistance by:

CH2MHILL

Sacramento, California

November 2010

Contents

Section **Page**

SWPPP Certification by Qualified SWPPP Developer (QSD) vii

1. SWPPP Requirements..... 1-1
1.1 Introduction..... 1-1
1.2 Permit Registration Documents 1-2
1.3 SWPPP Availability and Implementation..... 1-3
1.4 SWPPP Amendments 1-3
1.5 Retention of Records 1-3
1.6 Required Non-compliance Reporting 1-3
1.7 Annual Report 1-4
1.8 Changes to Permit Coverage 1-4
1.9 Notice of Termination..... 1-5

2. Project Information 2-1
2.1 Project and Site Description 2-1
2.1.1 Site Description 2-3
2.1.2 Site Characteristics..... 2-4
2.1.3 Estimated Total Disturbed Area 2-9
2.1.4 Existing Drainage 2-10
2.1.5 Proposed Drainage 2-11
2.1.6 Construction and Maintenance Access Road 2-12
2.1.7 Clearing and Grading Plans/Earthwork 2-12
2.2 Stormwater Run-On from Offsite Areas 2-13
2.3 Findings of the Construction Site Sediment and Receiving Water Risk Determination 2-14
2.3.1 Sediment Risk..... 2-14
2.3.2 Receiving Water Risk 2-15
2.4 Construction Schedule..... 2-15
2.5 Potential Construction Site Pollutant Sources..... 2-16
2.6 Identification of Non-Stormwater Discharges 2-16

3. Best Management Practices 3-1
3.1 Schedule for BMP Implementation..... 3-1
3.1.1 Implementation Schedule..... 3-1
3.2 Erosion and Sediment Control 3-2
3.2.1 Erosion Control 3-2
3.2.2 Sediment Controls 3-4
3.2.3 Wind Erosion Control 3-5
3.2.4 Tracking Control..... 3-5
3.3 Non-stormwater and Materials Management..... 3-6
3.3.1 Waste Management and Materials Pollution 3-7
3.4 Post-construction Stormwater Management Measures 3-10

4. BMP Inspection, Maintenance, and Rain Event Action Plans 4-1
4.1 BMP Inspection and Maintenance.....4-1
4.1.1 Site Inspections.....4-1
4.1.2 Maintenance.....4-2
4.2 Rain Event Action Plans.....4-3

5. Training.....5-1

6. Responsible Parties and Operators 6-1
6.1 Responsible Parties.....6-1
6.2 Contractor List.....6-1

7. Construction Site Monitoring Program 7-1
7.1 Purpose.....7-1
7.2 Applicability of Permit Requirements 7-1
7.3 Monitoring Locations 7-1
7.4 Safety 7-2
7.5 Visual Monitoring (Inspections) 7-2
7.5.1 Non-Stormwater Discharge Monitoring Requirements 7-3
7.6 Water Quality Sampling and Analysis 7-3
7.6.1 Identification of Non-visible Pollutants.....7-4
7.6.2 Sample Collection and Handling.....7-4
7.7 Watershed Monitoring Option.....7-7
7.8 Quality Assurance and Quality Control.....7-7
7.9 Reporting Requirements and Records Retention 7-8

8. References.....8-1

Tables

2.1-1 Soil Mapping Units
2.1-2 Historical Rainfall
2.1-3 Disturbed Area
2.4-1 Construction Schedule
7.6-1 Potential Non-visible Pollutants and Water Quality Indicator Constituents

Figures

1.1-1 Vicinity Map
1.1-2 Site and Linear Facilities Location Map
2.1-1 General Site Arrangement
2.1-2 Project Area Map
2.1-3 Land Use
2.1-4 Soils
2.1-5 Surface Water
2.1-6 Groundwater Resources
2.1-7 Grading and Drainage Site Plan (Sheets 1 and 2)
2.1-8 Post Development Drainage Plan
3.2-1 Project Site and Laydown Area BMP Map
3.2-2 Stockpile BMP Map
3.2-3 Transmission Line BMP Map (Sheets 1 and 2)
3.2-4 Example Installation Methods
3.2-5 Surfacing/Fencing/Roadway (Sheets 1 and 2)

Appendixes

A Construction General Permit
B Submitted Permit Registration Documents:
NOI, Risk Assessment (Construction Site Sediment and Receiving Water Risk Determination); Site Map (including vicinity map); Signed Certification Statement
C SWPPP Amendment Log
D Submitted Changes to PRDS (due to change in ownership or acreage)
E Preliminary Stormwater Management Design
F Risk Level 1 Requirements
G Construction Schedule
H CASQA BMP Handbook Fact Sheets
I Authorized Inspection Individuals
J Construction Site Inspection Report Forms
K Training Reporting Form
L Responsible Parties
M Contractors and Subcontractors
N Construction Site Monitoring Program
O Notice of Discharge

SWPPP Certification by Qualified SWPPP Developer (QSD)

QSD Name: Mieke Sheffield

Telephone: (530) 515-7850

Qualifying Professional Registration: Certified Professional in Stormwater Quality (CPSWQ)

Date of SWPPP Preparation: 11/02/2010

"I certify that this document and all attachments were prepared under my guidance, direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Printed Name of QSD: Mieke Sheffield

Signature: M. Sheffield

SECTION 1

SWPPP Requirements

1.1 Introduction

Contra Costa Generating Station, LLC, proposes to construct a state-of-the-art electrical generating plant in Oakley, Contra Costa County, California. The Oakley Generating Station (OGS) will be a natural gas-fired, combined-cycle electrical generating facility rated at a gross nominal generating capacity of 624 megawatts (MW).[1] As presented in Figure 1.1-1 and Figure 1.1-2, the facility will be located in Oakley, Contra Costa County, California on a 21.95-acre parcel that is currently part of a larger 210-acre parcel owned by E. I. du Pont de Nemours and Company (DuPont).

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared to comply with the California General Permit for *Storm Water Discharges Associated with Construction and Land Disturbance Activities* (General Permit), the State Water Resources Control Board (SWRCB) Order No. 2009-0009-DWQ for the General Permit and the Contra Costa Clean Water Program Stormwater C.3 Guidebook. A copy of the General Permit is located in Appendix A. A copy of the SWPPP and the General Permit will be kept on site for the duration of the project. This SWPPP has also been submitted to the Regional Water Quality Control Board (RWQCB) via the Stormwater Multi Application and Report Tracking System (SMARTS). The primary objectives of the SWPPP as identified in the General Permit (Section XIV.A) are listed on the following page. This SWPPP will also be separately submitted to the California Energy Commission (CEC) to meet CEC requirements for a Drainage, Erosion and Sediment Control Plan (DESCP). Officially this document is labeled as a DESCP/SWPPP, whereas in this document it is referred to as a SWPPP.

A Qualified SWPPP Developer (QSD) must prepare SWPPPs for projects covered by the General Permit. The SWPPP applies to all areas that are directly related to the construction activity, including but not limited to staging areas, storage yards, material borrow areas, access roads, etc. In most cases, the owner will enter into a contractual agreement with the QSD for preparation and with the QSP for the implementation of the SWPPP. However, owners must be aware that regardless of the contractual agreement between the owner and contractor with respect to BMP selections and SWPPP implementation, the owner is ultimately responsible for compliance with the General Permit. It is highly recommended that the owner and contractor jointly review the SWPPP with the QSD and QSP during its development and/or during a pre-construction conference. The SWPPP is a document that addresses water pollution control during construction. The SWPPP must be prepared, submitted electronically, and available on the project site before the project owner, developer, or contractor begins any activity with the potential to cause water pollution. The SWPPP must be implemented year-round throughout the duration of the construction project and it must be available on site at all times.

[1] Approximate facility output with both combustion turbines operating at 100 percent load at average January conditions (47 degrees F, 73 percent relative humidity)

The SWPPP shall be designed to address the following objectives:

1. All pollutants and their sources, including sources of sediment associated with construction, construction site erosion and all other activities associated with construction activity are controlled
2. Where not otherwise required to be under a RWQCB permit, all non-stormwater discharges are identified and either eliminated, controlled, or treated
3. Site Best Management Practices (BMPs) are effective and result in the reduction or elimination of pollutants in stormwater discharges and authorized non-stormwater discharges from construction activity to the Best Available Technology/Best Control Technology (BAT/BCT) standard
4. Calculations and design details as well as BMP controls for site run-on are complete and correct
5. Stabilization BMPs installed to reduce or eliminate pollutants after construction are completed

Additional SWPPP objectives are to:

- Identify post-construction BMPs, which are those measures to be installed during construction that are intended to reduce or eliminate pollutants after construction is completed (post-construction BMPs are required for all sites by Section XIII.B).
- Identify and provide methods to implement BMP inspection, visual monitoring, Rain Event Action Plan (REAP) as required, and Construction Site Monitoring Program (CSMP) requirements to comply with the General Permit.

1.2 Permit Registration Documents

Permit Registration Documents (PRDs) were submitted on [add submittal date]. To obtain coverage under the Construction General Permit, project related PRDs must be submitted to the SWRCB via SMARTS by the Legally Responsible Person (LRP).

The PRDs for this project (listed below) were submitted to SMARTS and copies of them are included in Appendix B.

1. Waste Discharge Identification (WDID) confirmation
2. Notice of Intent (NOI)
3. Risk Assessment (Construction Site Sediment and Receiving Water Risk Determination)
4. Site Map
5. Annual Fee
6. Signed Certification Statement
7. This SWPPP is also required to be filed electronically and has been submitted to the SWRCB as a PRD

1.3 SWPPP Availability and Implementation

The General Permit (Section XIV.C) requires the SWPPP be available at the construction site during working hours while construction is occurring and shall be made available upon request by a State or Municipal inspector. When the original SWPPP is retained by a crewmember in a construction vehicle and is not currently at the construction site, current copies of the BMPs and map/drawing will be left with the field crew and the original SWPPP shall be made available via a request by radio/telephone. The SWPPP shall be implemented concurrently with the start of ground disturbing activities.

1.4 SWPPP Amendments

The General Permit requires that SWPPPs be amended or revised by a QSD (Section XIV.A) and that the SWPPP include a listing of the date of initial preparation and the date of each amendment. Amendments must be signed by a QSD (Section VII.B.6). A log of all amendments (dated) will be kept throughout the duration of the project in Appendix C.

1.5 Retention of Records

The General Permit *(Sections I.J.69 and IV.G)* requires that all dischargers maintain a paper or electronic copy of all required records for three years from the date generated or date submitted, whichever is last. These records must be available at the construction site until construction is completed. The discharger shall furnish the RWQCB, SWRCB, or US Environmental Protection Agency (EPA), within a reasonable time, any requested information to determine compliance with this General Permit. This record will be located in a separate binder, and stored onsite with the SWPPP.

1.6 Required Non-compliance Reporting

The General Permit identifies several areas of non-compliance reporting. It is the responsibility of the permittee to properly document reportable discharges or other violations of the General Permit. Exceedances and violations should be reported using the SMARTS system. Under Risk Level 1, OGS is required to report violations through the following methods:

- Self-reporting of any discharge violations or to comply with RWQCB enforcement actions.
- Discharges which contain a hazardous substance in excess of reportable quantities established in 40 CFR §§ 117.3 and 302.4, unless a separate National Pollutant Discharge Elimination System (NPDES) Permit has been issued to regulate those discharges.

Any non-compliance events will be logged on the Notice of Discharge form in addition to reporting through the SMARTS system.

1.7 Annual Report

The General Permit requires that all permittees prepare, certify, and electronically submit an Annual Report no later than September 1 of each year. Reporting requirements are identified in Section XVI of the General Permit and include (but are not limited to) providing a summary of:

1. Sampling and analysis results including laboratory reports, analytical methods and reporting limits and chain of custody forms (Risk Levels 2 and 3 only)
2. Corrective actions and compliance activities, including those not implemented
3. Violations of the General Permit
4. Date, time, place, and name(s) of the inspector(s) for all sampling, inspections, and field measurement activities
5. Visual observation and sample collection exception records
6. Training documentation of all personnel responsible for General Permit compliance activities

It is the responsibility of the Qualified SWPPP Practitioner (QSP) to be responsible for overall site management, including making site personnel aware of required data collection and reporting elements of the SWPPP. The QSP is a certified individual assigned responsibility for the implementation of all elements of the SWPPP, including non-stormwater and stormwater visual observations, sampling and analysis, and preparation of Rain Event Action Plans.

1.8 Changes to Permit Coverage

In the event of a change to the permit coverage, the General Permit (Section II.C) allows a permittee to reduce or increase the total acreage covered under the General Permit when a portion of the project is complete and/or conditions for termination of coverage have been met; when ownership of a portion of the project is sold to a different entity; or when new acreage is added to the project.

To change the acreage covered, the permittee must electronically file modifications to PRDs (revised NOI, site map, SWPPP revisions as appropriate, and certification that new landowners have been notified of applicable requirements to obtain permit coverage (including name, address, phone number, and e-mail address of new landowner) in accordance with requirements of the General Permit within 30 days of a reduction or increase in total disturbed area. Include any updates to PRDs submitted via SMARTS in SWPPP Appendix D. The QSD or assigned person must document any related SWPPP revisions and/ or amendments (SectionII.C.2) in SWPPP Appendix C.

1.9 Notice of Termination

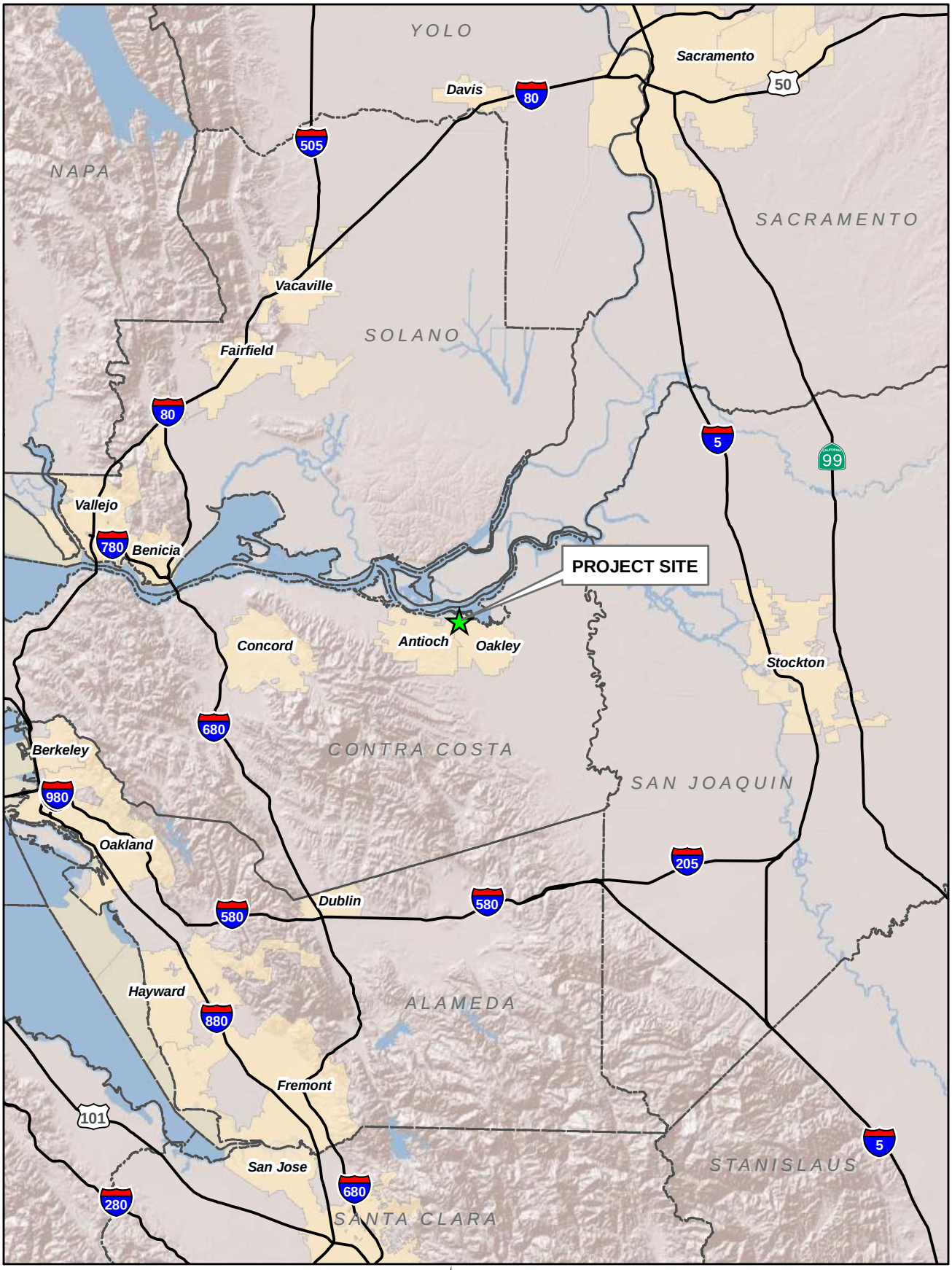
To terminate coverage under the General Permit, a Notice of Termination (NOT) must be submitted electronically via SMARTS. A "final site map" and photos are required to be submitted with the NOT. Filing a NOT certifies that all General Permit requirements have been met. The NOT is submitted when the construction project is complete and within 90 days of meeting all General Permit requirements for termination and final stabilization (Section II.D) including:

- The site will not pose any additional sediment discharge risk than it did prior to construction activity.
- All construction related equipment, materials and any temporary BMPs no longer needed are removed from the site.
- Post-construction stormwater management measures are installed and a long-term maintenance plan that is designed for a minimum of five years has been developed.

The NOT must demonstrate through photos, Revised Universal Soil Loss Equation (RUSLE) results, or results of testing and analysis that the project meets all of the requirements of Section II.D.1 of the General Permit by one of the following methods:

- 70 percent final cover method (no computational proof required)
- RUSLE/RUSLE2 method (computational proof required)
- Custom method (discharger demonstrates that site complies with final stabilization)

Figures



LEGEND

PROJECT SITE

N

0 5 10
Miles

FIGURE 1.1-1
Project Vicinity
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

SAC\\ZION\SACGIS\PROJ\RADBACKENERGY\385962\MAPFILES\VICINITYMAP.MXD MHASKELL 6/15/2009 17:35:29
IS012010223151SAC Figure_1.1-1.ai 03.03.2010 tdaus

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 1,000 2,000
Feet

FIGURE 1.1-2
Site And Linear Facilities Location Map
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

\\ZION\SACGIS\PROJ\RADBACKENERGY\385962\MAPFILES\SITELOCATION_A.MXD GPERDEW 10/26/2010 14:52:49

SECTION 2

Project Information

2.1 Project and Site Description

Contra Costa Generating Station, LLC, (the "Applicant") proposes to construct a state-of-the-art electrical generating plant in Oakley, Contra Costa County, California. The OGS will be a natural gas-fired, combined-cycle electrical generating facility rated at a gross nominal generating capacity of 624 megawatts (MW).[2] The generating facility will consist of two General Electric (GE) Frame 7FA combustion turbine-generators (CTGs) with a nominal rating of 213 MW each[3]- each equipped with metallurgical enhancements to improve efficiency, a single condensing steam turbine generator (STG), heat recovery steam generators (HRSGs), an air-cooled condenser to provide process cooling. CTGs will be equipped with evaporative coolers on the inlet air system and dry low oxides of nitrogen (NO_x) combustors.

The facility will be located near the intersection of Bridgehead Road and Wilbur Avenue in Oakley, Contra Costa County, California on a 21.95-acre parcel that is currently part of a larger 210-acre parcel owned by E. I. du Pont de Nemours and Company (DuPont) (see Figures 1.1-1 and 1.1-2). The elevation is approximately 18 ft above mean sea level. The general site arrangement is presented in Figure 2.1-1.

Construction laydown and parking areas will be within existing site boundaries, on a 20-acre parcel east of the plant site. Construction access will generally be from two locations along Bridgehead Road. Most of the surface area for the access roads will be the existing paved surfaces on the former DuPont facility. However, the unpaved access roads will be stabilized using coarse aggregate. Large or heavy equipment, such as the turbines, generators, step-up transformers, and HRSG modules will be delivered by rail to the existing rail siding located on the project site. Other materials and equipment will be delivered by truck. Three areas north of the OGS site are proposed for temporary stockpiling of soil associated with the project.

A 230-kV electrical transmission line will replace an existing 60-kV transmission line that runs approximately 2.4 miles south and west from OGS to the Pacific Gas and Electric Company (PG&E) Contra Costa substation. The new 230-kV transmission line would require the replacement of 17 existing steel-lattice towers with 20 tubular steel poles and the extension of one existing 230-kV transmission tower. The ROW for the existing transmission line is 80 feet wide. Boring and installation of 16-square-foot concrete foundations at each of the new tower locations will be required to provide subsurface support for the steel poles. It is assumed that the construction activities at each site will be limited to an 80 foot by 80 foot area. However, Contra Costa Generating Station, LLC has mitigated temporary impacts for

[2] Approximate facility output with both combustion turbines operating at 100 percent load at average January conditions (47 degrees F, 73 percent relative humidity)

[3] Nominal output at ISO conditions. At minimum design ambient conditions (34 degrees Fahrenheit, 83 percent relative humidity), combustion turbine output we be approximately 220 MW.

the entire existing 80-foot ROW to provide flexibility for the final installation design. Therefore, it is conservatively assumed that the installation of the new transmission line will impact up to 22.5 acres of transmission line ROW.

Natural gas for the facility will be delivered via direct connection with the adjacent PG&E Antioch natural gas terminal for natural gas supply. The OGS will use potable water provided by the Diablo Water District for process and potable uses. The project will access this water through a tap from an existing 27-inch-diameter distribution pipeline that runs north-south through the OGS site (just east of PG&E's Antioch Natural Gas Terminal). On an average annual basis, the total water use is estimated to be approximately 240 acre-feet per year.

A new sanitary sewer force main will be constructed in the Bridgehead Road and Main Street ROWs. The sanitary sewer force main will extend south along Bridgehead Road from a point adjacent to the plant entrance road for 0.33 mile to Main Street. It will then turn eastward and run for 0.11 mile to the interconnection point with the existing Ironhouse Sanitary District (ISD) gravity main.

Makeup water for the steam cycle will be demineralized by passing service water through a reverse osmosis system followed by offsite-regenerated mixed-bed demineralizer bottles. The reject stream from the reverse osmosis system will be discharged to the plant process drain system and the demineralized water will be sent to a 130,000-gallon storage tank. The demineralized water storage tank will provide approximately 48 hours of storage at peak demand. Demineralized water will be used for steam cycle makeup and for combustion turbine washwater. Cycle makeup water will be deaerated and fed to the condensate receiver. Blowdown from the HRSGs will be discharged to an atmospheric flash tank where the flash steam will be vented to atmosphere and the condensate will be cooled prior to discharge to the plant process drain system. Wastewater from combustion turbine water washes will be collected in combustion turbine drain tanks and then trucked offsite for disposal.

Service water will be used for makeup to the combustion turbine evaporative coolers, equipment washdown, and other miscellaneous plant uses. Blowdown from the combustion turbine evaporative coolers will be discharged to the plant process drain system and ultimately discharged to the sanitary sewer. Wastewater from process areas that could potentially include oil or other lubricants will be directed to an oil-water separator for removal of accumulated oil that may result from equipment leakage or small spills and large particulate matter that may be present from equipment washdowns. Effluent from the oil-water separator will be combined with other process wastewater and sanitary wastewater and discharged to the new ISD sewer line. ISD is in the process of constructing a new wastewater treatment plant that will include processes to produce recycled water meeting Title 22 requirements. Accordingly, the OGS will be designed to accommodate the potential future use of recycled water by providing space in the water treatment building to add a microfiltration system. The microfilters will provide additional filtering of the recycled water prior to use as service water and makeup to the demineralized water system. Backwash water from the microfilters will be discharged to the plant process drain system and ultimately the sanitary sewer.

2.1.1 Site Description

Project Area

The OGS project site is located on a former DuPont manufacturing facility site. The project parcel is in an area of active vineyard agriculture with a central cluster of oak trees. The project parcel is bordered to the north by a narrow row of mature eucalyptus trees that separates the project parcel from the rest of the former DuPont manufacturing site with intermittent strips of ruderal grassland surrounding the parcel. The western "panhandle" of the project parcel consists of a small conserved wetland, called Wetland E (discussed below). The project parcel consists of 21.95 contiguous acres; 13.9 acres are in agricultural production as a vineyard, 1.6 acres are the conservation easement for Wetland E, 3.0 acres are ruderal cover, 0.6 acre is non-native woodland, and 2.8 acres are paved surface (see Figure 2.1-2).

Soil Stockpile Areas

DuPont has requested the use of any excess soils resulting from initial leveling and grading of the OGS site. Three areas north of the OGS site are proposed for the temporary stockpiling of soil associated with the project. Stockpiles 1 through 3 are identified in Figure 2.1-2. Stockpile 1 will be located on an existing paved surface. Stockpile area 2 is located in a regularly disked field south of the row of salt cedar trees and is 84 feet north of Wetland F (0.37 acre). Stockpile area 3 is north of the trees and is 46 feet south of Wetland D (0.38 acre). Common ruderal vegetation in these areas includes rat-tail fescue (*Vulpia myuros*), redmaids (*Calandrinia* ciliata.), old-man-in-the-Spring (*Senecio vulgaris*), horseweed (Conyza canadensis), telegraph weed (*Heterotheca grandiflora*), Spanish clover (*Acmispon americanus*), longspine sandbur (*Cenchrus longispinus*), Russian thistle (*Salsola tragus*), and puncture vine (*Tribulus terrestris*). DuPont plans to use the stockpiled soil during build-out of the DuPont Oakley Specific Plan. The Applicant will move the soils and create and stabilize these soil piles in accordance with all applicable BMPs. After this takes place, the soil stockpiles will be owned and maintained by DuPont in accordance with all applicable BMPs.

Construction Laydown Area

Construction laydown and parking areas will be within the existing DuPont property boundary, on a 20-acre parcel east of and immediately adjacent to the plant site. The temporary construction laydown area will be used for equipment staging, material storage, worker parking, and temporary administrative buildings. Construction access will generally be from Bridgehead Road. Most of the surface area for the access roads will be the existing paved surfaces on the former DuPont facility. However, the unpaved access roads will be stabilized using coarse aggregate. Large or heavy equipment, such as the turbines, generators, step-up transformers, and HRSG modules will be delivered by rail to the existing rail siding located on the project site. Other materials and equipment will be delivered by truck. Habitat in the 14-acre unpaved portion of the construction laydown area is currently ruderal vegetation. The remaining 6 acres consist of an existing concrete pad. There is also a row of mature eucalyptus trees between the two sections, which will remain during construction. Site preparation of the construction laydown area will include site grading and soil berming along the perimeter of the site. The construction laydown area will be recontoured and restored to existing conditions following project construction.

Electrical Transmission Line Corridor

The proposed 230-kV transmission line will connect the OGS facility to an existing PG&E substation in Antioch, approximately 1.75 miles southwest of the OGS site. Within the City of Oakley, the transmission line will be placed in areas zoned for utility and commercial uses. Within the City of Antioch, the alignment is within areas zoned as Planned Development Districts (P-D) associated with the State Route (SR) 4 Industrial Frontage Focus Area (LSA, 2003). The 230-kV transmission line would require the replacement of 17 existing steel-lattice towers with steel monopole towers. The current 60-kV towers are located in a variety of land uses, including active industrial and commercial properties and paved roadways, landscaped residential areas, vacant lots, abandoned agricultural areas characterized by ruderal vegetation, and active vineyard agricultural, (Figure 2.1-3). The Contractor will be responsible for BMPs associated with the linear transmission.

Electrical Transmission Line Pull and Tensioning Areas

The proposed transmission line pull and tensioning sites are located in a variety of land uses, including active industrial and commercial properties, landscape residential/ruderal areas, active vineyard agricultural, and disturbed ruderal areas adjacent to the PG&E Contra Costa Substation (Figure 2.1-3).

Sanitary Sewer Force Main Line Corridor

The new sanitary sewer force main will be constructed from the project tie-in location on Bridgehead Road to the gravity main located in Main Street. Construction of this line would be within the Bridgehead Road and Main Street ROWs. It is assumed the force main will primarily impact areas within the existing paved roadway and that the ruderal areas impacted would be less than 1.0 acre and would already be impacted by routine roadside maintenance.

2.1.2 Site Characteristics

Land Use

The OGS site is located near the intersection of Bridgehead Road and Wilbur Avenue within the city limits of Oakley, California. Existing surrounding land uses include industrial, vacant industrial, commercial, and agricultural uses (Figure 2.1-3). Surrounding land uses include the former DuPont Oakley manufacturing site and marinas along the San Joaquin River to the north, power plants owned by PG&E and Mirant to the west; vineyards and mixed commercial, industrial, and residential uses to the south, and vineyards and residential uses to the east. Under the City of Oakley's General Plan, the land use designation for the project site is Utility Energy.

The OGS site has recently been created from the nearly 500-acre DuPont property (which is a one-owner property with multiple Assessor's Parcel Numbers). DuPont has recently obtained a lot line adjustment to create "Parcel A," the 21.95-acre project site, and two separate neighboring parcels. The new project parcel has been created from a 210-acre parcel on the larger 500-acre DuPont property. The portion of the site on which the power plant would be constructed is within an area called the "Western Development Area" and is currently used as a vineyard. This vineyard area of the DuPont property was never developed for industrial purposes. A row of mature eucalyptus trees separates the OGS

project site from the formerly developed portion of the DuPont property. The project site slopes to the west and drains into a small wetland that is part of the OGS.

Vegetation

The primary vegetation types in the project area (project site, laydown area, utility line) are agriculture, ruderal, and marsh. Agriculture within the area is primarily vineyard. Discontinuous open space occurs throughout the survey area, including the far west end of the 230-kV electrical transmission line. These areas are dominated by ruderal vegetation. The three small wetland features located in the project area are isolated wetlands and do not drain to Waters of the United States.

Farmland

Construction of the proposed project will remove vineyards to build the OGS, and will permanently remove from production soils that are classified as Farmland with Statewide Importance. According to the City of Oakley General Plan, the project site is located in the Northwest Oakley Planning Area. This area north of the Burlington Northern Santa Fe railroad is designated for Business Park, Utility Energy and Light Industrial uses, and is planned to eventually become a primary employment center for the city (City of Oakley, 2002). Because agriculture is not consistent with these designated uses, farming operations are expected to diminish as development progresses in the area.

Soils

Table 2.1-1 describes the properties of the soil mapping units that are found in the vicinity of the project site. As shown in Figure 2.1-4, the entire project site, laydown area, stockpile areas, the new sanitary sewer force main, and the majority of the transmission corridor are associated with a single soil map unit—Delhi sand, 2 to 9 percent slopes (DaC). This soil formed in eolian (i.e., deposited by wind) materials derived from granitic rock sources. Delhi sands are very deep and somewhat excessively drained, with a low shrink-swell potential.

The west side of the transmission corridor crosses two other soil units: Sycamore silty clay loam (So) and Zamora silty clay loam (ZaA). These soils have finer textures than Delhi sand, somewhat lower permeability, and moderate shrink-swell potentials.

Potential for Soil Loss and Erosion

The factors that have the largest effect on soil loss include steep slopes, lack of vegetation, and erodible soils composed of large proportions of silt and fine sands. The soils found in the project area are predicted to have slopes ranging from 2 to 9 percent.

In general, Delhi soils at the project site have a sandy texture, with over 95 percent of soil particles having a diameter of 0.05 to 2 millimeters (i.e., sand particles). These soils are fairly level and excessively drained with a low runoff potential. Therefore, soils at the project site are expected to have low water erosion potential. On the other hand, Delhi soils are expected to have high wind erosion potential. It is expected that the laydown areas will be covered (by gravel or paving) immediately after grading to prevent subsequent wind erosion losses and/or other wind erosion BMPs such as watering.

TABLE 2.1-1
Soil Mapping Unit Descriptions and Characteristics

Map Unit	Description
DaC	**Delhi sand, 2 to 9 percent slopes:** The entire OGS project site, stockpile and laydown areas, and the majority of the transmission corridor are associated with this soil unit. Formation: Wind modified material weathered from granitic rock sources Typical profile: Sand to a depth of >60 inches Shrink-swell capacity: Low Depth and drainage: Very deep, somewhat excessively drained Permeability: Rapid Runoff: Negligible to low Inherent fertility: Fair Capability class: 3s (irrigated), 6e (non-irrigated) Taxonomic class: Mixed, thermic Typic Xeropsamments
So	**Sycamore silty clay loam:** A portion of the transmission corridor crosses this soil unit. Formation: Mixed sedimentary alluvium Typical profile: Silty clay loam over silt loam and stratified loamy fine sand to silty clay Shrink-swell capacity: Moderate Depth and drainage: 40-60 inches to water table, poorly drained Permeability: Moderate to moderately slow Runoff: Slow to very slow Inherent fertility: High Capability class: 1 (irrigated), 4c (non-irrigated) Taxonomic class: Fine-silty, mixed, superactive, nonacid, thermic Mollic Endoaquepts
ZaA	**Zamora silty clay loam, 0 to 2 percent slopes:** A portion of the transmission corridor crosses this soil unit. Formation: Alluvium derived from sedimentary rock Typical profile: Silty clay loam to a depth of 72 inches Shrink-swell capacity: Moderate Depth and drainage: Very deep, well drained Permeability: Moderately slow Runoff: Slow to medium Inherent fertility: High Capability class: 1 (irrigated), 4c (non-irrigated) Taxonomic class: Fine-silty, mixed, superactive, thermic Mollic Haploxeralfs

Note:
Soil characteristics are based on soil mapping descriptions provided in the online soil survey reports (http://soildatamart.nrcs.usda.gov/) and Official Soil Series Descriptions (http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi). Soil descriptions provided above are limited to those soil units that could be directly affected by the OGS.

The silty clay loam surface horizons of the Zamora and Sycamore soils associated with a portion of the transmission corridor are not expected to be as readily transported by wind.

Other Significant Soil Characteristics

A significant soil characteristic of the proposed 20-acre laydown area is the presence of waste titanium dioxide. A portion of this area was historically used for disposal of titanium dioxide waste during manufacturing operations at the DuPont facilities. Titanium dioxide

(TiO_2) is an inert mineral pigment primarily used in paints, paper, and plastics, and is produced by reacting the mineral rutile, removing impurities, and oxidizing to TiO_2 (DuPont, 2003). During active manufacturing at the DuPont facility, the proposed laydown area was a TiO_2 landfill that was used for disposal of spent ore from the TiO_2 process after the material was acid-leached and settled in retention basins (DuPont, 2003). This material is estimated to be approximately 3 feet thick (DuPont, 2006); thus, soil material that is present in this area likely does not reflect characteristics of mapped soils. The fill material is not expected to present a human health or wildlife risk (DuPont, 2006). The soil map unit upon which the project will be built (DaC) contains soils with over 95 percent sand-sized particles. A geotechnical review (TRC, 2008) estimated that a moderate liquefaction potential exists at the site due to nature of subsurface soil materials; and that vibrating equipment could potentially cause settlement in these sandy soils. A design-level geotechnical study will be performed, which will specifically identify whether expansive soils are present in the project area and will include measures to mitigate the effects of these soils where they occur.

According to the official soil series description, Sycamore soils may have a seasonally high water table within the top 60 inches of the soil profile. Construction of replacement transmission towers in areas with Sycamore soils may need to include dewatering.

Hydrology

Contra Costa County has a moderate climate, similar to a Mediterranean climate. The influence of coastal fog is felt in the western and central portions of the county. The mean annual precipitation (January 1955 to December 2008) is 13.17 inches per year. The minimum and maximum annual precipitation for the period of record is 5.87 inches and 27.75 inches, respectively. Table 2.1-2 provides average historical rainfall from the meteorological station in Antioch, California.

TABLE 2.1-2
Rainfall near the Proposed Project Site (1955-2008)

Precipitation	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	13.17	2.78	2.39	1.96	0.9	0.37	0.09	0.02	0.04	0.19	0.65	1.58	2.2
Maximum	27.75	6.97	9.03	6.26	3.97	2.09	0.8	0.46	0.74	1.84	4.85	4.83	7.14
Minimum	5.87	0.13	0.0	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note:
Source: Western Regional Climate Center (WRCC), 2008.

Water Courses. The OGS site is located near the southern bank of the San Joaquin River, east of the Antioch (John A. Nejedly) Bridge, approximately 7 miles upstream of the confluence with the Sacramento River. Major surface water features in the vicinity of the OGS project site include the San Joaquin River and the Sacramento-San Joaquin Delta (Figure 2.1-5). The San Joaquin River is the only natural perennial surface water within 1 mile of the site. Naturally occurring wetlands are located adjacent to the San Joaquin River approximately 0.25 mile north of the project site.

Environmentally Sensitive Areas. One jurisdictional wetland called Wetland E, a 0.62-acre palustrine wetland, is present within 250 feet of the OGS site and two additional wetlands are located within 250 feet of the soil stockpile areas. (The three wetlands are identified as

"E", "F", and "D" on Figure 2.1-2.) Project construction would not cause loss or fill of any wetlands; therefore these wetlands will not be impacted. Wetland E has been found by the USACE to be an isolated and non-jurisdictional wetland. Based on historical information it appears this wetland has been constructed in what was previously upland and then placed under a conservation easement as mitigation for a nearby project. Two additional 0.38-acre and 0.37-acre palustrine emergent wetlands are located within 50 feet north and south, respectively, of soil stockpile areas. These wetlands were also found by USACE to be isolated and non-jurisdictional.

Currently, the Wetland E easement area collects runoff from a 25-acre area located to the east and south of the easement. Because the OGS will occupy the majority of the 25 acres of easement runoff area, the Applicant proposes to maintain the existing water quality and hydraulic flow to the Wetland E easement area after the project is built, which is a requirement of the 1997 conservation easement. To accomplish this goal, the Applicant and their engineering design consultant, Black & Veatch Engineering, designed a stormwater management system for the OGS and submitted the plan to the California Department of Fish and Game (CDFG) on August 13, 2009. The management system was designed so that (1) the quality of stormwater draining into the wetland is not negatively affected, and (2) the OGS will not adversely alter the flow of stormwater into the wetland. In addition, the OGS stormwater management design will incorporate a number of measures which are designed to enhance the functions and values of the mitigation wetland. These measures will be consistent with the intended purpose and restrictions of the easement for this property. The new design will block the overflow that drains into the wetland preserve via the existing sediment basin.

The stated purpose of the 1997 conservation easement is to "retain forever in a natural condition and to prevent any use of the property that will significantly impair or interfere with the conservation values of the property." The CDFG (the easement grantee) has the right to prevent any activity on or use of the property that is inconsistent with the habitat conservation purposes in the easement. Activities specifically prohibited included unseasonal watering, off-road vehicles, grazing, and surface entry for exploration and extraction of minerals. The Grantee may allow public access to property for scientific research and interpretive purposes.

A riparian area is also located along the transmission line route. This area will not be disturbed during tower installation and removal, but is located about 110 feet from the pole sites. Therefore, the area will be protected with environmentally significant area signage and sediment control BMPs to ensure no disturbance occurs in this area during construction activities.

Groundwater

The OGS site is within the San Joaquin Valley Basin (Figure 2.1-6). The Tracy subbasin lies in the southwestern portion of the Sacramento Basin and the northern portion of the Sacramento-San Joaquin Delta. Elevation varies from 120 feet in the northwest corner to sea level in the south. Subbasin boundaries are defined by Putah Creek on the north, the Sacramento River on the east, the North Mokelumne River on the southeast, and the San Joaquin River on the south (DWR, 2006).

The primary water-bearing formations comprising the Tracy subbasin are continental deposits of Late Tertiary to Quaternary age (DWR, 2006). Fresh water-bearing units include younger alluvium, older alluvium, flood basin deposits, and the Tulare Formation. With the exception of seasonal variation resulting from recharge and pumping, the majority of water levels in wells have remained relatively stable over the last 10 years (DWR, 2006). Well yields in the subbasin range from 500 to 3,000 gallons per minute at an average depth of 188 feet for domestic wells and 352 feet for municipal and irrigation wells (DWR, 2006).

In general, the northern part of the subbasin is characterized by a sodium water type and the southern part of the subbasin is characterized by calcium-sodium water types (DWR, 2006). Areas of poor water quality exist throughout the subbasin. Areas of elevated chloride occur in several areas including along the San Joaquin River and areas of elevated nitrate exist in the northwestern part of the subbasin (DWR, 2006). Total dissolved solids (TDS) levels in the subbasin range from 210 to 7,800 milligrams per liter (mg/L) with an average of about 1,190 mg/L (DWR, 2006).

Unless otherwise designated by the Central Valley RWQCB or excluded based on the minimum beneficial use exception criteria, all ground waters are considered suitable or potentially suitable, at a minimum, for municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply (Central Valley RWQCB, 1998).

The OGS would make no direct use of groundwater resources and would have no effect on groundwater quantity or quality.

2.1.3 Estimated Total Disturbed Area

The estimated area disturbed during project construction is listed in Table 2.1-3.

TABLE 2.1-3
Estimated Disturbed Area

Project Area	Acreage
Project Site	21.95 acres (2.8 acres of paved surface)
Project Laydown Area	20.3 acres (6.5 acres of paved surface)
Stockpile Areas	7.2 acres, (2.2 acres of paved surface)
T-Line ROW, tower replacement	22.5 acres (4.4 acres of paved surface)
T-Line Pull Sites outside the T-Line ROW	1.4 acres (0.2 acres of paved surface)
T-Line Access Roads Outside T-Line ROW	1.0 acres (0.5 acres of paved surface)
Sanitary Force Main ROW	1.6 acres (1.5 acres of paved surface)
Access Roads for Stockpiles 2 & 3 and the Construction Laydown Area	2.5 acres (2.3 acres of paved surface)

2.1.4 Existing Drainage

Project Area

The project site is part of the former DuPont industrial facility but DuPont did not have any buildings, process equipment, or other facilities placed at the project site when the industrial facility was in operation. The plant site is currently a vineyard with a row of eucalyptus trees along the northeastern corner. Runoff at the OGS site currently drains to Wetland E, which is located on the northwest corner of the project site.

Soil Stockpile Area

Stockpile 1 will be located in an existing paved parking lot inside the entrance of the DuPont Site. This area is relatively flat with drainage flowing generally west to east. An existing storm drain to the east of the laydown area captures stormwater that does not pool on the surface and routes water to the existing stormwater drainage system. Stockpiles 2 and 3 will be located in ruderal habitat north of wetland F and south of Wetland D adjacent to Bridgehead Road. These areas are currently tilled approximately twice a year and are graded generally flat. Stormwater infiltrates into the soil at these sites.

Construction Laydown Area

Much of the construction laydown area is covered by bare soil with little vegetation; however, the northeastern portion is covered by existing concrete. Stormwater flows across the asphalt, downward toward the north end of the pavement area and drains into an old asphalt swale that was part of the original DuPont stormwater system. Stormwater collects in the swale and pools, as the old stormwater system is not maintained. The bare soil portion of the site is roughly divided in half by existing eucalyptus trees. The topography is varied, but is relatively flat. Currently, stormwater infiltrates into the bare ground.

Linear Construction Areas

Although the transmission line corridor encompasses approximately 22.5 acres, an 80-foot by 80-foot buffer area has been designated as the construction disturbance area for new pole installation and old pole decommissioning and removal. The topography varies considerably along the transmission line and the land surfaces range from vegetated to asphalt surfaces. Drainage for each 80-foot by 80-foot disturbance is varied and BMPs will be implemented to reduce runoff during construction activities.

Transmission Line Pull and Tensioning Areas

Four transmission line pull and tensioning areas occur along the linear construction line. Similar to the description above for the linear construction areas, drainage varies at each site. BMPs will be implemented to reduce runoff during construction activities. Access roads are attached to these pull sites and BMPs for tracking control also will be implemented during construction activities.

Sanitary Sewer Force Main

A new sanitary sewer force main will be constructed from the project tie-in location on Bridgehead Road to the gravity main located in Main Street. Construction of this line would be within the Bridgehead Road and Main Street ROWs. Drainage occurs from the centerline of

the asphalt roads to the sides of the roads. On Bridgehead Road, runoff drains directly into the ROW which is predominantly ruderal vegetation and bare soil. Main Street is more developed and runoff is contained by curbs and discharges into storm drain inlets. Therefore, drainage patterns would not change as a result of the installation of the force main; and BMPs would protect against extra runoff and sediment due to construction activities.

2.1.5 Proposed Drainage

Project Area

The OGS stormwater design will be governed by the stormwater management requirements of the Contra Costa Clean Water Program Stormwater C.3 Guidebook (CCCWP, 2008). The "C.3" stormwater regulations for new development currently apply to any development project which will create one acre or more of impervious area. The C.3 requirements address both flow control and treatment of stormwater. Per page 8 of the C.3 guidebook, using the Option 2 design process detailed in Chapter 4 will allow the OGS project to meet both treatment and flow control requirements.

Post-development drainage at the site will be designed to maintain the natural drainage pattern of the site. All stormwater will be contained onsite via a series of bioswales and a detention basin, eventually discharging into Wetland E. The volume provided within these areas is sufficient to store the combined 100-year and 10-year runoff volumes provided without discharging stormwater offsite. Water will either infiltrate directly into the ground or will be routed into the detention basin, which will provide stormwater treatment prior to discharge to the wetland. Given the high permeability of the Delhi Sand soils found in the project area, infiltration has been calculated to be fairly rapid. Bioswales 4 and 5 will provide additional treatment, particularly during construction, to limit sedimentation from construction activities reaching the wetland. Gravel check dams will be installed within the bioswales to limit erosion and transport of soil mix within the bioswales during higher flow rates. To maintain hydration of the wetland area, the detention pond has been designed with low-flow orifices that will release water into the pond within a 24-hour period when water would be stored in the pond. Four bioswales and a detention basin will be utilized to collect all stormwater runoff from the project site. The locations of bioswales, delineated drainage areas for each bioswale, and the detention basin are shown on Figure 2.1-8. Rainfall less than the design event will be contained in the bioswales and will infiltrate through the sandy soils or evaporate. The soils, plantings, and irrigation for the bioswales will be in accordance with Appendix B of the Contra Costa Clean Water Program Stormwater C.3 Guidebook.

Runoff from the power block area will be routed through an oil/water separator before being discharged to the sanitary sewer system and will not be discharged onsite. Appendix E contains the Preliminary Stormwater Management Design for the project, which includes stormwater calculations and the pre- and post-development drainage plans.

Soil Stockpile Area

The temporary soil Stockpile 1 area will not be impacted (graded) during construction activities, and therefore the pre-construction drainage will be maintained following construction. The Stockpile 2 and 3 areas will be vegetated following construction and will be maintained over time during build-out of the DuPont Oakley Specific Plan. Post-

construction drainage will be in the form of infiltration into the stockpiles, using applicable BMPs for erosion and sediment control.

Construction Laydown Area

The unpaved portion of the construction laydown area will be graded. The area will be graded so that runoff from the non-asphalt area is collected in a bioswale. Excess water from the construction laydown bioswale will not be pumped offsite as previously indicated in Section 5.15.1.6 of the AFC, but instead will be allowed to pond in the bioswale and percolate (Figure 2.1-7). Appendix E contains the Preliminary Stormwater Management Design and a revised Stormwater Management Design (September 2010) for the project, which includes stormwater calculations and the pre- and post-development drainage plans.

Transmission Line Construction Areas

Following installment of the new pole towers and removal of the old towers, the land surface will be regraded and revegetated to pre-construction conditions.

Transmission Line Pull and Tensioning Areas

The land surface will be regraded and revegetated to pre-construction conditions.

Sanitary Sewer Force Main Areas

Drainage patterns would not change because of installation of the force main; and BMPs would protect against extra runoff and sediment due to construction activities. Following construction, both roads and their respective ROWs would be returned to pre-construction conditions.

2.1.6 Construction and Maintenance Access Road

Two access roads will be used for the project. One of the access roads will be via a new entrance lane extending from Bridgehead Road, just south of the intersection of Bridgehead Road and Wilbur Avenue. During construction, the access road will be stabilized using coarse aggregate. At the end of construction, the entrance road will be permanently paved. Another access road will be provided via the existing site entrance located further north on Bridgehead Road. Most of the surface area for the access roads will be the existing paved surfaces on the former DuPont facility. However, the unpaved portion of the access road will be stabilized using coarse aggregate. Large or heavy equipment, such as the turbines, generators, step-up transformers, and HRSG modules will be delivered by rail to the existing rail siding located on the project site. Other materials and equipment will be delivered by truck. At the end of construction, the portion of the access road that was originally non-paved surface will be hydro-seeded and returned to the pre-construction conditions. The paved access road surfaces on the DuPont facility will remain paved.

2.1.7 Clearing and Grading Plans/Earthwork

Plant Site Earthwork

Excavation work will consist of removal, storage, and/or disposal of earthen materials to the lines and grades necessary for construction. Disturbed soils will either be covered (e.g., metal plates, pavement, plastic covers over spoil piles) or stabilized by appropriate BMPs to

ensure sediment does not migrate from the site. Materials suitable for backfill will be stored in stockpiles at three designated locations using proper erosion protection methods. Excess materials will be incorporated into the unused portion of the site or removed from the site and disposed of at an acceptable location.

Site areas that will be graded include the project construction site, the laydown area, except for the approximately 6-acre portion that is concrete, and portions of the utility line construction corridor. Grading will retain the pre-project site contours to ensure that stormwater flows either to the onsite wetland or into construction bioswale. During construction, stormwater will flow into a temporary bioswale constructed within the laydown area. At the end of construction, bare ground will be hydro-seeded.

Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain. Structures will be designed to meet appropriate seismic requirements (the site is located in Seismic Risk Zone 4) and California Building Code requirements. Areas to be backfilled will be prepared by removing unsuitable materials and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill.

Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve the specified density. To verify compaction, representative field density and moisture-content tests will be performed during compaction in accordance with ASTM standards.

Transmission Line Construction

The OGS will connect with the existing Pacific Gas and Electric Company (PG&E) substation within an existing 2.4-mile transmission corridor. Existing steel-lattice towers will be replaced with monopole towers. Grading will occur in portions of the 22.5-acre electrical utility line corridor.

Sanitary Sewer Force Main Construction

The sanitary sewer force main will be constructed from the project tie-in location on Bridgehead Road to the gravity main located in Main Street. Construction of this line would be within the Bridgehead Road and Main Street ROWs and trenching and grading will occur within this corridor.

2.2 Stormwater Run-On from Offsite Areas

DuPont has a retention pond located north of the preserve area that receives drainage from industrial site surfaces covered by asphalt and concrete. A drain has been installed to allow the overflow to drain into the Wetland E conservation easement. However, as part of the Wetland E conservation enhancement plan proposed for the project, the drain will be blocked. Therefore, no areas have been identified near the project site that will contribute to potential run-on during construction. If run-on is identified during construction activities, a SWPPP amendment will be completed which will explain the control methods of site run-on and the BMPs used for control. The BMP maps would also be updated as part of the amendment.

2.3 Findings of the Construction Site Sediment and Receiving Water Risk Determination

This General Permit establishes three levels of risk possible for a construction site. Risk is calculated in two parts: (1) project sediment risk (the relative amount of sediment that can be discharged, given the project and location details) and (2) receiving water risk (the risk sediment discharges pose to the receiving waters). The OGS site has been determined to be a Risk Level 1 site based on the construction site sediment and receiving water risk determination.

2.3.1 Sediment Risk

Project Sediment Risk is determined by multiplying the R, K, and LS factors from the Revised Universal Soil Loss Equation (RUSLE) to obtain an estimate of project-related bare ground soil loss expressed in tons/acre.

The RUSLE equation is as follows:

A = (R)(K)(LS)(C)(P)

Where: A = the rate of sheet and rill erosion
R = rainfall-runoff erosivity factor
K = soil erodibility factor
LS = length-slope factor
C = cover factor (erosion controls)
P = management operations and support practices (sediment controls)
The C and P factors are given values of 1.0 to simulate bare ground conditions.

The map option was used for this project. For the map option, the R factor for the project is calculated using the online calculator on the EPA NPDES website.[4]

To determine soil loss in tons per acre, the discharger multiplies the R factor times the value for K times LS from the map. The R factor (rainfall erosivity) was obtained from inputing latitude and longitude and the project construction dates into the online EPA NPDES Rainfall Erosivity calculator. The result was an R factor of 40.28. Using Option (1), the GIS map provided in the General Permit, the Length/Slope (LS) Factor Map, and the Soil Erodibility (K) Factor map found on the State Water Resources Control Board websites,[5] the LS value is 1.75 and the K value is 0.25.

R= 40.28
K= 0.25
LS= 1.75

Watershed Erosion Estimate= (40.28) (0.25) (1.75)= 17.62 = **MEDIUM Sediment Risk Factor.**

[4] http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm

[5] http://www.swrcb.ca.gov/water_issues/programs/stormwater/docs/constpermits/guidance/rusle_k.jpg
http://www.swrcb.ca.gov/water_issues/programs/stormwater/docs/constpermits/guidance/rusle_ls.jpg

2.3.2 Receiving Water Risk

Receiving water risk as defined in the General Permit is based on whether a project drains to a sediment-sensitive waterbody. A sediment-sensitive waterbody is either on the most recent 303d list for waterbodies impaired for sediment; has an EPA-approved Total Maximum Daily Load implementation plan for sediment; or has the beneficial uses of COLD, SPAWN, and MIGRATORY. The San Joaquin River is not listed on the State Board 303d list as a sediment impaired waterbody, and does not have an EPA-approved Total Maximum Daily Load implementation plan for sediment. The San Joaquin River does have beneficial uses of COLD, SPAWN and MIGRATORY but not in the stretch of river near the project location. These beneficial uses are designated on the San Joaquin River several miles south of the project site from Friant Dam to Mendota Pool, sources to Millerton Lake, Mendota Dam to Sack Dam, Mouth of Merced River to Vernalis, and Sack Dam to Merced River.[6]

A project that meets at least one of the three criteria has a high receiving water risk. However, the OGS project does not meet any of the above listed criteria, and therefore has a **LOW Receiving Water Risk.**

Because the OGS project has a medium sediment risk and a low receiving risk, OGS is required to comply with all Risk Level 1 requirements in Attachment C of the General Permit (see Appendix F).

2.4 Construction Schedule

Construction of the generating facility, from site preparation and grading to commercial operation is expected to take place from the first quarter of 2011 to the fourth quarter of 2013 (33 months total). Major milestones are listed in Table 2.4-1. A copy of this schedule is in Appendix G.

TABLE 2.4-1
Project Schedule Major Milestones

Activity	Date
Begin/Construction	Second quarter 2011
Startup and Test	Second quarter 2013
Commercial Operation	Fourth quarter 2013

There will be an average and peak workforce of approximately 303 and 729, respectively, of construction craft people, supervisory, support, and construction management personnel on site during construction. The peak construction site workforce level is expected to last from month 10 through month 30 of the 33-month construction period, with the peak being month 23.

[6] The sources for this information are located below and are sources recommended in the General Permit.
http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml
http://endeavor.des.ucdavis.edu/wqsid/bu.asp

Typically, noisy construction will be scheduled to occur between 6:00 a.m. and 7:00 p.m. Monday through Saturday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities (for example, pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the startup phase of the project, some activities will continue 24 hours per day, 7 days per week.

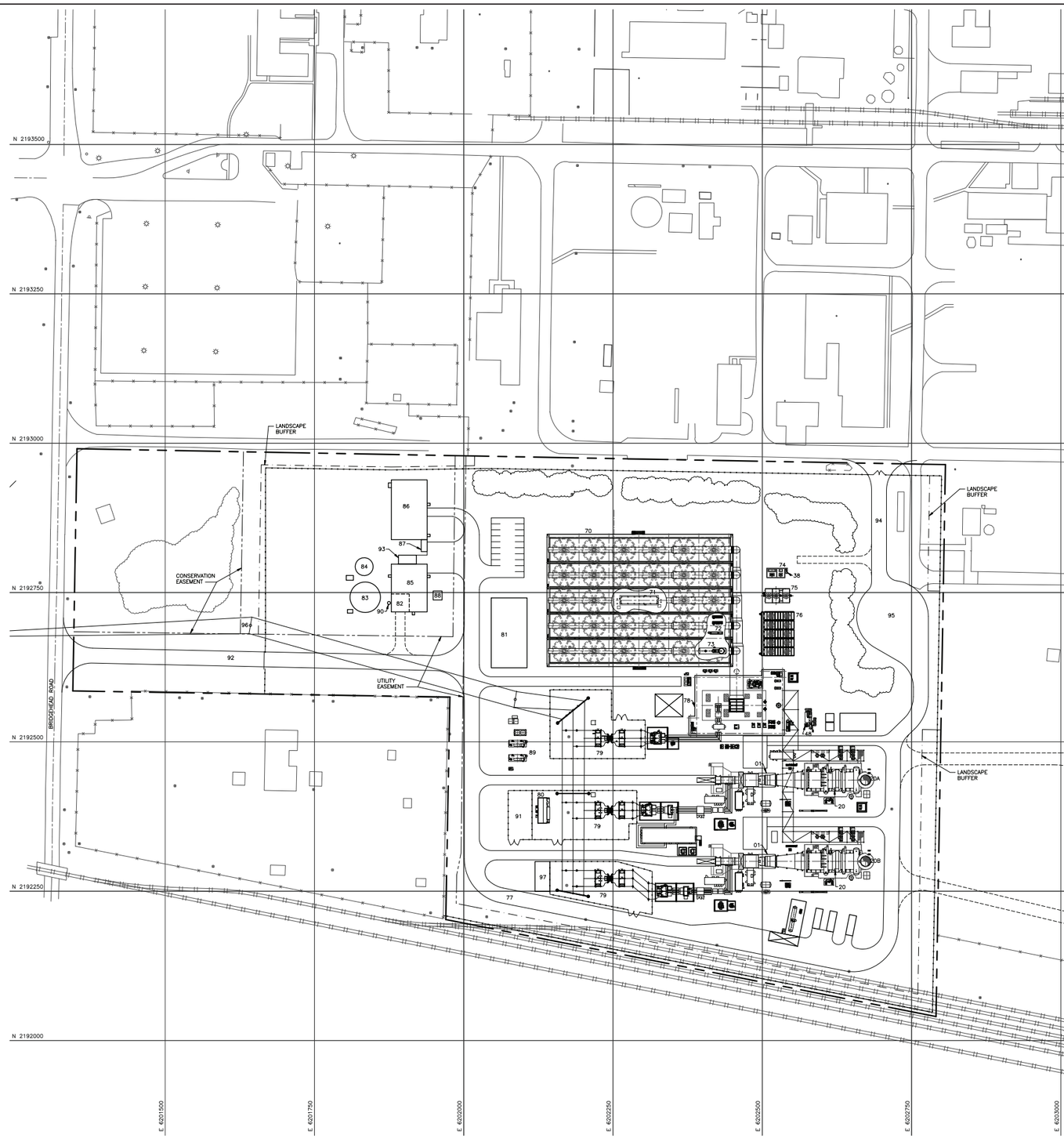
2.5 Potential Construction Site Pollutant Sources

Construction of the project will involve handling a large variety of building materials. The primary potential pollutant source for stormwater during the construction of the OGS project results from soil materials being exposed to wind and water movement. The greatest amount of soil will be exposed during preparation and site grading phases of the project. Upon completion of the foundation phase, the amount of soil exposed will be significantly reduced. Due to the controls and BMPs described in subsequent sections of this SWPPP, soils and sediments in stormwater runoff from the OGS Project site will be minimized. A number of other constituents that could contribute to non-stormwater discharges will also be onsite and are discussed below. Other chemicals that could be potentially stored and used during construction of the facility include: gasoline, diesel fuel, oil, lubricants (i.e., motor oil, transmission fluid, and hydraulic fluid), solvents, adhesives, asphalt products, and paint materials. There are no feasible alternatives to these materials for construction or operation of construction vehicles and equipment, repaving areas, pouring concrete, or for painting and caulking buildings and equipment. Material Safety Data Sheets for each chemical used will be kept onsite, and construction employees will be made aware of their location and content.

2.6 Identification of Non-Stormwater Discharges

The contractor will be responsible for assuring that the use, storage and handling of the materials listed above in Section 2.5 will comply with applicable federal, state, and local laws, ordinances, regulations, and standards (LORS), including licensing, personnel training, accumulation limits, reporting requirements, and record keeping. The contractor will also comply with the requirements contained in the General Permit Attachment C for Risk Level 1 dischargers. Attachment C is located in SWPPP Appendix F. Compliance includes recording the discharge in the SMARTS system, and logging and filing the discharge in the Notice of Discharge form located in Appendix O.

Figures



FACILITIES LEGEND

ID	FACILITY	STRUCTURE HEIGHT	TIEDOWN LOCATION NORTH	TIEDOWN LOCATION EAST	REMARKS
01	COMBUSTION TURBINE	70'	–	–	–
20	HEAT RECOVERY STEAM GENERATOR (HRSG)	103'	–	–	–
20A	HRSG EXHAUST STACK A	155'	2192436.00	6202665.00	CL EXHAUST STACK
20B	HRSG EXHAUST STACK B	155'	2192300.00	6202665.00	CL EXHAUST STACK
38	SAFETY SHOWER EYEWASH STATION	–	–	–	–
48	AUXILIARY BOILER	50'	2192527.61	6202572.26	CL EXHAUST STACK
70	AIR COOLED CONDENSER (ACC)	124'	–	–	–
71	ACC ELECTRICAL ENCLOSURE	14'	–	–	–
72	CONDENSER AIR EXTRACTION SKIDS	6'	–	–	–
73	ACC CONDENSATE COLLECTION TANK	28'	–	–	–
74	WET SURFACE AIR COOLER CHEMICAL FEED SKIDS	8'	–	–	–
75	WET SURFACE AIR COOLER	23'	2192744.67	6202523.00	CL COOLER
76	CLOSED CYCLE COOLING WATER HEAT EXCHANGER	19'	–	–	–
77	LOOP ROAD	–	–	–	–
78	STEAM TURBINE FOUNDATION	–	–	–	–
79	SWITCHYARD	18' & 45'	–	–	–
80	SWITCHYARD CONTROL ENCLOSURE	12'	–	–	–
81	CONTROL & ADMIN BUILDING	14'	–	–	–
82	FIRE WATER PUMP ROOM	20'	–	–	–
83	FIRE/SERVICE WATER STORAGE TANK	32'	–	–	–
84	DEMIN WATER STORAGE TANK	24'	–	–	–
85	WATER TREATMENT BUILDING	20'	–	–	–
86	WAREHOUSE/MAINTENANCE BUILDING	16'	–	–	–
87	LUBRICANT STORAGE SHED	10'	–	–	–
88	WASTE WATER LIFT STATION (IF REQUIRED)	–	–	–	–
89	GAS COMPRESSORS & GAS CONDITIONING	13'	–	–	–
90	DIESEL FIRE PUMP EXHAUST	16'	2192732.52	6201874.72	CL EXHAUST STACK
91	GAS METERING STATION	–	–	–	–
92	ACCESS ROAD	–	–	–	–
93	LEASED MIX BED EXCHANGER CONCRETE SLAB	–	–	–	–
94	EMERGENCY ACCESS ROAD	–	–	–	–
95	CUL DA SAC (TURNAROUND)	–	–	–	–
96	230KV POWER POLE	106'	–	–	–
97	OUTAGE MAINTENANCE TRAILERS AREA	–	–	–	–

NOTES

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. SEE PLANT ARRANGEMENT DRAWING SM-2001, FOR LEGEND OF MAIN POWER BLOCK.
3. PROPERTY AND EASEMENT BOUNDARY INFORMATION IS BASED UPON DRAWING EXHIBIT D, BY RONALD GREENWELL & ASSOCIATES, INC. REVISION DATED 05/FEB/09.

GENERAL LEGEND

- NEW FENCE
- EXISTING FENCE
- PROPERTY BOUNDRY (SEE NOTE 3)
- EASEMENT BOUNDARY (SEE NOTE 3)
- LANDSCAPE BUFFER

NOT TO BE USED FOR CONSTRUCTION

Source: Black & Veatch Holding Company, 03/26/09, Drawing 163994-SS-1002 R1

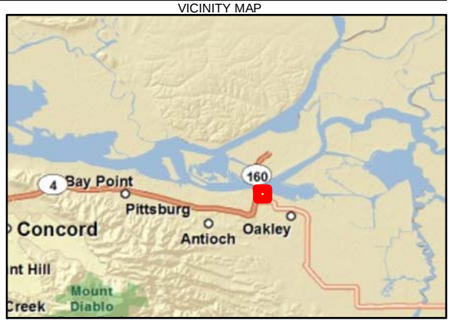
60' 30' 0 60' 120'

FIGURE 2.1-1
General Site Arrangement
Oakley Generating Station DESCP/SWPPP
Oakley, California

IS012010223151SAC Figure_2.1-1.ai 03.03.2010 tdaus

CH2MHILL

VICINITY MAP



LEGEND

- Existing 60 kV Tower Locations
- New 230 kV Tower Locations
- Proposed 230 kV Transmission Line
- Sanitary Sewer Force Main
- Wetland E Conservation Easement
- Wetland
- ESA Fencing
- Construction Laydown Area
- Pull Site
- Access Road
- Access Road
- Stockpiles
- Project Site
- (2) Soil Stockpile Area

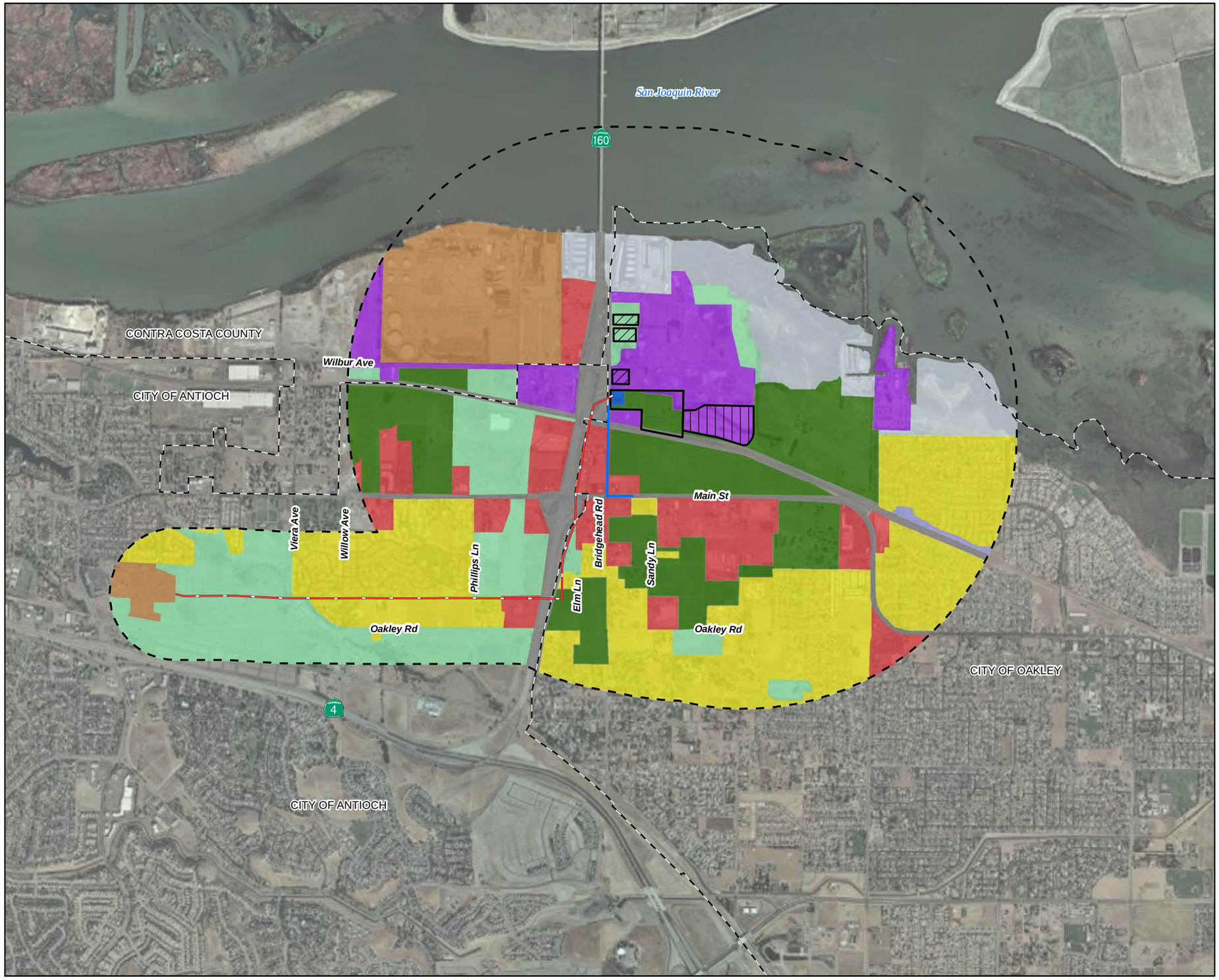
N

0 150 300
Feet

FIGURE 2.1-2
Project Area Map
DESCP/SWPPP
Oakley Generating Station

CH2MHILL

\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\FIG_PROJECTAREA_REV.MXD SSCOPES 10/19/2010 14:40:10



LEGEND

- Sanitary Sewer Force Main
- EXISTING 60kV TRANSMISSION LINE
- CITY LIMITS
- BUFFER
- DIRT STOCKPILE AREAS
- LAYDOWN AREA
- PROJECT SITE

EXISTING LAND USE

- AGRICULTURAL
- COMMERCIAL
- DELTA RECREATION
- INDUSTRIAL
- OPEN SPACE
- PARKS
- RESIDENTIAL
- RIGHT-OF-WAY
- UTILITIES
- WETLAND

Notes:
1. 1 mile around Project Site, 1/4 mile around Transmisson Corridor.

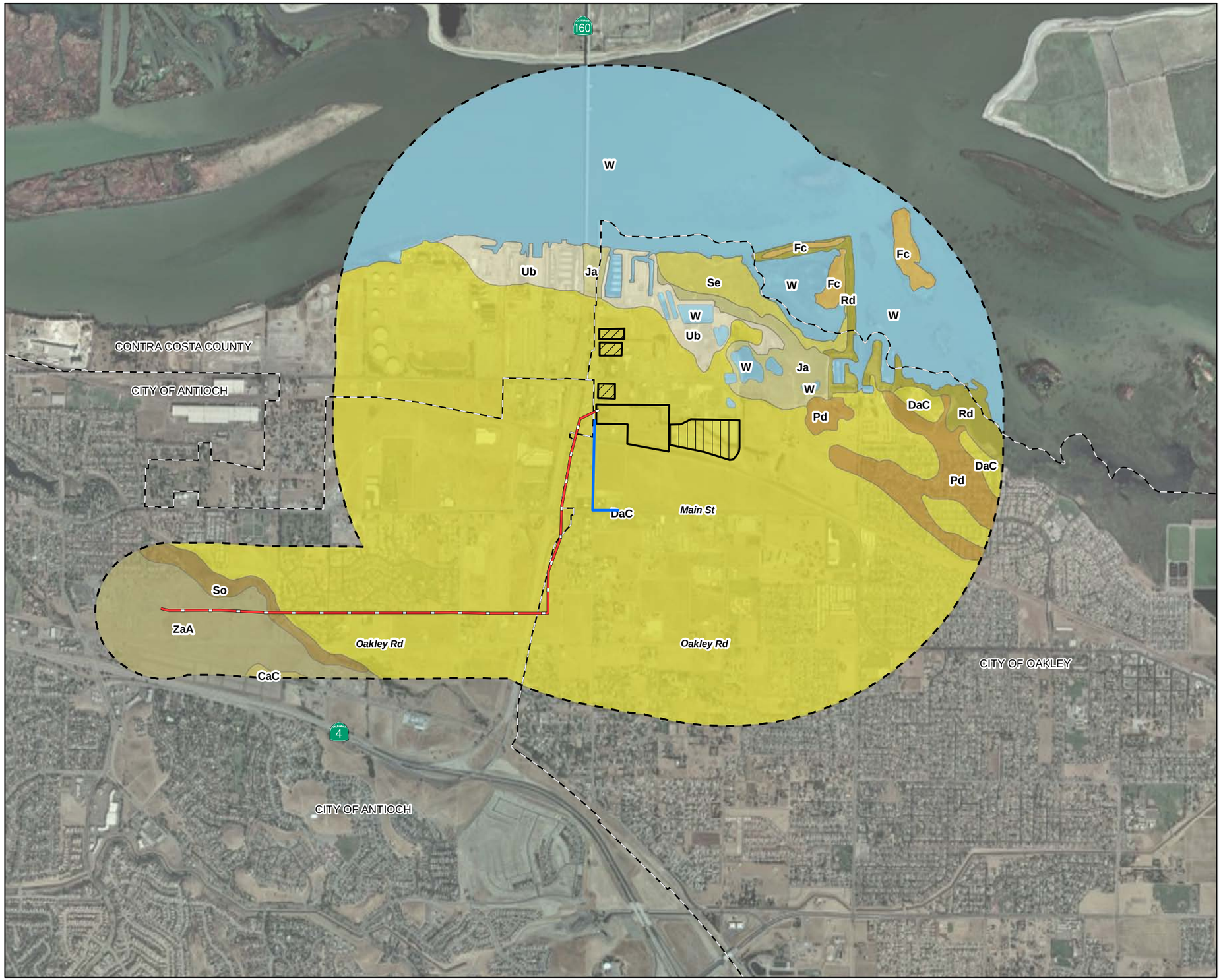
This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 1,000 2,000
Feet
1:24,000

FIGURE 2.1-3
Land Use
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL



LEGEND

- Sanitary Sewer Force Main
- EXISTING 60kV TRANSMISSION LINE
- DIRT STOCKPILE AREAS
- LAYDOWN AREA
- PROJECT SITE
- CITY LIMITS
- BUFFER

SOIL TYPES

- CaC - CAPAY CLAY, 2 TO 9 PERCENT SLOPES
- DaC - DELHI SAND, 2 TO 9 PERCENT SLOPES
- Fc - FLUVAQUENTS
- Ja - JOICE MUCK
- Pd - PIPER SAND
- Rd - RINDGE MUCK
- Se - SHIMA MUCK
- So - SYCAMORE SILTY CLAY LOAM
- Ub - URBAN LAND
- W - WATER
- ZaA - ZAMORA SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES

Notes:
1. 1 mile around Project Site, 1/4 mile around NG Pipeline and Transmisson Line.
2. Source: U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) database for Contra Costa County, California.

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

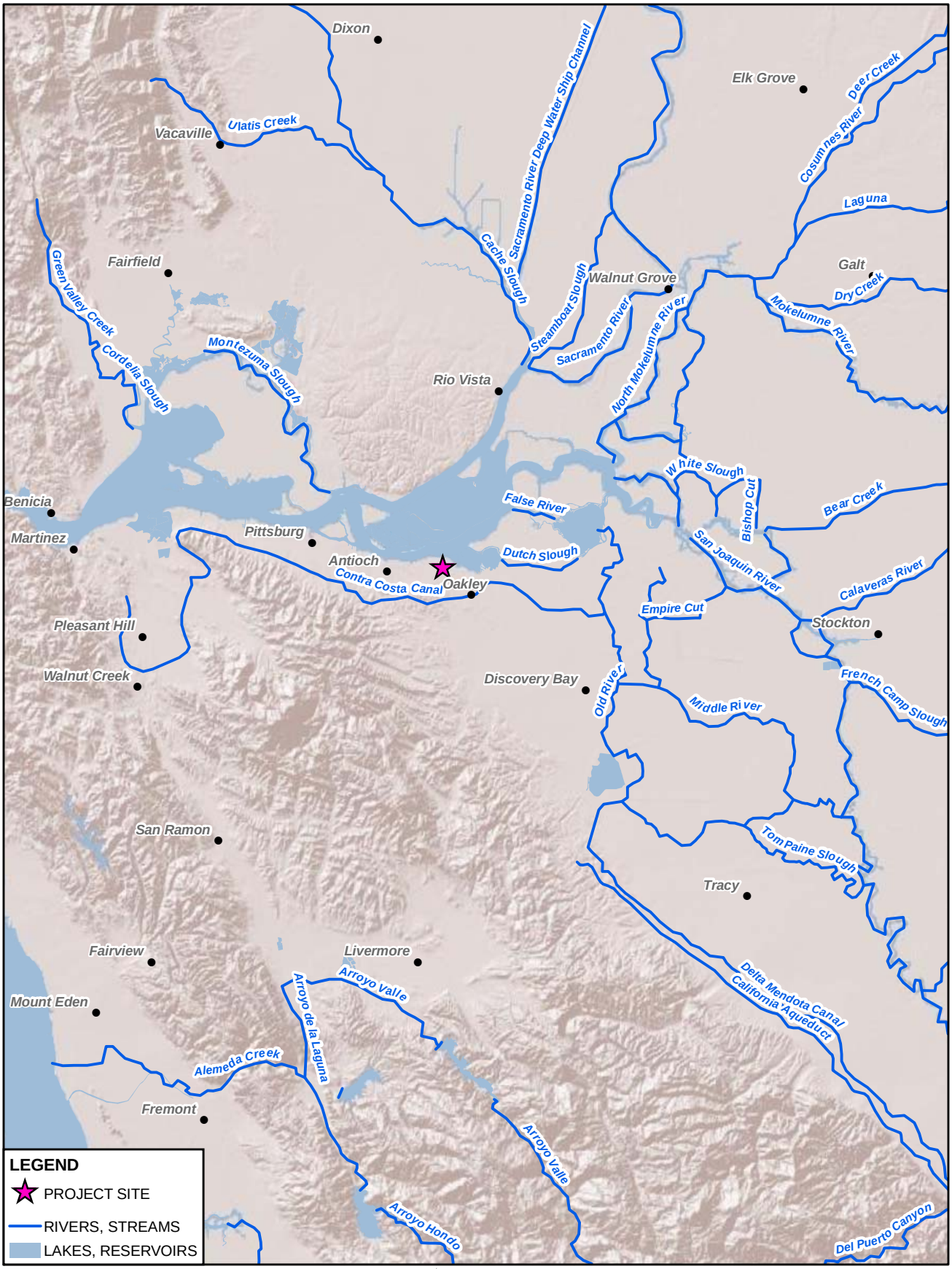
N

0 1,000 2,000
Feet
1:24,000

FIGURE 2.1-4
Soils
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

\\ZION\SACGIS\PROJ\RADBACKENERGY\385962\MAPFILES\SOILS.MXD GPERDEW 10/26/2010 15:05:07



Notes:
1. Source: USGS, the National Atlas of the United States, Environmental Systems Research Institute (ESRI). Water Bodies - 2004, River and Streams - 2006.

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

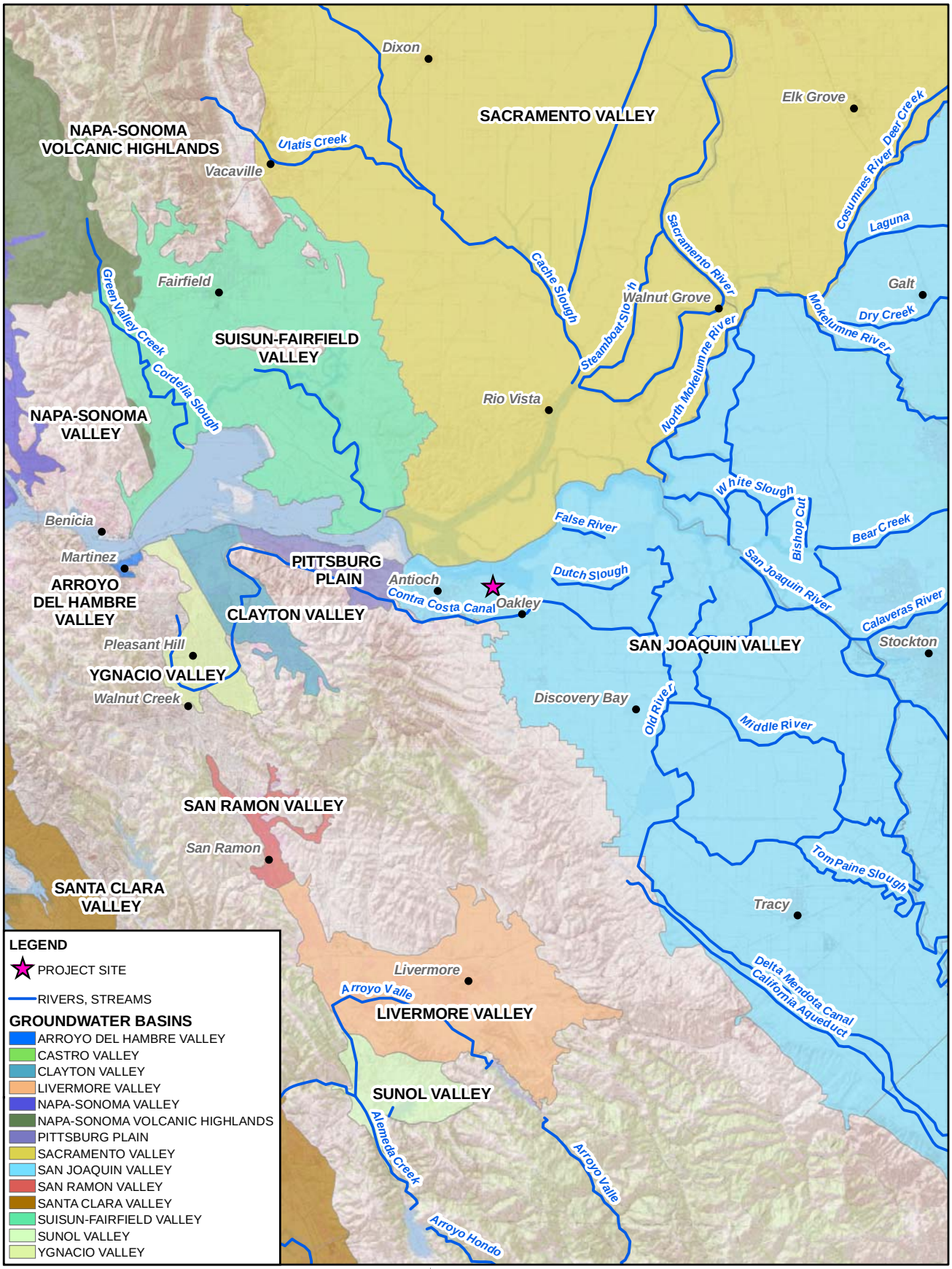
N

0 4 8
Miles

FIGURE 2.1-5
Surface Water
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

SAC\\ZION\SACGIS\PROJ\RADBACKENERGY\385962\MAPFILES\SURFACEWATER.MXD MHASKELL 6/11/2009 13:29:00
IS012010223151SAC Figure_2.1-5.ai 03.03.2010 tdaus



Notes:
1. Source: The Dept. of Water Resources, Groundwater Basin Map, 2004.

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

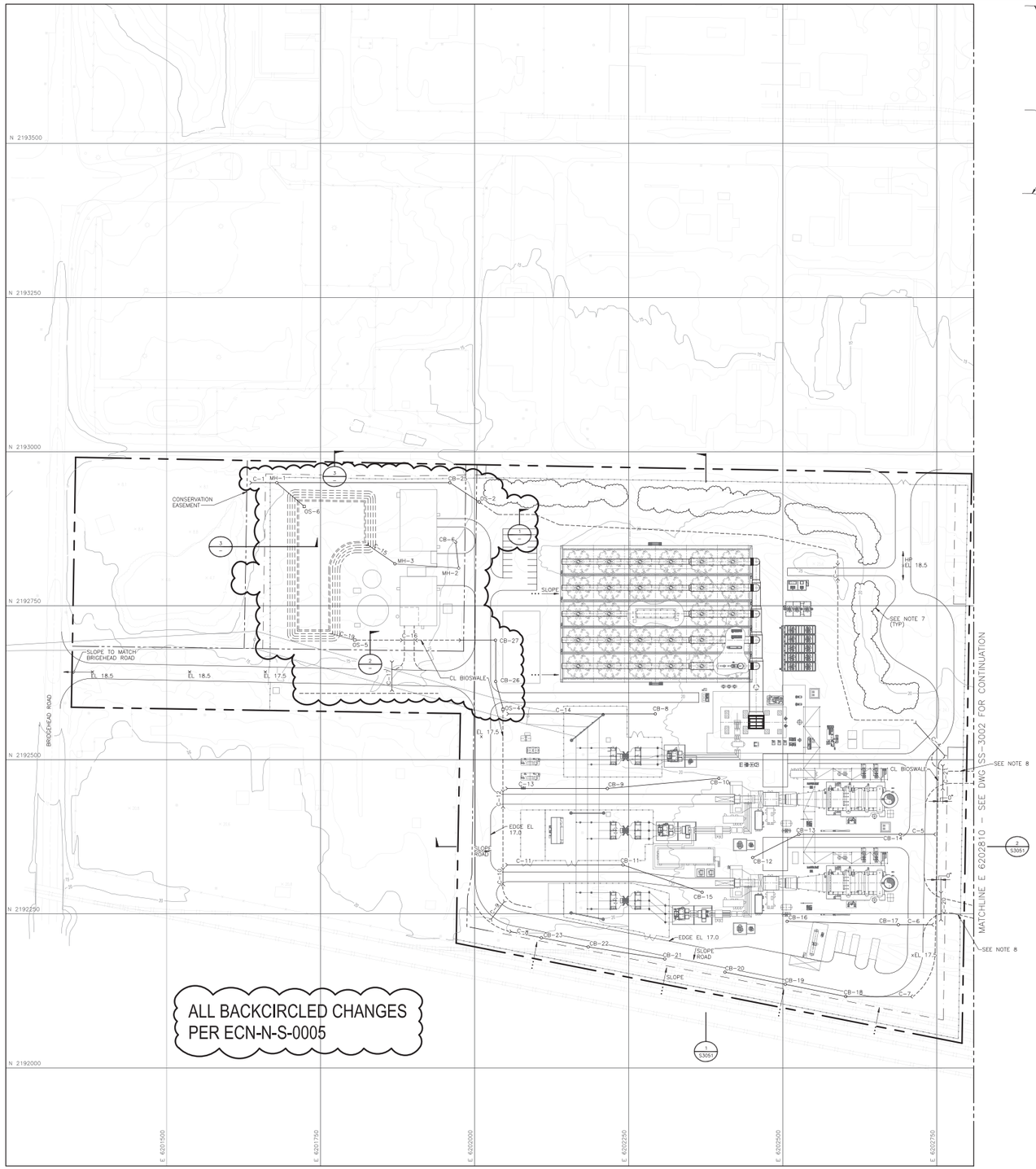
N

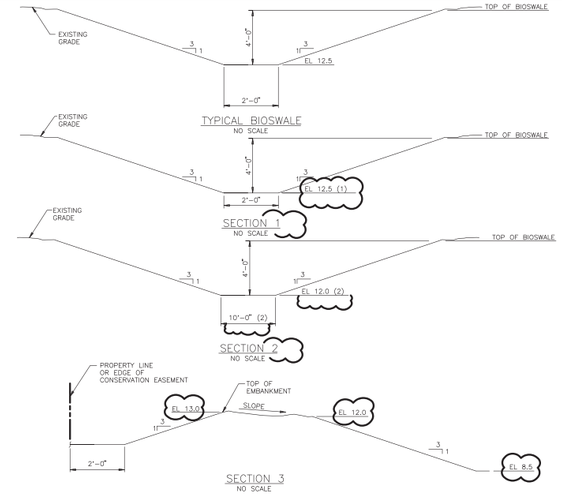
0 4 8
Miles

FIGURE 2.1-6
Groundwater Resources
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

SAC\\ZION\SACGIS\PROJ\RADBACKENERGY\385962\MAPFILES\GROUNDWATER.MXD MHASKELL 6/11/2009 13:34:34
IS012010223151SAC Figure_2.1-6.ai 03.03.2010 tdaus





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	–	APPROXIMATE	LTR	–	LATER
ASPH	–	ASPHALT	MAX	–	MAXIMUM
AVG	–	AVERAGE	MH	–	MANHOLE
BND	–	BEND	MIN	–	MINIMUM
BLDG	–	BUILDING	MJ	–	MECHANICAL JOINT
B/MH	–	BOTTOM OF MANHOLE ELEVATION	MSL	–	MEAN SEA LEVEL
BOC	–	BOTTOM OF CONDUIT ELEVATION	NO.	–	NUMBER
BOD	–	BOTTOM OF DUCTBANK ELEVATION	NTS	–	NOT TO SCALE
BOP	–	BOTTOM OF PIPE ELEVATION	OD	–	OUTSIDE DIAMETER
BU	–	BELL-UP	OWS	–	OIL WATER SEPARATOR
C	–	CULVERT	OWMH	–	OILYWASTE MANHOLE
CB	–	CATCH BASIN	PC	–	POINT OF CURVATURE
CD	–	CABLE DUCT	PE	–	PLAIN END
CHDPE	–	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	–	POINT OF INTERSECTION
CL	–	CENTERLINE	PLCS	–	PLACES
CLR	–	CLEAR	PM	–	PLANT MANHOLE
CMH	–	CHEMICAL MANHOLE	POT	–	POINT OF TANGENT
CND	–	CONDUIT	PT	–	PULL TERMINATION
CONC	–	CONCRETE	PVC	–	POLYVINYL CHLORIDE PIPE
CO	–	CLEAN OUT	QTY	–	QUANTITY
CS	–	CARBON STEEL	R	–	RADIUS
CW	–	CIRCULATING WATER	RCP	–	REINFORCED CONCRETE PIPE
DB	–	DUCTBANK	RD	–	ROOF DRAIN
DBC	–	DIRECT BURIED CABLE	REV	–	REVISION
DET	–	DETAIL	RGS	–	RIGID GALVANIZED STEEL
DIA	–	DIAMETER	RR	–	RAILROAD
DIP	–	DUCTILE IRON PIPE	SECT	–	SECTION
DWG	–	DRAWING	SIM	–	SIMILAR
DWP	–	DOUBLE WALL PIPE	SLS	–	SANITARY LIFT STATION
EC	–	ELECTRICAL CONDUIT	SMH	–	SANITARY MANHOLE
ECC	–	ECCENTRIC	STMH	–	STORM MANHOLE
EF	–	EACH FACE	STRL	–	STRUCTURAL
EHH	–	ELECTRICAL HANDHOLE	T/C	–	TOP OF CONCRETE ELEVATION
EL	–	ELEVATION	T/G	–	TOP OF GRADE ELEVATION
EMH	–	ELECTRICAL MANHOLE	TMH	–	TELEPHONE SERVICE HANDHOLE
EW	–	EACH WAY	T/MH	–	TOP OF MANHOLE ELEVATION
FC	–	FIELD CHECK	T/P	–	TOP OF PAVEMENT ELEVATION
FDN	–	FOUNDATION	TP	–	MECH PIPE TERMINAL POINT
FF	–	FLAT FACE	TYP	–	TYPICAL
FRP	–	FIBERGLASS REINFORCED PIPE	UGL	–	UNDERGROUND LIGHTING CONDUIT
GR	–	GRADE	UNO	–	UNLESS NOTED OTHERWISE
HDM	–	HOT DRAIN MANHOLE	VERT	–	VERTICAL
HDPE	–	HIGH DENSITY POLYETHYLENE PIPE	WGT	–	WEIGHT
HP	–	HIGH POINT	WTR	–	WATER
HYD	–	HYDRANT	W/	–	WITH
ID	–	INSIDE DIAMETER	W/O	–	WITHOUT
INV	–	INVERT	WP	–	WORK POINT
JBX	–	JUNCTION BOX	XFMR	–	TRANSFORMER
L	–	LENGTH			
LP	–	LOW POINT			

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

	NEW CULVERT		NEW SLIDE GATE
	CL BIOSWALE		NEW SWING GATE
1 / S3000	SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER		EXISTING POWER POLE
× 326.5	FINISHED SPOT ELEVATIONS	CB-101	NEW CATCH BASIN
			NEW DROP STRUCTURE
BM-1	SURVEY MONUMENT/CONTROL POINT		PROPERTY LINE
	EXISTING FENCE		BOUNDARY LINE
	NEW SECURITY FENCE	126	EXISTING CONTOURS
	TEMPORARY CONSTRUCTION FENCE		GRADE TO DRAIN (DIRECTION OF ARROW)
TR-1	EROSION CONTROL METHOD		

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE. ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN, DROP AND OUTLET STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.

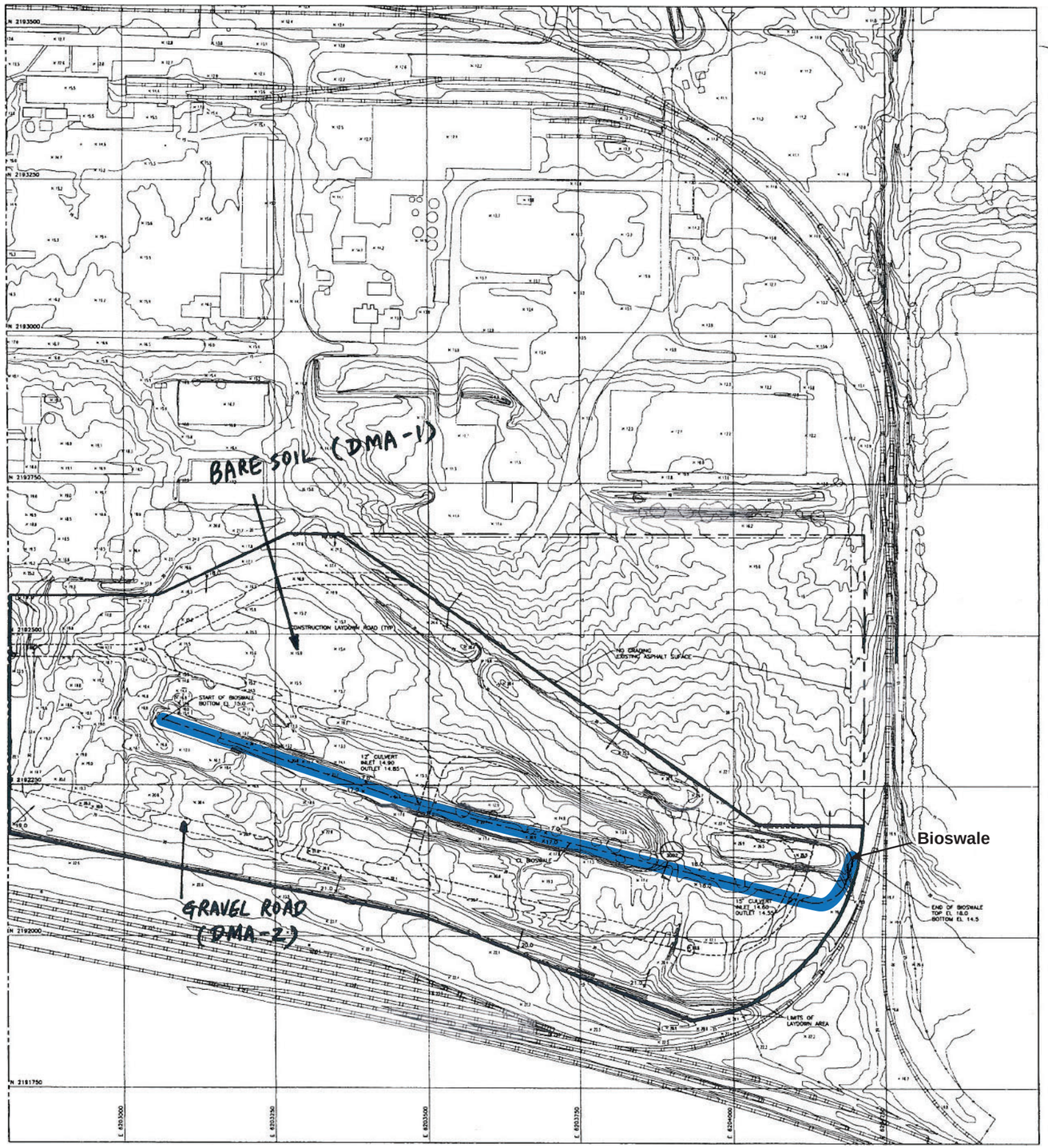
NOT TO BE USED FOR CONSTRUCTION

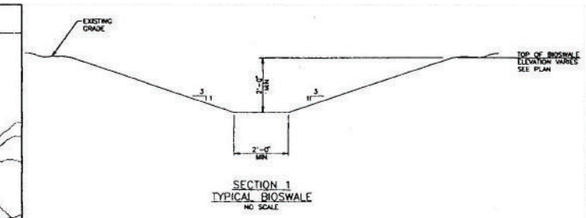
THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

Source: Black & Veatch Holding Company, Drawing 163994-SS-3001 R2, 09/22/2010.

60' 30' 0 60' 120'
SCALE: 1"=60'

FIGURE 2.1-7
Grading And Drainage Site Plan Sheet 1
Oakley Generating Station DESCP/SWPPP
Oakley, California





SECTION 1
TYPICAL BIOSWALE
NO SCALE

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. ALL TREES WITHIN LAYDOWN AREA SHALL BE REMOVED.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

Source: Black & Veatch Holding Company, 04/18/09, Drawing 163994-SS-3002 Rev. A

FIGURE 2.1-7
Grading And Drainage Site Plan Sheet 2
Oakley Generating Station DESCP/SWPPP
Oakley, California

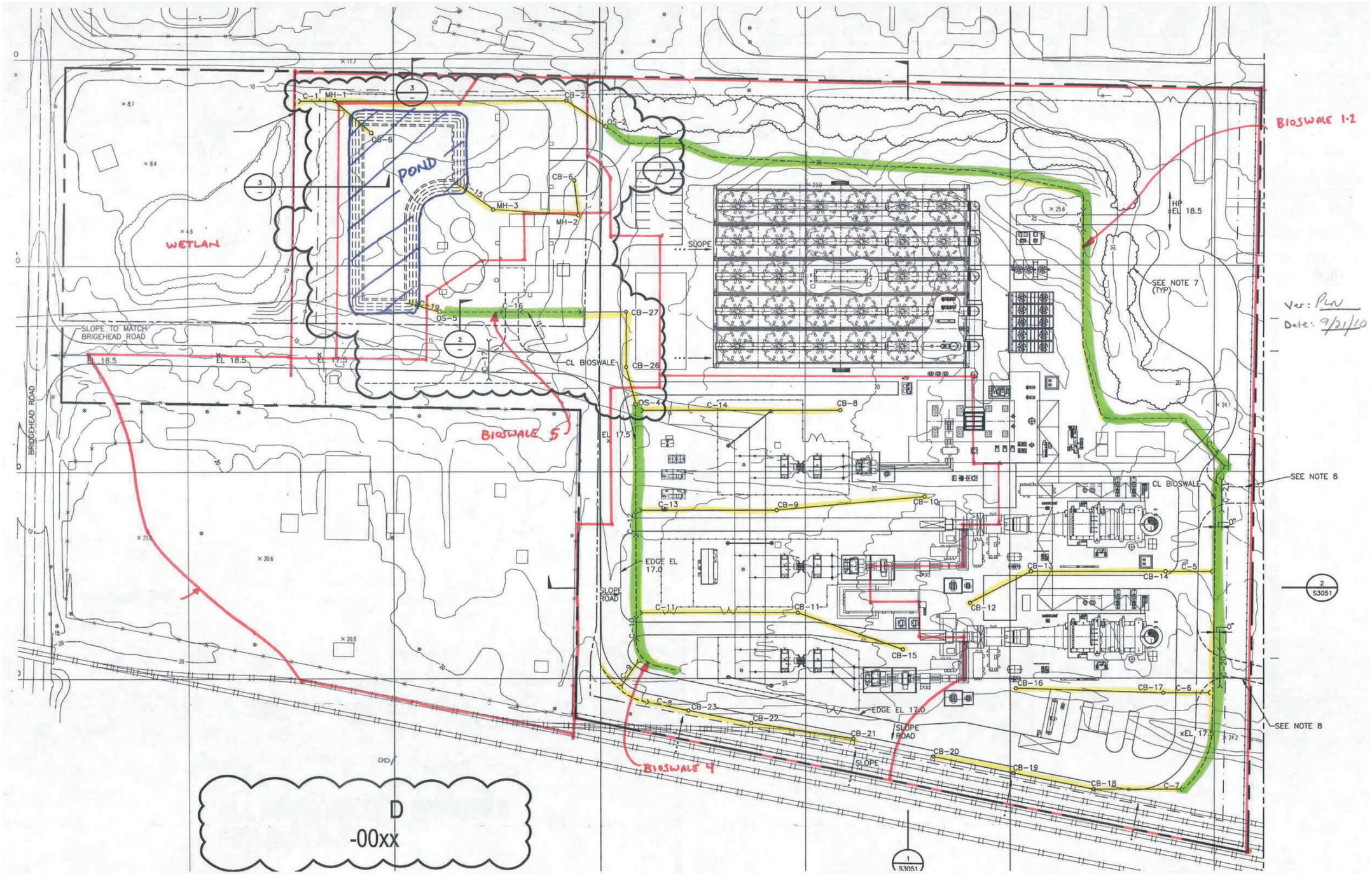


FIGURE 2.1-8
Post Development Drainage Plan
Oakley Generating Station DESCP/SWPPP
Oakley, California

SECTION 3

Best Management Practices

3.1 Schedule for BMP Implementation

3.1.1 Implementation Schedule

Construction of the generating facility, from site preparation and grading to commercial operation is expected to take place from the first quarter of 2011 to the fourth quarter of 2013 (33 months total). The construction phases of the OGS Project as they pertain to stormwater management and BMP implementation are expected to be as follows:

- **Preparation**—Most of the construction laydown area, which will be used for construction worker parking and construction materials, is covered by bare soil with little vegetation; however, the northeastern portion is covered by concrete pavement. The unpaved portion of the construction laydown area will be graded. A bioswale will be constructed at the center of this unpaved area laydown area and the area will be graded such that runoff is collected in the bioswale. The excess water will be allowed to pond and percolate into the soil.

  Detailed information regarding timing and sequencing of construction events and the location of the laydown and parking areas will be developed by the construction contractor and incorporated into the SWPPP as appropriate.

- **Access Road—** Two access roads will be used for the project. One of the access roads will be a new entrance lane extending from Bridgehead Road, just south of the intersection of Bridgehead Road and Wilbur Avenue. During construction, the access road will be stabilized using coarse aggregate. At the end of construction, the entrance road will be permanently paved. Another access road will be provided via the existing site entrance and entrance to the DuPont facility located further north on Bridgehead Road. Most of the surface area for the access roads will be the existing paved surfaces on the former DuPont facility. However, the unpaved portion of the access road will be stabilized using coarse aggregate. At the end of construction, the portion of the access road that was originally non-paved surface will be hydroseeded and returned to the pre-construction conditions. The paved access road surfaces on the DuPont facility will remain paved.

- **Site Grading—** Grading on the project site will occur on approximately 17 acres (the 1.6-acre Wetland E conservation area and the eucalyptus grove will not be disturbed) and will last for 2 months; grading will occur on up to 38 acres of the project laydown area, stockpile area, transmission line and pull sites, and sanitary sewer force main for a duration of approximately 1 month for each of the areas. The laydown area will be covered with gravel to allow wet season use and to further minimize soil erosion potential. Heavy equipment stored on site will be placed on dunnage to protect it from ground moisture. Once construction is completed, the gravelled area would be removed and the laydown area would be hydroseeded.

- **Foundation**—All underground piping and wiring will be installed, followed by installation of the foundation for the new generating facility and associated structures. Post-construction treatment of stormwater will be accomplished by directing stormwater to engineered bioswales.
- **Plant Construction**—After final site design and prior to construction, the Applicant will be required to finalize the Drainage, Erosion and Sediment Control Plan Construction SWPPP (this document). During construction, the Applicant will be required to follow the SWPPP to prevent the offsite migration of sediment and other pollutants and to reduce the effects of runoff from the construction site. BMPs to be used at the site will be fully addressed in the Final SWPPP; the SWPPP will include the location of BMPs to be used, installation instructions, and maintenance schedules for each BMP.
- **Site Stabilization**—Permanent stormwater management fixtures will replace any temporary items at the end of project construction including the construction of the permanent bioswales on the project site and hydroseeding of bare ground.
- **Demobilization**—All temporary construction facilities will be removed. Permanent stormwater controls will then be in effect.

3.2 Erosion and Sediment Control

The combination of erosion control and sediment control is the most effective means to prevent sediment from leaving the project site and potentially entering storm drains or receiving waters. This section describes the BMPs that will be used for the project. BMP Drawings (Figures 3.2-1 through 3.2-3) show the locations of the project BMPs. Figure 3.2-4 shows example installation methods for various BMPs that apply to the project (and is a part of Appendix E Preliminary Stormwater Management Design). BMP Fact Sheets are located in Appendix H.

3.2.1 Erosion Control

Erosion control is any source control measure that is designed to prevent soil particles from becoming detached by rainfall, flowing water, or wind. Erosion control consists of using project scheduling and planning to reduce soil or vegetation disturbance (particularly during the rainy season), preventing or reducing erosion potential by diverting or controlling drainage as well as preparing and stabilizing disturbed soil areas.

This construction project will implement the following practices to assure effective temporary and final soil stabilization (erosion control) during construction:

- Preserve existing vegetation where required and when feasible.
- Apply temporary soil stabilization (erosion control) to remaining active and non-active areas as required by the SWPPP BMP Manual as necessary to maintain effectiveness.
- Implement temporary soil stabilization measures at regular intervals throughout the defined rainy season to achieve and maintain the contract's disturbed soil area requirements.

- Stabilize non-active areas within 14 days of cessation of construction activities.
- Sufficient soil stabilization materials will be maintained onsite to allow implementation of requirements described in this DESCP/SWPPP. This includes implementation requirements for active areas and non-active areas that require deployment before the onset of rain.

The erosion control BMPs are listed below:

- EC-1 Scheduling
- EC-2 Preservation of Existing Vegetation
- EC-4 Hydroseeding
- EC-7 Geotextiles and Mats
- EC-15 Soil Preparation/Roughening
- EC-16 Non-Vegetative Stabilization

Site preparation will consist of grading the proposed project site and the laydown area. Existing eucalyptus trees along the northern perimeter of these areas will be preserved with the exception of six trees that will be removed to connect the small project area north and east of the eucalyptus grove to the main project area. The row of eucalyptus trees bisecting the laydown area also will be preserved. However, six oak trees located within the footprint of the project facility will be removed. Three wetland areas (Wetlands D, E, and F) and associated habitat will be preserved. Potential runoff to the wetland areas from project construction activities will be prevented by using sediment control BMPs discussed in Section 3.2.2.

Excavation work will consist of removal, storage, and/or disposal of earthen materials to the lines and grades necessary for construction. During construction activities, stockpile areas 2 and 3 will be bermed with soil used from the project. The berm will be placed on the perimeter of the stockpiles, and the berm will be hydroseeded to help stabilize the berm. Geotextiles and mats may be used with other BMPs on stockpiles during the rainy season and during the windy dry season (with the watering BMP) to prevent erosion of the stockpiles.

Site areas that will be graded include the project site and the construction laydown area, with the exception of the 6-acre portion of the laydown area that is concrete. Grading will retain the pre-project site contours to ensure that stormwater flows to the onsite construction bioswale located within the laydown area or into the stormwater drains. After being graded, the laydown area would be covered with gravel to allow for construction traffic and to prevent erosion. This gravelled area would be removed after construction, and the laydown area would be hydroseeded.

Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain. Structures will be designed to meet appropriate seismic requirements (the site is located in Seismic Risk Zone 4) and California Building Code requirements. Areas to be backfilled will be prepared by removing unsuitable materials and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill. Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve

the specified density. To verify compaction, representative field density and moisture-content tests will be performed during compaction in accordance with ASTM standards.

Site access for construction and maintenance of the transmission line will be constructed by grading and aggregating up to a 22.5-acre construction corridor through existing ruderal vegetation. Aggregate will be removed after construction, and the corridor will be hydroseeded with native grasses. Prior to ground-disturbance associated with the linear construction phases, all or a combination of the BMPs listed in this section may be used. Post-grading plans will be available when site drawings are finalized.

As the foundation for the project structures are developed, temporary BMPs will be replaced with permanent BMPs. Sediments and hydrocarbons will be minimized or prevented from entering the surface collectors with storm drain inlet protection devices and rings of hydrocarbon-absorbing fabric.

A concrete washout site will be designated onsite or will occur offsite at the concrete contractor's facility. Notices will be posted to inform all drivers.

As construction nears completion, areas used for parking, storage and laydown will be stabilized. Areas that will continue to be used (for parking or storage) will have permanent stormwater collection and conveyance structures provided. All disturbed areas associated with the linear facilities will be stabilized. Figure 3.2-5 depicts the permanent site surfacing materials including asphalt surfacing, aggregate surfacing, concrete, grass, open graded stone surfacing, riprap, and natural soil.

Non-vegetation BMPs consist of four bioswales that will be built for the operation of the plant. These bioswales will be designed to maintain the natural drainage pattern of the site. All stormwater runoff from the site will be directed into the bioswales, which ultimately flow into Wetland E. A complete description of the bioswales is presented in Section 3.4.

BMP Fact Sheets that will be used on this project are included in SWPPP Appendix H.

3.2.2 Sediment Controls

Sediment control is any practice that traps soil particles after they have been detached and moved by rain, flowing water, or wind. Sediment control measures are usually passive systems that rely on filtering or settling the particles out of the water or wind that is transporting them. Construction activities that have the potential to contribute sediment to stormwater discharges include the following activities:

- Excavation and backfill
- Erosion control material application
- Traffic movement out of lay down area
- Steel pipe welding

The following sediment controls will be used onsite during project construction:

- SE-1 Silt Fence
- SE-2 Sediment Basin
- SE 3 Sediment Trap
- SE-5 Fiber Rolls

- SE-6 Gravel Bag Berm
- SE-7 Street Sweeping and Vacuuming
- SE-8 Sandbag Barrier
- SE-9 Straw Bale Barrier
- SE-10 Storm Drain Inlet Protection
- SE-14 Biofilter Bags

A combination of silt fence and fiber rolls will be used on the upslope sides of Wetlands D and F and completely surrounding Wetland E to prevent the transmittal of soil particles in runoff flowing into them. Fiber rolls will also be placed around the perimeter of stockpile 1 (located on a concrete parking area) to prevent sediment transport from the stockpile area. Additional BMPs such as Gravel Bag Berms, Sand Bag Barriers or Straw Bale Barriers may also be used in these areas for reinforcement. Street sweeping and/or vacuuming will be implemented at the access roads entrances and exits.

3.2.3 Wind Erosion Control

Wind erosion controls shall be evaluated and implemented as needed throughout the duration of the project on all disturbed soils on the project site and linear facility sites that are subject to wind erosion, and when significant wind and dry conditions are anticipated during project construction. Wind controls will be used to prevent the transport of soil from soil-disturbed areas of the project site. The following control methods will be used for dust suppression, as necessary: The BMP used for wind control is listed below.

- WE-1 Wind Erosion Control

Additional wind control management measures will be implemented throughout the duration of construction and are listed below:

- Water aggregate roadways, parking areas and construction areas as needed.
- Cover all trucks hauling soil, sand and other loose materials offsite or require all trucks to maintain at least 18 inches of freeboard.
- Sweep adjacent streets and onsite paved roadways.
- Hydroseed or apply non-toxic soil stabilizers to inactive or completed construction areas as soon as is practical.
- Enclose, cover, water or apply non-toxic soil stabilizers to exposed stockpiles of sand, dirt, etc.
- Limit traffic speed onsite to 15 mph or less.
- Suspend excavation and grading during periods of high winds.

3.2.4 Tracking Control

Because sediment reaching public roads generally has a clear path to water bodies, controls will be in place to minimize or eliminate soils from being tracked off the project site from vehicles. Site access road and entrance/exits will be made of coarse aggregate to limit the amount of material adhering to tires. Paved roads used during the linear facilities

construction phase and those located at the entrance of the construction site will be inspected daily and cleaned as necessary using manual or mechanical street sweepers (BMP SC-7).

- TC-1 Stabilized Construction Entrance/Exit
- TC-2 Stabilized Construction Roadway
- TC-3 Entrance/Outlet Tire Wash

3.3 Non-stormwater and Materials Management

Non-stormwater management and materials management BMPs are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source or eliminating off-site discharge.

These practices involve day-to-day operations of the construction site and are also referred to as "good housekeeping practices, which include keeping a clean, orderly construction site.

Construction of the project will involve handling a large variety of building materials and chemicals associated with construction. As a Risk Level 1 site, the OGS project shall follow good site management (housekeeping) practices for construction materials and chemicals. These practices include conducting inventories of the products that will be used on-site; covering stockpiled construction materials; storing chemicals in water tight containers or in storage sheds using appropriate secondary containment to prevent any spillage or leakage; minimize exposure of construction materials with precipitation; and implementing BMPs to prevent off-site tracking of construction and landscape materials. Chemicals that could be potentially stored and used during construction of the facility include: gasoline, diesel fuel, oil, lubricants (i.e., motor oil, transmission fluid, and hydraulic fluid), solvents, adhesives, asphalt products, and paint materials. There are no feasible alternatives to these materials for construction or operation of construction vehicles and equipment, repaving areas, pouring concrete, or for painting and caulking buildings and equipment. Material Safety Data Sheets for each chemical used will be kept onsite, and construction employees will be made aware of their location and content. The contractor will be responsible for assuring that the use, storage and handling of these materials will comply with applicable federal, state, and local laws, ordinances, regulations, and standards (LORS), including licensing, personnel training, accumulation limits, reporting requirements, and record keeping.

Non-stormwater management BMPs to be used for this project are listed below:

- NS-1 Water Conservation Practices
- NS-2 Dewatering Operation
- NS-3 Paving and Grinding Operations
- NS-6 Illicit Connection/Discharge reporting
- NS-7 Potable Water/Irrigation
- NS-8 Vehicle and Equipment Cleaning
- NS-9 Vehicle and Equipment Fueling
- NS-10 Vehicle and Equipment Maintenance
- NS-11 Pile Driving Operations

- NS-12 Concrete Curing
- NS-13 Concrete Finishing
- NS-16 Temporary Batch Plant

Vehicle and equipment cleaning will occur at the access road entrance/outlet to the laydown area in the location of the tire wash or in an appropriate location per the direction of the QSD and QSP. Vehicle and Equipment Fueling shall be conducted in designated staging areas whenever possible. Leaks will be cleaned immediately and waste materials disposed of appropriately. The QSD and QSP shall designate an appropriate vehicle and equipment fueling area, and provide appropriate BMPs. Construction of replacement transmission towers in areas of Sycamore soils may need to include dewatering.

3.3.1 Waste Management and Materials Pollution

Waste Management consists of implementing procedural and structural BMPs for handling, storing, and disposing of wastes generated by a construction project to prevent the release of waste materials into stormwater runoff or discharges through proper management of the following types of wastes:

- Solid
- Sanitary
- Concrete
- Hazardous
- Equipment-related wastes

The construction of the facility will generate various types of non-hazardous solid wastes, including debris and other materials requiring removal during site grading and excavation, excess concrete, lumber, scrap metal, and empty non-hazardous chemical containers. Management of these wastes will be the responsibility of the construction contractor(s). The generation of waste materials will be minimized through efficient and careful use of materials, and recycling when possible. Non-hazardous materials will be used where acceptable to meet construction requirements. Drummed and bagged wastes will not be stored directly on the ground, and will be covered or stored indoors where feasible. Incompatible materials will be separated, and secondary containment will be provided for liquids. Sufficient spill cleanup materials will be kept in proximity to areas where materials are stored and used.

Small quantities of hazardous wastes will be generated over the course of construction. These may include flushing and cleaning fluids, passivating fluid (to prepare pipes for use), and solvents. All hazardous wastes generated during facility construction will be handled and disposed of in accordance with applicable laws, ordinances, regulations, and standards, including licensing, personnel training, accumulation limits and times, and reporting and recordkeeping. The hazardous waste will be collected in satellite accumulation containers near the points of generation. It will be moved daily to the contractor's 90-day hazardous waste storage area, located at the site construction laydown area. The waste will be removed from the site by a certified hazardous waste collection company and delivered to an authorized hazardous waste management facility, prior to expiration of the 90-day storage limit.

Nonhazardous solid waste generated during construction will be collected in onsite dumpsters. The dumpsters will meet local and state solid waste management regulations, and be provided with solid lids or removable flexible covers. Wastes will be recycled where practical. Waste that cannot be recycled will be disposed of in a Class III landfill.

At a minimum, Risk Level 1 dischargers shall implement the following good housekeeping measures:

a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e., soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

e. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.

Risk Level 1 dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the stormwater drainage system or receiving water.

c. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

d. Cover waste disposal containers at the end of every business day and during a rain event.

e. Prevent discharges from waste disposal containers to the stormwater drainage system or receiving water.

f. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.

g. Implement procedures that effectively address hazardous and nonhazardous spills.

h. Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities.

In the case of a spill, the project site must be prepared and have onsite equipment and materials for cleanup of spills; spills and leaks shall be cleaned up immediately and disposed of properly; and appropriate spill response personnel are assigned and trained.

Controls for common activities should be established, and preparations should be made to allow for quick response to accidents or spills including contingency plans for clean up and for sampling the contaminated stormwater.

The following waste management BMPs will be used on the project:

- WM-1 Material delivery and storage
- WM-2 Material use
- WM-3 Stockpile management
- WM-4 Spill Prevention and Control
- WM-5 Solid Waste Management (including use of covered dumpsters and containers for waste)
- WM-6 Hazardous Waste Management
- WM-8 Concrete Waste Management
- WM-9 Sanitary and septic waste management
- WM-10 Liquid Waste Management

Potential Contaminated Soil

A significant soil characteristic concerning the proposed 20-acre laydown area is the presence of waste titanium dioxide. A portion of this area was historically used for disposal of titanium dioxide waste during manufacturing operations at the DuPont facilities. As described in Section 2.2.5, during active manufacturing at the DuPont facility, the proposed laydown area was a TiO_2 landfill that was used for disposal of spent ore from the TiO_2 process (DuPont, 2003). This material is estimated to be approximately 3 feet thick (DuPont, 2006); the fill material is not expected to present a human health or wildlife risk (DuPont, 2006).

Groundwater Controls

Groundwater at the project site is currently not used for potable water. For construction, open excavations for some of the project's foundations will be required but will generally be small in size (less than 15 by 20 feet) and will extend no deeper than 23 feet below present ground surface. A percolation trench will be placed between the excavation areas and the existing contamination plumes and construction dewatering water will be discharged into the trench after carbon filtration. Because a percolation trench will prevent significant changes to groundwater flow and monitoring in the area, project construction will have no effect on groundwater. The linear facilities, excavation, grading and foundation structures required for OGS would not result in any substantial change from the existing groundwater flow and conditions at the site. During construction, the project would be subject to LORS requiring standards for isolating and controlling offsite runoff and contaminants that could

enter groundwater. During construction, the project would isolate all work areas using fiber, rolls, mats or similar devices to keep contaminated runoff from leaving the site.

3.4 Post-construction Stormwater Management Measures

The OGS stormwater design will be governed by the stormwater management requirements of the Contra Costa Clean Water Program Stormwater C.3 Guidebook (CCCWP, 2008). The C.3 requirements address both flow control and treatment of stormwater. Per page 8 of the C.3 guidebook, using the Option 2 design process detailed in Chapter 4 will allow the OGS project to meet both treatment and flow control requirements.

Post-development drainage at the site will be designed to maintain the natural drainage pattern of the site. All stormwater will be contained onsite via a series of bioswales and a detention basin, eventually discharging into Wetland E. Four bioswales and a detention basin will be utilized to collect all stormwater runoff from the project site. The volume provided within these areas is sufficient to store the combined 100-year and 10-year runoff volumes provided without discharging stormwater offsite. Water will either infiltrate directly into the ground or will be routed into the detention basin which will provide stormwater treatment prior to discharge to the wetland. Given the high permeability of the Delhi Sand soils found in the project area, infiltration has been calculated to be fairly rapid. Bioswales 4 and 5 will provide additional treatment, particularly during construction, to limit sedimentation from construction activities reaching the wetland. Gravel check dams will be installed within the bioswales to limit erosion and transport of soil mix within the bioswales during higher flow rates. To maintain hydration of the wetland area, the detention pond has been designed with low-flow orifices that will release water into the wetland within a 24-hour period after the water has been held in the pond. Rainfall less than the design event will be contained in the bioswales and will infiltrate through the sandy soils or evaporate. The soils, plantings, and irrigation for the bioswales will be in accordance with Appendix B of the Contra Costa Clean Water Program Stormwater C.3 Guidebook. The locations of bioswales, delineated drainage areas for each bioswale, and the detention basin are shown on Figure 2.1-8. The stormwater system is designed so that it does not adversely affect the supply of runoff to the wetland or the quality of water flowing into it. Refer to Appendix E, Preliminary Stormwater Management Design for specifics.

Runoff from the power block area will be routed through an oil/water separator before being discharged to the sanitary sewer system and will not be discharged onsite. Appendix E contains the Preliminary Stormwater Management Design for the project, which includes stormwater calculations and the pre- and post-development drainage plans. The owner of the site will operate and maintain the post-construction permanent bioswales for the life of the facility.

Figures

LEGEND

- Project Site
- Stockpiles
- Construction Laydown Area
- Wetland
- Existing Retention Basin
- Access Road (TC-2 Stabilized Construction Roadway)
- TC-1 Stabilized Construction Entrance/Exit
- TC-3 Entrance/Outlet Tire Wash
- SE-5 Fiber Roll
- SE-1 Silt Fence
- Soil Berm
- ESA Fencing/EC-2 Preservation of Existing Vegetation
- EC-4 Hydroseed
- EC-4 Hydroseed, Post-construction
- EC-7 Geotextiles and Mats
- "Sensitive Area" Signage

Note: Watering or street sweeping will occur throughout the site for the duration of construction, as needed, for dust control.

N

0 100 200
Feet

FIGURE 3.2-1
Project Site and Laydown Area BMP Map
DESCP/SWPP
Oakley Generating Station

CH2MHILL

\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\FIG_PROJECTSITE_LAYDOWN.MXD SSCOPES 10/19/2010 12:37:27
IS012010223151SAC Figure_3.2-1_Project_Site_BMP_Map.ai 10.25.2010 tdaus

LEGEND

- Stockpiles
- Wetland
- Access Road (TC-2 Stabilized Construction Roadway)
- TC-1 Stabilized Construction Entrance/Exit
- TC-3 Entrance/Outlet Tire Wash
- SE-5 Fiber Roll
- SE-1 Silt Fence
- Soil Berm
- EC-4 Hydroseed
- EC-4 Hydroseed, Post-construction
- EC-7 Geotextiles and Mats
- "Sensitive Area" Signage

N

0 125 250
Feet

VICINITY MAP

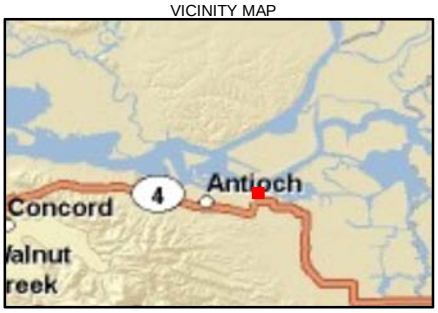
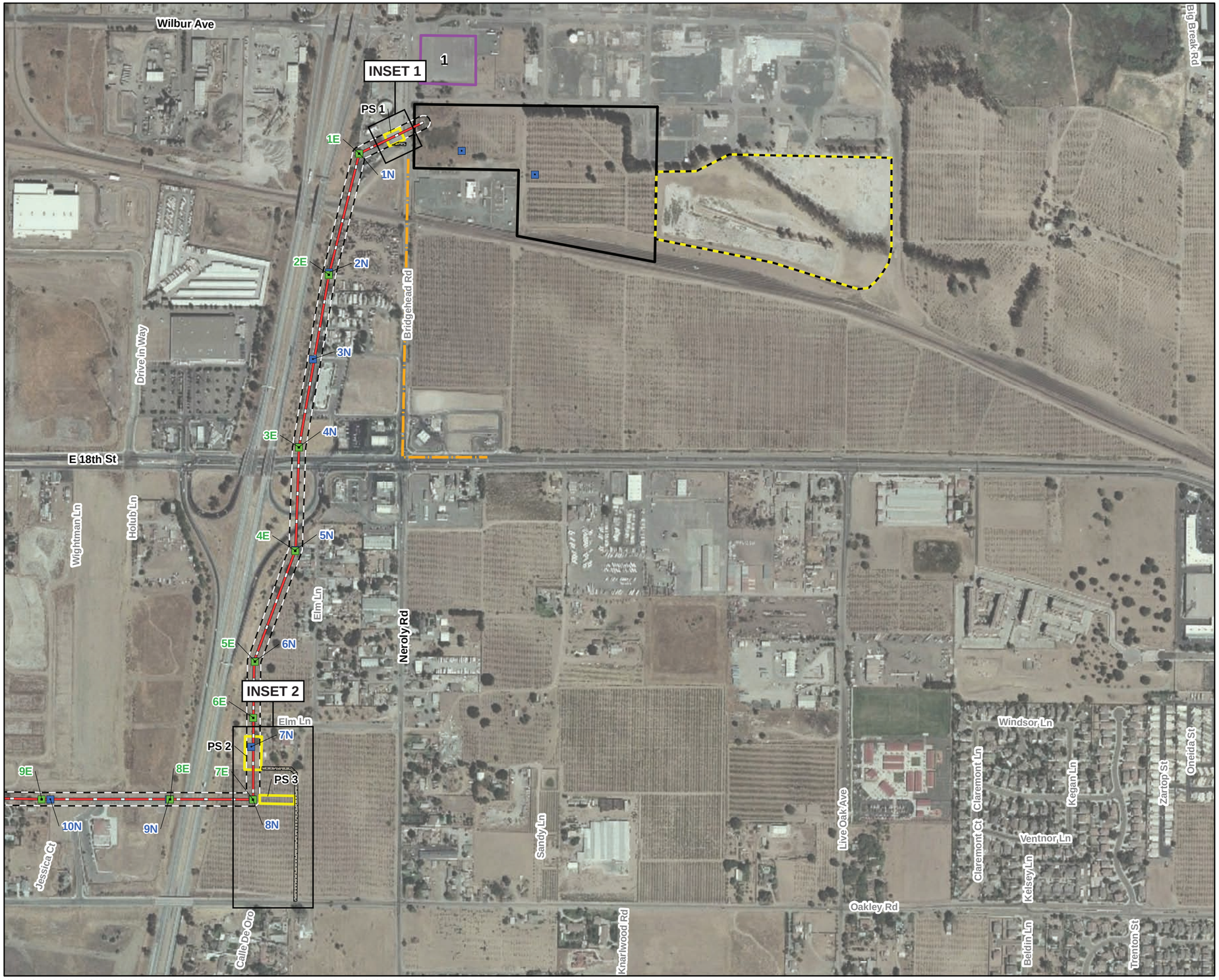


FIGURE 3.2-2
Stockpiles BMP Map
DESCP/SWPPP
Oakley Generating Station

CH2MHILL

\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\FIG_STOCKFILE.MXD SSCOPES 10/19/2010 12:27:28
IS012010223151SAC Figure_3.2-2_Stockpile_BMP_Map.ai 10.26.2010 tdaus



VICINITY MAP

LEGEND

- Existing 60 KV Tower Locations
- New 230 KV Tower Locations
- Existing 60kV Transmission Line
- Construction Laydown Area
- Sanitary Sewer Force Main
- Project Site
- Stockpiles
- 80 ft. Construction Footprint
- Pull Site
- Access Road

Insets are described in Figure 3.2-3, Map Sheet 3.

BMPs are described on Map Sheets 4 and 5.

N

0 300 600
Feet

FIGURE 3.2-3
Transmission Line/BMP Map Sheet 1
Oakley Generating Station DESCP/SWPPP
Oakley, California

\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\UTILITY_SHEET2.MXD GPERDEW 10/27/2010 13:57:20

IS012010223151SAC Figure_3.2-3.ai 10.28.2010 tdaus

CH2MHILL

VICINITY MAP

LEGEND

- Existing 60 kV Tower Locations
- New 230 kV Tower Locations
- Existing 230 kV Tower Location (40' Extension to be Added)
- Existing 60 kV Transmission Line
- 80 ft. Construction Footprint
- Pull Site
- Access Road
- ESA Fencing
- Riparian Habitat
- Water Edge

Insets are described in Figure 3.2-3, Map Sheet 3.
BMPs are described on Map Sheets 4 and 5.

N

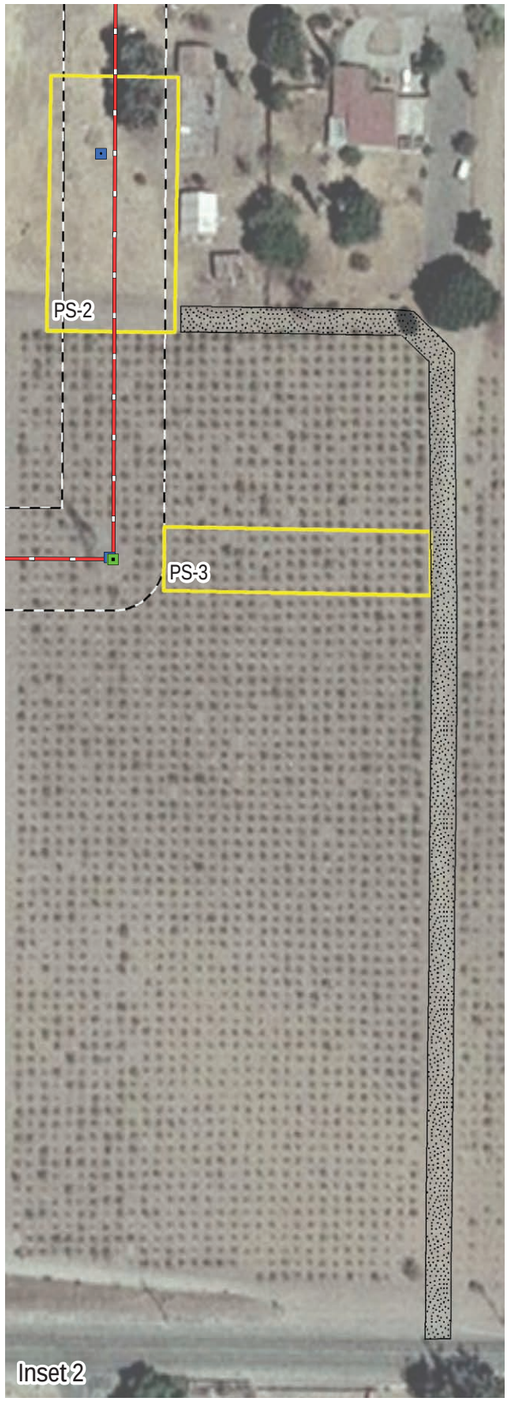
0 350 700 1,400
Feet

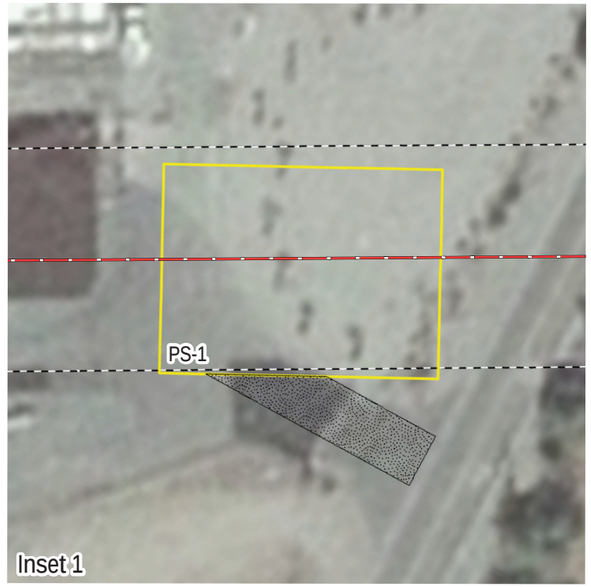
FIGURE 3.2-3
Transmission Line/BMP Map Sheet 2
Oakley Generating Station DESCP/SWPPP
Oakley, California

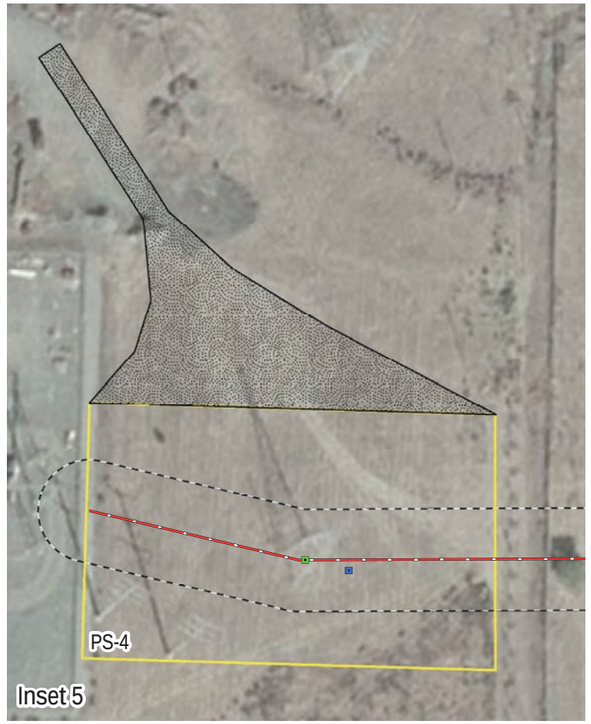
\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\UTILITY_LOCATION.MXD GPERDEW 10/21/2010 09:50:05

IS012010223151SAC Figure_3.2-3.ai 10.28.2010 tdaus

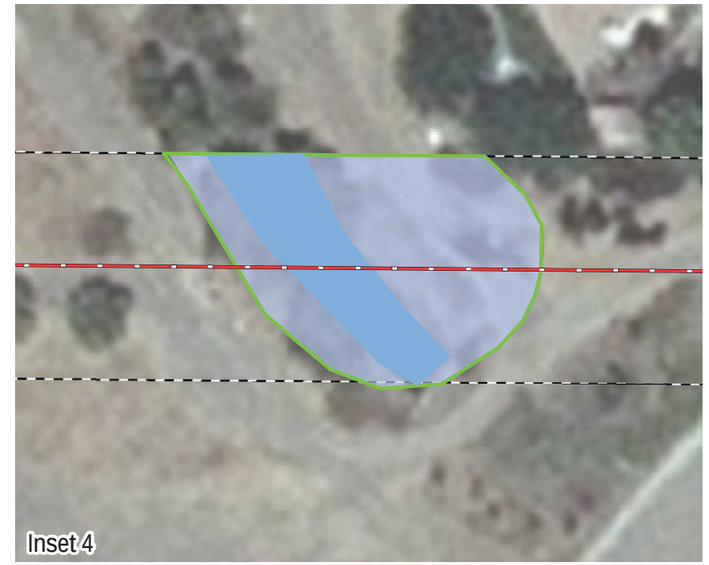
CH2MHILL



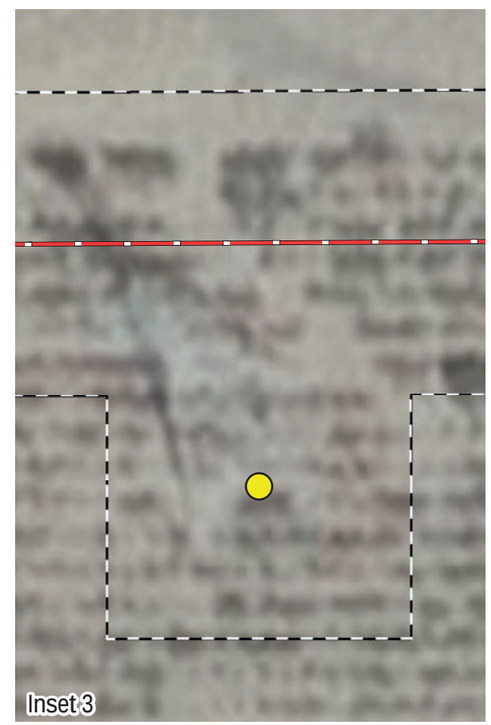




Pull Sites



Riparian Habitat



Existing 230 kV Tower Location

FIGURE 3.2-3
Transmission Line/BMP Map Sheet 3
Oakley Generating Station DESCP/SWPPP
Oakley, California

Transmission Towers

The new transmission towers will be installed within the existing 80 foot PG&E right of way (ROW) between the OGS project site and the Contra Costa Substation. The proposed access routes for each of the towers are based on aerial photographs and site surveys. The tower access routes are for initial planning purposes only and have not been finalized. Therefore, the access routes are subject to change during the final transmission tower design phase.

It is assumed that all impacted areas will be within an 80 foot by 80 foot construction area. The impacted areas consist primarily of soil or other pervious material. Therefore, similar BMPs will be employed at each of the sites. The objective of the BMPs is to prevent topsoil from leaving the construction area and entering into waterways or into tributaries to waterways (including storm drains via gutters or overland flow) either associated with water or wind erosion. The following BMPs are recommended for use at each pole site; any pole sites that are atypical and require additional control measure will use additional BMPs, to be prescribed by the onsite Qualified SWPPP Developer (QSD).

Pole Site BMPs

Sediment Control

- SE-1 Silt Fence
- SE-5 Fiber Rolls

  A combination of silt fence and fiber rolls will be placed around the perimeter to prevent sediment transport from the construction area to adjacent areas. Additional BMPs such as Gravel Bag Berms (SE-6), Sand Bag Barriers (SE-8) or Straw Bale Barriers (SE-9) may also be used for reinforcement.

Erosion Control

- EC-4 Hydroseeding

  Stabilize non-active areas within 14 days of cessation of construction activities.

Wind Erosion Control

- WE-1 Wind Erosion Control

  Wind control management measures will be implemented throughout the duration of construction and are listed below:
  - Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least 18 inches of freeboard while driving on access roads and adjacent roadways.
  - Sweep adjacent streets and onsite paved roadways.
  - Hydroseed or apply non toxic soil stabilizers to inactive or completed construction areas as soon as is practical.
  - Enclose, cover, water or apply non toxic soil stabilizers to exposed stockpiles of sand, dirt, etc.
  - Limit traffic speed onsite to 15 mph or less on access roads and adjacent roads.
  - Suspend excavation and grading during periods of high winds.

Tracking Control

- TC-1 Stabilized Construction Entrance/Exit
- TC-2 Stabilized Construction Roadway
- TC-3 Entrance/Outlet Tire Wash

  Tracking control would be required on all access roads.

  Paved roads used during the linear facilities construction phase will be inspected daily and cleaned as necessary using manual or mechanical street sweepers (BMP SC-7).

In addition to the BMPs listed above, all applicable Non-stormwater and Materials BMPs and Waste Management and Materials Pollution BMPs prescribed in the OGS SWPPP will be used during transmission line post-installation/construction.

New Pole Number	Existing Pole Number	Access	Proposed Revegetation	Comment
1E	1N	Access site from an existing access driveway and paved lot off Bridgehead Road.	Hydroseed with native grass mix.	Concrete and asphalt areas will be replaced as needed.
2E	2N	Access site from an existing private driveway off Bridgehead Rd., just north of mobile home park.	Hydroseed with native grass mix.	It is assumed the new tower will be placed within the existing storage yard. Therefore, biological impacts will be minimal. Concrete and asphalt areas will be replaced as needed.
3N	none	Access site from an existing private driveway off of Bridgehead Rd. south of mobile home park and north of the existing hotel north of E. 18th Street.	Hydroseed with native grass mix.	Concrete and asphalt areas will be replaced as needed.
4N	3E	Access site from Main Street.	Hydroseed with native grass mix..	Vehicle tracks are visible on an aerial image of the ruderal habitat near the existing tower.
5N	4E	Access site from Elm Lane and perimeter vineyard roads.	Hydroseed with native grass mix. Replant vineyard per owner's specification	Site may require the removal of existing fencing in order to place the new tower. Fencing will be replaced as needed.
6N	5E	Access site from Elm Lane and perimeter vineyard roads.	Replant vineyard per owner's specification	Ruderal vegetation at the edge of the 80 foot buffer. However, it would require the removal of existing fencing in order to impact this ruderal area. Therefore, minimal (if any) ruderal impacts are expected.
None	6E	Access site from Elm Lane via an existing private property access route.	Hydroseed with native grass mix.	Site may require the removal of a tree.
7N	none	Access site from existing dirt road through vineyards off of Oakley Rd. (same access as Pull Site #2 and #3)	Hydroseed with native grass mix.	
8N	7E	Access site from existing dirt road through vineyards off of Oakley Rd. (same access as Pull Site #2 and #3)	Replant vineyard per owner's specification	
9N	8E	Access site from Jessica Ct. off of Oakley Road west of Hwy. 160.	Hydroseed with native grass mix.	Site is located in the corner of an existing paved parking lot for a church. Concrete and asphalt areas will be replaced as needed.
10N	9E	Access site from Jessica Ct. off of Oakley Road west of Hwy. 160.	Hydroseed with native grass mix.	Site may require the removal of existing fencing in order to remove the existing tower. Fencing will be replaced as needed.
11N	10E	Access site from Phillips Lane	Replant vineyard per owner's specification.	
12N	none	Access site from empty lot in subdivision off of Filbert St.	Replant vineyard per owner's specification	Empty lot in subdivision off of Filbert St. does not have any vegetative cover.
None	Existing 230-kV Tower Extension	Access site from empty lot in subdivision off of Filbert St.	Replant vineyard per owner's specification	Empty lot in subdivision off of Filbert St. does not have any vegetative cover.
13N	none	Access site from empty lot in subdivision off of Filbert St.	Replant vineyard per owner's specification	Empty lot in subdivision off of Filbert St. does not have any vegetative cover.
none	11E	Access site from empty lot in subdivision off of Filbert St.	Replant vineyard per owner's specification	Empty lot in subdivision off of Filbert St. does not have any vegetative cover.
14N	12E	Access site through empty lot off of Honeynut St.	Replant vineyard per owner's specification	
15N	13E	Access site via existing drive off of Oakley Road.	Replant vineyard per owner's specification	
16N	14E	Access site via an open space parkway that begins at the intersection of Oakley Road and Viera Ave.	Hydroseed with native grass mix.	Site access may require trimming of additional trees along the access route.
17N	15E	Access site via ruderal habitat west of Viera Ave.	Hydroseed with native grass mix.	There are existing vehicle tracks present in the ROW from Viera Ave to the three tower locations within the large ruderal habitat area. The riparian habitat will also be further protected by restricting access to the riparian habitat using ESA and silt fencing
18N	16E	Access site via ruderal habitat west of Viera Ave.	Hydroseed with native grass mix.	There are existing vehicle tracks present in the ROW from Viera Ave to the three tower locations within the large ruderal habitat area. The riparian habitat will also be further protected by restricting access to the riparian habitat using ESA and silt fencing
19N	none	Access site via ruderal habitat west of Viera Ave.	Hydroseed with native grass mix.	There are existing vehicle tracks present in the ROW from Viera Ave to the three tower locations within the large ruderal habitat area. The riparian habitat will also be further protected by restricting access to the riparian habitat using ESA and silt fencing
20N	17E	Access site via the proposed access road to pull site area #4, access to this area is through existing PG&E Corporate yard east of Hillcrest Ave.	Hydroseed with native grass mix.	

FIGURE 3.2-3
Transmission Line BMPs Sheet 4
Oakley Generating Station DESCP/SWPPP
Oakley, California

Transmission Line Pull Sites

The proposed transmission line pull and tensioning sites are located in a variety of land uses, including active industrial and commercial properties, vacant lots composed of ruderal grassland, active vineyard agricultural, and inactive non-native ruderal grassland habitat. The Pull Sites labeled on Figure 3.2-3 (Transmission Line/BMP Map Sheets 1 and 2) are shown on a larger scale on Map Sheet 3 and are described by acreage and location in Table 2 below. The BMPs listed for Transmission Tower Pole Sites on the previous page (Map Sheet 4) also apply to pull sites.

The BMPs listed for Transmission Tower Pole Sites on the previous page (Map Sheet 4) also apply to pull sites.

Table 2 Pull Site Acreage, Access Road Acreage, and Revegetation

Pull Site	Pull Site Acreage	Access Road Acreage	Access Road Location	Revegetation
PS 1	0.17	0.03	Access road connects to Bridgehead Rd.	Hydroseed with native grass mix.
PS 2	0.46	0.46	Access road connects to Oakley Rd.	Hydroseed with native grass mix.
PS 3	0.24	Shares access area of PS 2	Access road connects to Oakley Rd.	Replant vineyard per owner's specification.
PS 4	1.47	0.55	Access road connects to Hillcrest Ave.	Hydroseed with native grass mix.

Existing 230 kV Tower Location

Because an existing tower along the intersecting transmission route will be extended vertically by 40 feet, vegetation and soil disturbance will occur during installation. Because this tower is outside the 80 ft. transmission line buffer area, the buffer zone in the location of this pole has also been extended. Access will be from the empty lot in the subdivision along Filbert St. The BMPs listed for transmission line pole sites on the previous page (Map Sheet 4) also apply to this tower site.

Riparian Habitat

The riparian habitat shown on Figure 3.2-3, Sheet 2, is defined as an environmentally sensitive area (ESA) for biological resources, and therefore no disturbance shall occur in this area. Transmission tower installation and decommissioning will occur approximately 110 feet to the west, and therefore disturbance will occur very close to this ESA. ESA fencing will be installed around this area. DESCP BMPs that will be implemented are listed below and include BMPs for Sediment Control and Tracking Control. These BMPs will be installed in conjunction with the ESA fencing. Access will be through ruderal habitat at the end of Viera Ave. BMPs are listed below.

Sediment Control

- SE-1 Silt Fence
- SE-5 Fiber Rolls

A combination of silt fence and fiber rolls will be placed around the perimeter to prevent sediment transport from the construction area to adjacent areas. Additional BMPs such as Gravel Bag Berms (SE-6), Sand Bag Barriers (SE-8) or Straw Bale Barriers (SE-9) may also be used for reinforcement.

Tracking Control

- TC-1 Stabilized Construction Entrance/Exit
- TC-2 Stabilized Construction Roadway
- TC-3 Entrance/Outlet Tire Wash

Tracking control would be required on all access roads. A combination of the tracking control BMPs listed above and/or watering or street sweeping will be used, as needed, and as applicable to the area, for the duration disturbance to this area.

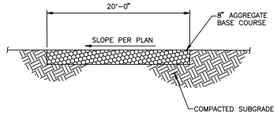
Sanitary Sewer Line

The 0.44 mile long sanitary sewer force main will be constructed from the project site tie-in location in Bridgehead Road to the force main located under Main Street. Construction of this line would be within the Bridgehead Road and Main Street ROWs. The sanitary sewer force main is shown on Figure 3.2-3, Sheet 1. All construction activities are expected to occur within the ROW. BMPs along Bridgehead Road would consist of sediment control BMPs to control runoff from the road into the adjacent ruderal habitat. BMPs along Main Street will include similar sediment control BMPs used for Bridgehead Road but would also include BMPs to prevent sediment from entering the existing stormwater drain system regulated by the City of Oakley (BMPs are listed below). All construction areas will also use Non Stormwater (NS) Management Control and Waste Management (WM) and Material Pollution Control BMPs. Refer to Figure 3.2-1 for NS and WM BMPs. A combination or all of these may be used as applicable.

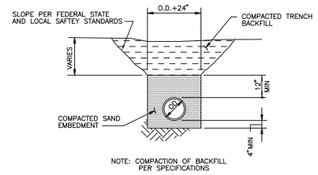
Sediment Control BMPs

- SE-1 Silt Fence
- SE-5 Fiber Rolls
- SE-7 Street Sweeping and Vacuuming
- SE-8 Sandbag Barrier
- SE-9 Straw Bale Barrier
- SE-10 Storm Drain Inlet Protection
- SE-14 Biofilter Bags

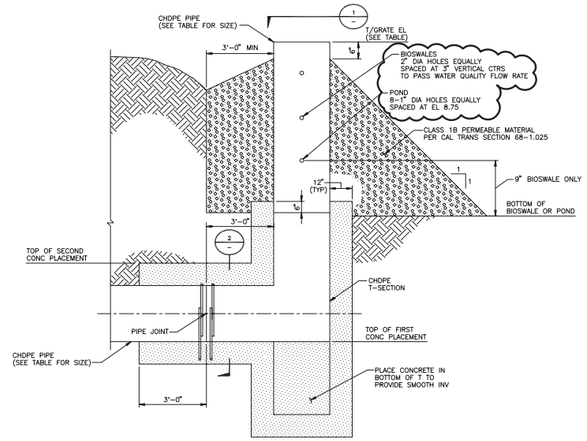
FIGURE 3.2-3
Transmission Line/BMP Map Sheet 5
Oakley Generating Station DESCP/SWPPP
Oakley, California



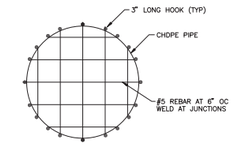
TYPICAL CONSTRUCTION LAYDOWN ROAD
NO SCALE



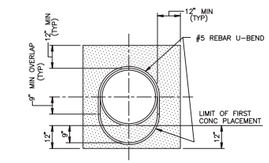
TYPICAL PIPE EMBEDMENT
NO SCALE



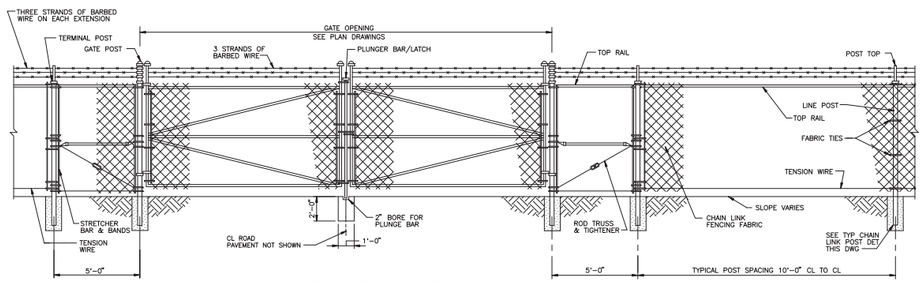
TYPICAL OUTLET STRUCTURE DETAIL
NO SCALE



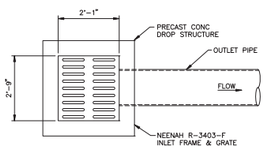
SECTION 1
NO SCALE



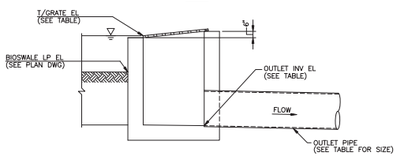
SECTION 2
NO SCALE



TYPICAL CHAIN LINK SECURITY FENCE AND GATE DETAIL
NO SCALE

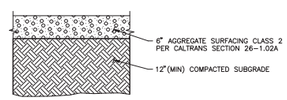


PLAN

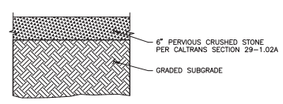


SECTION

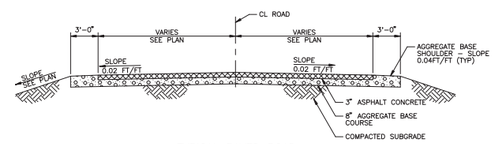
TYPICAL BIOSWALE DROP STRUCTURE DETAIL
NO SCALE



TYPICAL AGGREGATE SURFACING SECTION
NO SCALE

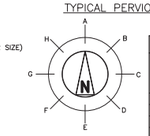


TYPICAL PERVIOUS CRUSHED STONE SURFACING SECTION
NO SCALE



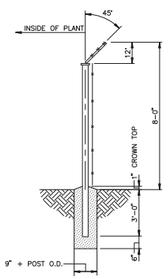
TYPICAL PAVED ROAD
NO SCALE
SEE DWG SS-3201

CULVERT TABLE						
CULVERT NO.	INLET INV ELEVATION	OUTLET INV. ELEVATION	LENGTH	PIPE DIAMETER	PIPE MATERIAL	REMARKS
C-1	8.2	8.0	–	24"	–	
C-2						NOT USED
C-3	13.0	13.0	–	18"	–	
C-4	13.2	13.0	–	18"	–	
C-5	13.1	12.9	–	12"	–	
C-6	13.1	12.9	–	12"	–	
C-7	13.3	13.0	–	12"	–	
C-8	13.2	13.0	–	12"	–	
C-9	13.0	13.0	–	12"	–	
C-10	13.0	13.0	–	15"	–	
C-11	13.4	12.6	–	12"	–	
C-12	13.0	13.0	–	18"	–	
C-13	13.4	12.6	–	12"	–	
C-14	13.5	12.5	–	12"	–	
C-15	10.3	10.0	–	18"	–	
C-16	12.5	12.5	–	18"	–	
C-17	14.7	14.4	–	12"	–	
C-18	12.8	12.5	–	18"	–	
C-19	10.5	10.0	–	18"	–	
C-20	13.0	13.0	–	18"	–	
C-21	13.0	13.0	–	18"	–	

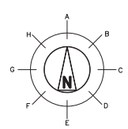


CATCH BASIN AND MAN HOLE TABLE																						
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																		REMARKS
				A		B		C		D		E		F		G		H				
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA			
CB-6	–	–	16.0	–	–	–	–	–	–	–	–	12.3	18"	–	–	–	–	–	–			
CB-7	NOT USED																					
CB-8	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.5	12"			
CB-9	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-10	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–			
CB-11	–	–	17.0	–	–	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–			
CB-12	–	–	17.0	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	–	–			
CB-13	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	–	–			
CB-14	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–			
CB-15	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"			
CB-16	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–			
CB-17	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–			
CB-18	–	–	16.5	–	–	13.2	12"	–	–	–	–	–	–	–	–	13.2	12"	–	–			
CB-19	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-20	–	–	16.5	–	–	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–			
CB-21	–	–	16.5	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	–	–			
CB-22	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-23	–	–	16.5	–	–	–	–	13.2	12"	–	–	–	–	–	–	13.2	12"	–	–			
CB-24	NOT USED																					
CB-25	–	–	15.0	–	–	–	–	–	–	11.6	18"	–	–	–	–	11.8	18"	–	–			
CB-26	–	–	16.0	13.2	18"	–	–	–	–	–	–	13.2	18"	–	–	–	–	–	–			
CB-27	–	–	16.5	–	–	–	–	–	–	–	–	12.8	18"	–	–	12.8	18"	–	–			
MH-1	–	–	13.0	–	–	–	–	8.2	24"	8.7	18"	–	–	–	–	8.2	24"	–	–			
MH-2	–	–	17.0	11.2	18"	–	–	–	–	–	–	–	–	–	–	11.0	18"	–	–			
MH-3	–	–	16.5	–	–	–	–	10.3	18"	–	–	–	–	–	–	–	–	10.3	18"			

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST



TYPICAL SECURITY FENCE POST DETAIL
NO SCALE



DROP (DS) AND OUTLET (OS) STRUCTURE TABLE																						
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																		REMARKS
				A		B		C		D		E		F		G		H				
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA			
DS-1	NOT USED																					
OS-2	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11.8	18"			
OS-3	NOT USED																					
OS-4	–	–	15.5	13.5	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
OS-5	–	–	14.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10.5	18"			
OS-6	–	–	14.0			–	–	–	–	–	–	–	–	–	–	–	–	8.5	24"			

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST

ALL BACKCIRCLED CHANGES PER ECN-N-S-0005

NOTES

1. FILTER FABRIC SHALL BE UV-STABILIZED NONWOVEN GEOTEXTILE HAVING A MINIMUM WEIGHT OF 135 g/M^2 PER CALTRANS SS 88-1.03.
2. SEE DWG SS-3001 FOR GENERAL NOTES AND LEGEND.

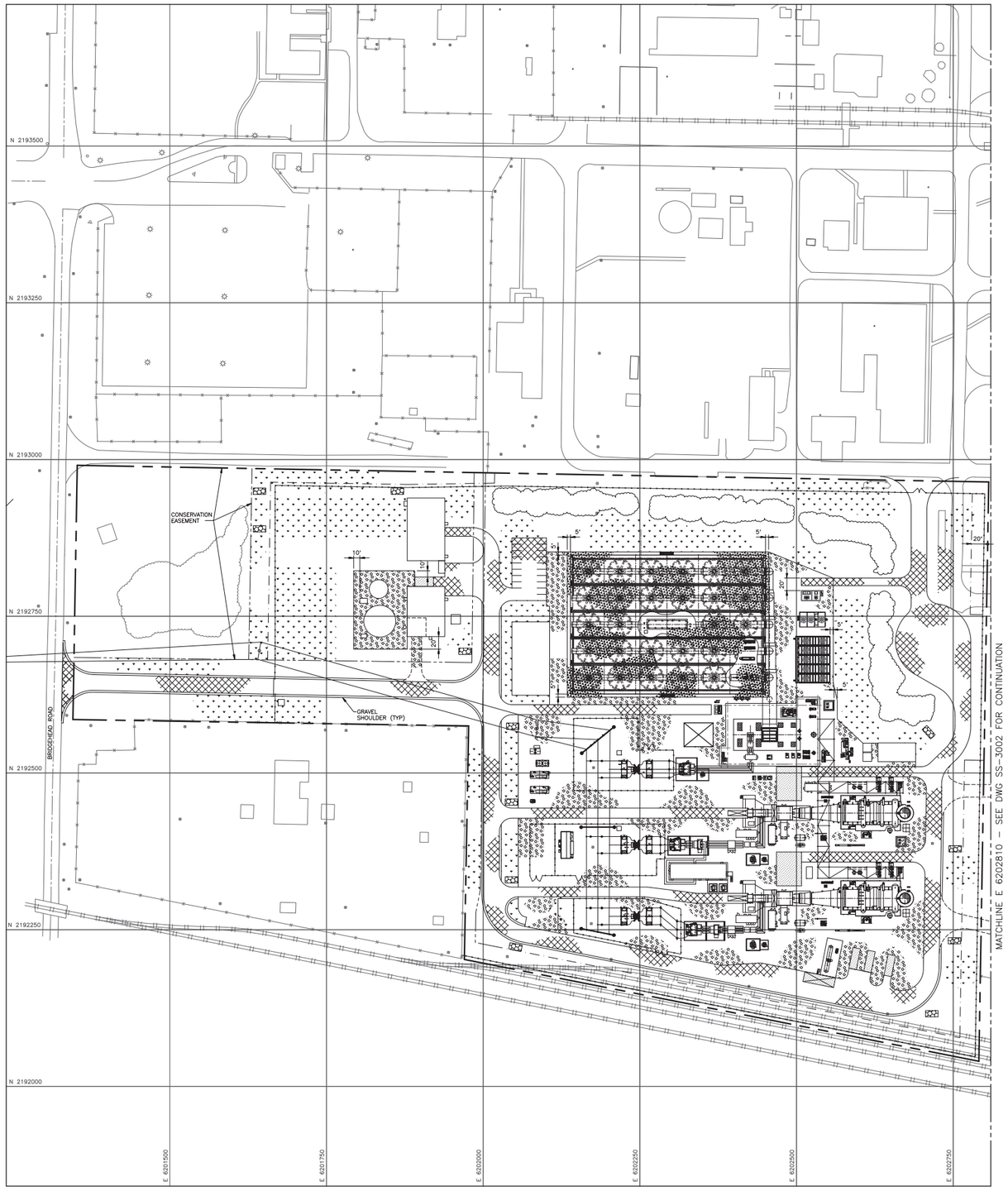
NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

FIGURE 3.2-4
Example Installation Methods
Oakley Generating Station DESCP/SWPPP
Oakley, California

Source: Black & Veatch Holding Company, Drawing 163994-SS-3050 R2, 09/22/2010.

CH2MHILL



SITE SURFACING LEGEND

- ASPHALT SURFACING
- AGGREGATE SURFACING
- CONCRETE
- GRASS
- OPEN GRADED STONE SURFACING
- RIPRAP
- EXISTING FACILITY
- NEW FACILITY
- NATURAL SOIL

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

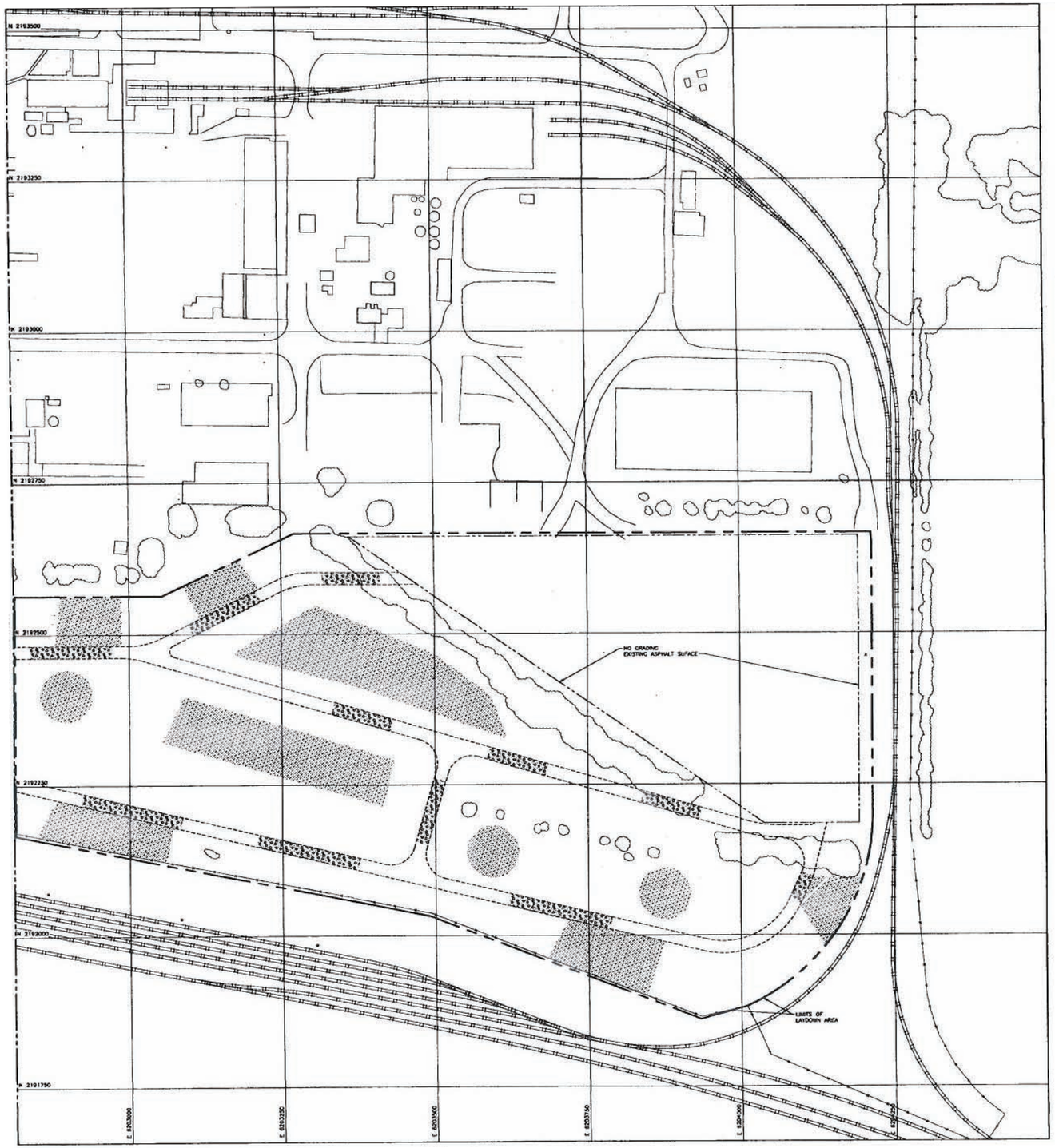
N

60' 30' 0 60' 120'
SCALE: 1" =60'

Source: Black & Veatch Holding Company, Drawing 163994-SS-3201, 04/16/2009.

FIGURE 3.2-5
Surfacing/Fencing/Roadway Sheet 1
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL



SITE SURFACING LEGEND

ASPHALT SURFACING	RIPRAP
AGGREGATE SURFACING	EXISTING FACILITY
CONCRETE	NEW FACILITY
GRASS	NATURAL SOIL
OPEN GRADED STONE SURFACING	

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED
FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

Source: Black & Veatch Holding Company, 04/18/09, Drawing 163994-SS-3202 Rev. A

60' 30' 0 60' 120'

FIGURE 3.2-5
Surfacing/Fencing/Roadway
Sheet 2
Oakley Generating Station DESCP/SWPPP
Oakley, California

SECTION 4

BMP Inspection, Maintenance, and Rain Event Action Plans

4.1 BMP Inspection and Maintenance

Risk Level 1 sites are required to ensure that all inspection, maintenance repair and sampling activities at the project location shall be performed by a QSP representing the owner. The QSP may delegate any or all of these activities to an employee trained to do the tasks appropriately. The QSP shall ensure adequate performance by the trained employee. Personnel responsible for inspections before, during and after storm events will receive additional training specific for this purpose. This can take the form of formal classroom training and/or "walk-around" with an experienced individual, who discusses the appropriate conditions and those conditions requiring action. The QSD (or designee) will maintain a list of authorized inspection individuals for the SWPPP (Appendix I), including the QSD and the QSP. Information on the list will include the name and contact information for the individual, their role on the project, date of training, and date of recorded entry as well as a copy of training certificates or other verification of training.

4.1.1 Site Inspections

Weekly inspections and observations, and at least once each 24-hour period during extended storm events, to identify BMPs that need maintenance to operative effectively, that have failed, or that could fail to operate as intend shall be performed by the QSP or employees trained by the QSP.

Upon identifying failures or other shortcomings, repairs or design changes to BMPs must be implemented within 72 hours of identification and complete the changes as soon as possible.

For each inspection required, the QSP (or designee) shall complete an inspection checklist (Appendix J). All site checklists shall be kept onsite with the SWPPP at all times. Photographs and descriptions must accompany each inspection list.

Records of SWPPP inspections will be maintained onsite for at least 3 years. An example checklist will contain, at a minimum, the following information required by the Regional Water Quality Control Board:

- Inspection date and the date the report was written.
- Weather information: best estimate of beginning of storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall (inches).
- Site information, including stage of construction, activities completed, and approximate area of the site exposed.
- Description of any inadequate BMPs.

- If possible to safely access during inclement weather, observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-stormwater controls; otherwise, result of visual inspection at relevant outfall, discharge point, or downstream location and projected required maintenance activities.
- Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.
- Corrective actions required, including any changes to SWPPP necessary and implementation dates.
- Photographs taken during the inspection.
- Inspectors name, title, and signature.

Records of all monitoring information, copies of all reports required by the general stormwater permit, and records of all data used to complete the Notice of Intent for the construction activity shall be held, retained, and kept in possession by the facility operator and/or contractor for at least 3 years.

The facility operator and/or contractor will annually certify that its construction activity is in compliance with the requirements of this general permit and its SWPPP. Noncompliance notifications will be submitted within 30 days of identification of noncompliance to the Regional Water Quality Control Board.

Equipment, materials, and workers will be available for rapid response to failures and emergencies. All corrective maintenance to BMPs will be performed as soon as possible, depending upon worker safety.

Prior to plan commencement, names of responsible personnel will be added to this plan.

4.1.2 Maintenance

Erosion and sediment control structures must be maintained to remain effective. Features that are washed out or damaged will be repaired as soon as possible, contingent at all times on worker safety. Structures designed to accumulate sediment will have sediment removed in advance of the rainy season, and before major storm events. The following criteria will be used to determine whether erosion and sediment control features should be cleaned, repaired, or replaced:

- Sediment or other debris has accumulated to greater than one-third the height of sediment fabric fences.
- Sediment or debris has reduced the storage capacity of sediment traps by 50 percent or more.
- More than one-third of the cross-section of conveyance structures, such as drainage swales or ditches are plugged or blocked.

In addition, the following maintenance activities will be performed:

- Paved roads immediately surrounding the construction sites will be cleaned as necessary using manual or mechanical street sweepers.

- Coarse aggregate on plant access road and entrance/exit will be maintained so as to limit sediment tracking and creation of dust.
- Surfaces that are not paved or provided with gravel surfacing will be watered to limit the generation of dust (but will not be excessively watered so as to generate runoff).
- All equipment will be maintained according to manufacturers' specifications so as to prevent leaks and spills.
- Any contaminated soils resulting from spills will be dug up as quickly as possible, and then removed from the site for proper disposal.

If failing BMPs or changes to the BMP program are warranted, SWPPP amendments should be prepared by the QSD if warranted by the problem encountered and corrective action required.

4.2 Rain Event Action Plans

The Project site has been identified as a Risk Level 1 site and therefore a REAP is not required.

SECTION 5

Training

The General Permit requires (Section VII) that all elements of the SWPPP be developed by a QSD and implemented by a QSP. The QSP may delegate tasks to trained employees provided adequate supervision and oversight is provided.

Personnel at the site shall receive training appropriate for individual roles and responsibilities on the project. Appropriate personnel shall receive training on SWPPP implementation, BMP inspection and maintenance, and record keeping. All training activities will be documented (formal and informal) and retained in Appendix K. Training documentation must also be submitted in the Annual Report

SECTION 6

Responsible Parties and Operators

6.1 Responsible Parties

The General Permit requires (Section VII.B.4) that the name of any "Approved Signatory" be listed in the SWPPP, and a copy of the written agreement or other mechanism that provides this authority from the LRP be provided in the SWPPP. A list of responsible parties is provided in Appendix L.

6.2 Contractor List

The General Permit requires (Section VII.B.5) that the SWPPP include a list of names of all contractors, subcontractors, and individuals who will be directed by the QSP. This list is located in SWPPP Appendix M. Contents of the list include telephone numbers, work addresses, and the specific areas of responsibility for each contractor, and emergency contact numbers.

SECTION 7

Construction Site Monitoring Program

7.1 Purpose

The Construction General Permit requires that a written site specific Construction Site Monitoring Program (CSMP) be developed by each discharger prior to the commencement of construction activities, and be revised as necessary to reflect project revision. The CSMP is included with the SWPPP (Appendix N), and described in this section.

7.2 Applicability of Permit Requirements

The OGS CSMP is designed to meet the specific requirements and objectives identified in the General Permit for Risk Level 1 sites. These requirements are listed below in this section.

7.3 Monitoring Locations

Considerations for determining sampling locations will be proximity to the non-visible pollutant of concern, accessibility for sampling, personnel safety, and other factors in accordance with the applicable requirements in the Permit.

The locations of potential sampling and observation points in the project site are given in Appendix N, Construction Site Monitoring Program (CSMP), Figure 1. These locations are typically located in low-lying areas, upslope of the wetlands, yet down slope of potential areas that may discharge non-visible pollutants and sediment. Sampling of wetlands will occur throughout the entire construction period. A sampling point near the temporary bioswale in the laydown area is also delineated and will be monitored and sampled as required during construction activities. These locations will be verified in the field prior to sampling events and may change due to field conditions. Any changes will be documented in the Amendment Section of the SWPPP (Appendix C) and in the CSMP. Sampling points along the linear utility line will be specified as site plans are developed.

A background sample location for comparison with the samples being analyzed for non-visible pollutants will be selected such that the sample will not have come in contact with: (1) operational or storage areas associated with project materials, wastes, and activities; (2) areas in which soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied; or (3) disturbed soil areas.

If an operational activity or stormwater inspection conducted 24 hours prior to or during a rain event identifies the presence of a material storage, waste storage, or operations area with spills or the potential for the discharge of non-visible pollutants to surface waters or a storm sewer system that was an unplanned location, sampling locations will be selected using the same rationale as that used to identify planned locations.

7.4 Safety

Inspections shall not occur during dangerous weather conditions, or outside of scheduled business hours. If no required inspections are collected due to these exceptions, the inspector shall include an explanation in the SWPPP and in the Annual Report documenting why the inspections were not conducted.

7.5 Visual Monitoring (Inspections)

The OGS project will comply with monitoring based Risk Level 1 Projects. The requirements are listed below.

1. The QSP or designated trained employee shall visually observe (inspect) stormwater discharges at all discharge locations within two business days (48 hours) after each qualifying rain event.
2. Dischargers shall inspect the discharge of stored or contained stormwater that is derived from and discharged subsequent to a qualifying rain event producing precipitation of ½ inch or more at the time of discharge. Stored or contained stormwater that will likely discharge after operating hours due to anticipated precipitation shall be observed prior to the discharge operating hours.
3. Inspections shall occur during business hours only.
4. All inspections shall have recorded the time, date and rain gauge reading of all qualifying rain events.
5. Within 2 business days (48 hours) prior to each qualifying rain event the following inspections shall occur:
    - Identify any spills, leaks or uncontrolled pollutant sources. If needed, implement appropriate corrective actions.
    - Inspect all BMPs to identify whether they have been properly implemented in accordance with the SWPPP. Implement appropriate corrective actions.
    - Inspect any stormwater storage and containment areas to detect leaks and ensure maintenance of adequate freeboard.
6. For visual observations described above, inspectors shall observe the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors and sources of any observed pollutants.
7. Within two business days (48 hours) after each qualifying rain event, inspectors shall conduct post rain event inspections to identify whether BMPs were adequately designed, implemented and effective, and identify additional BMPs and revise the SWPPP accordingly.
8. Project personnel shall maintain on-site records of all inspections, personnel performing the observations, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations.

9. Inspections shall not occur during dangerous weather conditions, or outside of scheduled business hours. If no required inspections are collected due to these exceptions, the inspector shall include an explanation in the SWPPP and in the Annual Report documenting why the inspections were not conducted.

7.5.1 Non-Stormwater Discharge Monitoring Requirements

The following non-stormwater discharge monitoring requirements are listed below:

- Inspect each drainage area for the presence (or indications of prior) of unauthorized and authorized non-stormwater discharges and their sources.
- Conduct one inspection quarterly in each of the following periods: January-March, April-June, July-September, and October-December. Inspections are only required during daylight hours.
- All inspections must document the presence or evidence of any non-stormwater discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc), and source. Inspectors shall maintain onsite records indicating the personnel performing the inspection, the dates and approximate time each drainage area and non-stormwater discharge was observed, and the response taken to eliminated unauthorized non-stormwater discharges and to reduce or prevent pollutants from contacting non-stormwater discharges.

7.6 Water Quality Sampling and Analysis

All Sites are required to monitor runoff for non-visible pollutants in the event of a BMP failure, breach, or spill. An area unaffected by the failure, breach, or spill must also be sampled to serve as the basis of comparison. Additional sampling requirements are listed below:

- Sampling must ensure that water samples are large enough to characterize the site condition. Dischargers shall collect samples at all discharge locations that can be safely accessed.
- Sampling shall occur during the first two hours of discharge from rain events that occur during business hours and which generate runoff.
- All samples shall be analyzed for all non-visible pollutant parameters indicating the presence of pollutants in the pollutant source assessment required. CSMPs will be modified to address any additional parameters in accordance with any updated SWPPP pollutant source assessment.
- Samples shall contain stormwater that has not come in contact with the disturbed soils or the materials stored on-site (uncontaminated sample) for comparison with the discharge sample.
- Laboratory analysis shall be conducted to compare the uncontaminated sample to the discharge sample.

All field and analytical data shall be kept with the SWPPP document. The following are common construction materials, wastes, or activities that are potential sources of non-visible pollutants to stormwater discharges from a project. Identification, storage, use, and operational locations of the potential sources at this project will be determined, identified on site maps, and incorporated into this SWPPP at a later date.

- Vehicle batteries
- Painting products
- Contaminated soil
- Line flushing products
- Dust palliative products
- Masonry products
- Landscaping products
- Concrete curing
- Sealants
- Adhesives
- Cleaning products

Soil amendments may be used on the project sites that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil.

7.6.1 Identification of Non-visible Pollutants

Table 7.6-1 lists common potential sources and types of non-visible pollutants on a project site and the applicable water quality indicator constituent(s) for that pollutant.

TABLE 7.6-1
Potential Non-Visible Pollutants and Water Quality Indicator Constituents

Potential Non-Visible Pollutants based on Common Construction	Activities	Activity Potential Pollutant Source Laboratory Analysis
Water line flushing Chlorinated water Residual chlorine	Portable toilets Bacteria, disinfectants Total/fecal coliform	Concrete & Masonry Acid wash pH
Curing compounds	pH, alkalinity,	Volatile organic compounds (VOCs)
Concrete rinse water pH	Painting Resins Semi-volatile organic compounds (SVOCs)	Thinners Phenols, VOCs
Paint Strippers VOCs	Solvents Phenols, VOCs	Adhesives Phenols, SVOCs
Sealants SVOCs	Methylene Blue Activated Substances (MBAS),	phosphates

7.6.2 Sample Collection and Handling

Collection Procedures

Samples of discharge will be collected at the designated sampling locations for observed breaches, malfunctions, leakages, spills, operational areas, soil amendment application areas, and historical site usage areas that triggered the sampling event. A sampling point

will be designated at the bioswale discharge point and any other location the QSP requires based on stormwater movement and current site conditions.

Grab samples will be collected and preserved in accordance with the methods identified in the Table 7.6-1 included in Section 7.6 the Water Quality Sample and Analysis Section. Only personnel trained in proper water quality sampling will collect samples.

Samples will be collected by placing a separate lab-provided sample container directly into a stream of water downgradient and within close proximity to the potential non-visible pollutant discharge location. This separate lab-provided sample container will be used to collect water, which will be transferred to sample bottles for laboratory analysis. The upgradient and uncontaminated background samples shall be collected first prior to collecting the downgradient to minimize cross-contamination. The sampling personnel will collect the water upgradient of where they are standing. Once the separate lab-provided sample container is filled, the water sample will be poured directly into sample bottles provided by the laboratory for the analyte(s) being monitored.

To maintain sample integrity and prevent cross-contamination, sampling collection personnel will:

- Wear a clean pair of surgical gloves prior to the collection and handling of each sample at each location.
- Not contaminate the inside of the sample bottle by not allowing it to come into contact with any material other than the water sample.
- Discard sample bottles or sample lids that have been dropped onto the ground prior to sample collection.
- Not leave the cooler lid open for an extended period of time once samples are placed inside.
- Not sample near a running vehicle where exhaust fumes may impact the sample.
- Not touch the exposed end of a sampling tube, if applicable.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.
- Not eat, smoke, or drink during sample collection.
- Not sneeze or cough in the direction of an open sample bottle.
- Minimize the exposure of the samples to direct sunlight, as sunlight may cause biochemical transformation of the samples to take place.
- Decontaminate sampling equipment prior to sample collection using a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water.
- Dispose of decontamination water/soaps appropriately; i.e., not discharge to the storm drain system or receiving water.

Handling Procedures

Immediately following collection, sample bottles for laboratory analytical testing will be capped, labeled, documented on a chain of custody (COC) form provided by the analytical laboratory, sealed in a re-sealable storage bag, placed in an ice-chilled cooler, at as near to 4 degrees Celsius as practicable, and delivered within 24 hours to a California state-certified laboratory to be identified at a later date.

Any samples for field analysis will be tested immediately following collected in accordance with the field instrument manufacturer's instructions and results recorded on a Sampling Activity Log.

Sample Documentation Procedures

All original data documented on sample bottle identification labels, COC forms, Sampling Activity Logs, and Inspection Checklists will be recorded using waterproof ink. These will be considered accountable documents. If an error is made on an accountable document, the individual will make corrections by lining through the error and entering the correct information. The erroneous information will not be obliterated. All corrections will be initialed and dated.

Sampling and field analysis activities will be documented using the following:

Sample Bottle Identification Labels. Sampling personnel will attach an identification label to each sample bottle. At a minimum, the following information will be recorded on the label, as appropriate:

- Project name
- Project number
- Unique sample identification number and location
- [Project Number]-[Six digit sample collection date]-[Location]
- Quality assurance/quality control (QA/QC) samples shall be identified similarly using a unique sample number or designation
- Collection date/time (No time applied to QA/QC samples)
- Analysis constituent

Sampling Activity Logs. A log of sampling events will identify:

- Sampling date
- Separate times for collected samples and QA/QC samples recorded to the nearest minute
- Unique sample identification number and location
- Analysis constituent
- Names of sampling personnel

- Weather conditions (including precipitation amount)
- Field analysis results
- Other pertinent data

Chain of Custody Forms. All samples to be analyzed by a laboratory will be accompanied by a COC form provided by the laboratory. Only the sample collectors will sign the COC form over to the lab. COC procedures will be strictly adhered to for QA/QC purposes.

All Sites are required to monitor runoff for non-visible pollutants in the event of a BMP failure, breach, or spill. An area unaffected by the failure, breach, or spill must also be sampled to serve as the basis of comparison. Additional sampling requirements are listed below:

- Sampling must ensure that water samples are large enough to characterize the site condition. Dischargers shall collect samples at all discharge locations that can be safely accessed.
- Sampling shall occur during the first two hours of discharge from rain events that occur during business hours and which generate runoff.
- All samples shall be analyzed for all non-visible pollutant parameters indication the presence of pollutants in the pollutant source assessment required. CSMPs will be modified to address any additional parameters in accordance with any updated SWPPP pollutant source assessment.
- Samples shall contain stormwater that has not come in contacted with the disturbed soils or the materials stored on-site (uncontaminated sample) for comparison with the discharge sample.
- Laboratory analysis shall be conducted to compare the uncontaminated sample to the discharge sample.
- All field and analytical data shall be kept with the SWPPP document.

7.7 Watershed Monitoring Option

The OGS project site will not be participating in a qualified regional watershed-based monitoring program.

7.8 Quality Assurance and Quality Control

For an initial verification of laboratory or field analysis, duplicate samples will be collected at a rate of 10 percent or 1 duplicate per sampling event. The duplicate sample will be collected, handled, and analyzed using the same protocols as primary samples. A duplicate sample will be collected at each location immediately after the primary sample has been collected. Duplicates will be collected where contamination is likely, not on the background sample. Duplicate samples will not influence any evaluations or conclusions; however, they will be used as a check on laboratory quality assurance.

7.9 Reporting Requirements and Records Retention

The OGS project shall retain records of all stormwater monitoring information and copies of all reports (including Annual Reports) for at least 3 years. All records must be retained onsite while construction is ongoing. The required records are listed below:

- Date, place, time of facility inspections, sampling, inspections, and/or measurements including precipitation
- Individual(s) who performed the facility inspections, sampling, inspections, and measurements
- Date and time of analyses
- Name of individuals who performed the analyses
- Summary of al analytical results from the last three years, the method detection limits and reporting units, and the analytical techniques or methods used
- Rain gauge readings from site inspections
- Quality assurance/quality control records and results
- Non-stormwater discharge inspections and visual observations and stormwater discharge visual observation records
- Records of reasons why sampling did not occur
- Records of any corrective actions and follow-up activities that resulted from analytical results, visual observations, or inspections.

SECTION 8

References

California Department of Water Resources (DWR). 2006. San Joaquin Valley Groundwater Basin, Tracy Subbasin. Bulletin No. 118.

Central Valley Regional Water Quality Control Board (Central Valley RWQCB). 1998. Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. Web site: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr.pdf. Accessed June 20, 2008.

Central Valley Regional Water Quality Control Board (Central Valley RWQCB). 2010. 303d listing for impaired waters. Website and data base accessed November 2, 2010. http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml

City of Oakley. 2002. 2020 General Plan. December 16.

Contra Costa County. 2008. Stormwater C.3 Guidebook: Stormwater Quality Requirements for Development Applications. 4th Edition. September, 2008.

DuPont. 2003. Current Conditions Report-Final, for DuPont Oakley Site, Volume I of IV. Revised September 12.

DuPont. 2006. Phase I Soil RFI Report – DuPont Oakley Site. Volume 1: Text and Tables.

Environmental Protection Agency (EPA) NPDES Website. 2010. Rainfall Erosivity Factor Calculator Web. Accessed November 2, 2010. http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm

LSA Associates, Inc. 2003. General Plan. City of Antioch, Contra Costa County, California. November 24.

State Water Resources Control Board. 2009. National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities. Order No. 2009-0009-DWQ. NPDES No. CA S000002.

TRC. 2008. Geotechnical File Review: Contra Costa Generating Station, Oakley, California.

University of California, Davis. 2010. Water Quality Standards Inventory Database. Accessed November 2, 2010. http://endeavor.des.ucdavis.edu/wqsid/bu.asp

Western Regional Climate Center (WRCC). 2008. Historical Climate Summaries for Antioch, CA. Web site: http://www.wrcc.dri.edu/summary/Climsmcca.html

Appendix A
Construction General Permit

Linda S. Adams
Secretary for Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Arnold Schwarzenegger
Governor

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT FOR
STORM WATER DISCHARGES
ASSOCIATED WITH CONSTRUCTION AND LAND DISTURBANCE
ACTIVITIES

ORDER NO. 2009-0009-DWQ
NPDES NO**. CAS000002**

This Order was adopted by the State Water Resources Control Board on:	**September 2, 2009**
This Order shall become effective on:	**July 1, 2010**
This Order shall expire on:	**September 2, 2014**

IT IS HEREBY ORDERED, that this Order supersedes Order No. 99-08-DWQ except for enforcement purposes. The Discharger shall comply with the requirements in this Order to meet the provisions contained in Division 7 of the California Water Code (commencing with section 13000) and regulations adopted thereunder, and the provisions of the federal Clean Water Act and regulations and guidelines adopted thereunder.

I, Jeanine Townsend, Clerk to the Board, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the State Water Resources Control Board, on September 2, 2009.

AYE: Vice Chair Frances Spivy-Weber
Board Member Arthur G. Baggett, Jr.
Board Member Tam M. Doduc

NAY: Chairman Charles R. Hoppin

ABSENT: None

ABSTAIN: None

Jeanine Townsend

Jeanine Townsend
Clerk to the Board

List of Documents included in this single file saved in pdf format on September 22, 2009:

- Fact Sheet
- Order
- Attachment A – Linear Underground/Overhead Requirements
- Attachment A.1 – LUP Project Type Determination
- Attachment A.2 – LUP Permit Registration Documents
- Attachment B – Permit Registration Documents
- Attachment C – Risk Level 1 Requirements
- Attachment D – Risk Level 2 Requirements
- Attachment E – Risk Level 3 Requirements
- Attachment F – Active Treatment System Requirements
- Appendix 1 – Risk Determination Worksheet and Sediment-related 303d List
- Appendix 2 – Post-Construction Water Balance
- Appendix 2.1 – Post-Construction Water Balance Calculator
- Appendix 3 - Bioassessment Monitoring Guidelines
- Appendix 4 – Adopted/Implemented Sediment and Non-sediment TMDLs
- Appendix 5 – Glossary
- Appendix 6 - Acronym List
- Appendix 7 – State and Regional Water Board Contacts

Linda S. Adams
Secretary for
Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Arnold Schwarzenegger
Governor

CONSTRUCTION GENERAL PERMIT FACT SHEET TABLE OF CONTENTS

I. BACKGROUND 1

A. History 1

B. Legal Challenges and Court Decisions 1

C. Blue Ribbon Panel of Experts and Feasibility of Numeric Effluent Limitations 3

D. Summary of Panel Findings on Construction Activities 4

E. How the Panel's Findings are Used in this General Permit 5

F. Summary of Significant Changes in This General Permit 5

II. RATIONALE 7

A. General Permit Approach 7

B. Construction Activities Covered 7

C. Construction Activities Not Covered 9

D. Obtaining and Terminating Permit Coverage 11

E. Discharge Prohibitions 12

F. Effluent Standards for All Types of Discharges 13

G. Receiving Water Limitations 20

H. Training Qualifications and Requirements 21

I. Sampling, Monitoring, Reporting and Record Keeping 21

J. Risk Determination 28

K. ATS Requirements 36

L. Post-Construction Requirements 37

M. Storm Water Pollution Prevention Plans 45

N. Regional Water Board Authorities 47

LIST OF TABLES

Table 1 - Regional Water Board Basin Plans, Water Quality Objectives for Turbidity 16
Table 2 - Results of Ecoregion Analysis 16
Table 3 – ACL Sampling Data taken by Regional Water Board Staff 17
Table 4 - Required Monitoring Elements for Risk Levels 21
Table 5 - Storm Water Effluent Monitoring Requirements by Risk Level 23
Table 6 - Receiving Water Monitoring Requirements 26
Table 7 - Combined Risk Level Matrix 30
Table 8 -National Oceanic and Atmospheric Administration (NOAA) Definition of Probability of Precipitation (PoP) 32
Table 9 - Qualified SWPPP Developer/ Qualified SWPPP Practitioner Certification Criteria 46

LIST OF FIGURES

Figure 1 -Statewide Map of K * LS 29
Figure 2 - Suite of Storm Events 38
Figure 3 - Northern CA (2009) Counties / Cities With SUSMP-Plus Coverage 39
Figure 4 - Southern CA (2009) Counties / Cities With SUSMP-Plus Coverage 40
Figure 5 - Schematic of the Lane Relationship 42
Figure 6 - Channel Changes Associated with Urbanization 43

I. BACKGROUND

A. History

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 amendments to the CWA added Section 402(p), which establishes a framework for regulating municipal and industrial storm water discharges under the NPDES Program. On November 16, 1990, the U.S. Environmental Protection Agency (USEPA) published final regulations that established storm water permit application requirements for specified categories of industries. The regulations provide that discharges of storm water to waters of the United States from construction projects that encompass five or more acres of soil disturbance are effectively prohibited unless the discharge is in compliance with an NPDES Permit. Regulations (Phase II Rule) that became final on December 8, 1999 lowered the permitting threshold from five acres to one acre.

While federal regulations allow two permitting options for storm water discharges (Individual Permits and General Permits), the State Water Board has elected to adopt only one statewide General Permit at this time that will apply to most storm water discharges associated with construction activity.

On August 19, 1999, the State Water Board reissued the General Construction Storm Water Permit (Water Quality Order 99-08-DWQ). On December 8, 1999 the State Water Board amended Order 99-08-DWQ to apply to sites as small as one acre.

The General Permit accompanying this fact sheet regulates storm water runoff from construction sites. Regulating many storm water discharges under one permit will greatly reduce the administrative burden associated with permitting individual storm water discharges. To obtain coverage under this General Permit, dischargers shall electronically file the Permit Registration Documents (PRDs), which includes a Notice of Intent (NOI), Storm Water Pollution Prevention Plan (SWPPP), and other compliance related documents required by this General Permit and mail the appropriate permit fee to the State Water Board. It is expected that as the storm water program develops, the Regional Water Quality Control Boards (Regional Water Boards) may issue General Permits or Individual Permits containing more specific permit provisions. When this occurs, this General Permit will no longer regulate those dischargers.

B. Legal Challenges and Court Decisions

1. Early Court Decisions

Shortly after the passage of the CWA, the USEPA promulgated regulations exempting most storm water discharges from the NPDES permit requirements. (See 40 C.F.R. § 125.4 (1975); see also *Natural Resources Defense Council v. Costle* (D.C. Cir. 1977) 568 F.2d 1369, 1372 (*Costle*); *Defenders of Wildlife v. Browner* (9th Cir. 1999) 191 F.3d 1159, 1163 (*Defenders of Wildlife*).) When environmental groups challenged this exemption in federal court, the District of Columbia Court of Appeals invalidated the regulation, holding that the USEPA "does not have authority to exempt categories of point sources from the permit requirements of [CWA] § 402." (*Costle*, 568 F.2d at 1377.) The *Costle* court rejected the USEPA's argument that effluent-based storm sewer regulation was administratively infeasible because of the variable nature of storm water pollution and the number of affected storm sewers throughout the country. (*Id.* at 1377-82.) Although the court acknowledged the practical problems relating to storm sewer regulation, the court found the USEPA had the flexibility under the CWA to design regulations that would overcome these problems. (*Id.* at 1379-83.) In particular, the court pointed to general permits and permits based on requiring best management practices (BMPs).

During the next 15 years, the USEPA made numerous attempts to reconcile the statutory requirement of point source regulation with the practical problem of regulating possibly millions of diverse point source discharges of storm water. (See *Defenders of Wildlife*, 191 F.3d at 1163; see also Gallagher, Clean Water Act in Environmental Law Handbook (Sullivan, edit., 2003)
p. 300 (Environmental Law Handbook); Eisen, *Toward a Sustainable Urbanism: Lessons from Federal Regulation of Urban Storm Water Runoff* (1995) 48 Wash. U.J. Urb. & Contemp. L.1, 40-41 [Regulation of Urban Storm Water Runoff].)

In 1987, Congress amended the CWA to require NPDES permits for storm water discharges. (See CWA § 402(p), 33 U.S.C. § 1342(p); *Defenders of Wildlife,* 191 F.3d at 1163; *Natural Resources Defense Council v. USEPA* (9th Cir. 1992) 966 F.2d 1292, 1296.) In these amendments, enacted as part of the Water Quality Act of 1987, Congress distinguished between industrial and municipal storm water discharges. With respect to industrial storm water discharges, Congress provided that NPDES permits "shall meet all applicable provisions of this section and section 1311 [requiring the USEPA to establish effluent limitations under specific timetables]." (CWA § 402(p)(3)(A), 33 U.S.C. § 1342(p)(3)(A); see also *Defenders of Wildlife,* 191 F.3d at 1163-64.)

In 1990, USEPA adopted regulations specifying what activities were considered "industrial" and thus required discharges of storm water associated with those activities to obtain coverage under NPDES permits. (55 Fed. Reg. 47,990 (1990); 40 C.F.R. § 122.26(b)(14).) Construction activities, deemed a subset of the industrial activities category, must also be regulated by an NPDES permit. (40 C.F.R. § 122.26(b)(14)(x)). In 1999, USEPA issued regulations for "Phase II" of storm water regulation, which required most small construction sites (1-5 acres) to be regulated under the NPDES program. (64 Fed. Reg. 68,722; 40 C.F.R. § 122.26(b)(15)(i).)

2. Court Decisions on Public Participation

Two recent federal court opinions have vacated USEPA rules that denied meaningful public review of NPDES permit conditions. On January 14, 2003, the Ninth Circuit Court of Appeals held that certain aspects of USEPA's Phase II regulations governing MS4s were invalid primarily because the general permit did not contain express requirements for public participation. (*Environmental Defense Center v. USEPA* (9th Cir. 2003) 344 F.3d 832.) Specifically, the court determined that applications for general permit coverage (including the Notice of Intent (NOI) and Storm Water Management Program (SWMP)) must be made available to the public, the applications must be reviewed and determined to meet the applicable standard by the permitting authority before coverage commences, and there must be a process to accommodate public hearings. (*Id.* at 852-54.) Similarly, on February 28, 2005, the Second Circuit Court of Appeals held that the USEPA's confined animal feeding operation (CAFO) rule violated the CWA because it allowed dischargers to write their own nutrient management plans without public review. (*Waterkeeper Alliance v. USEPA* (2d Cir. 2005) 399 F.3d 486.) Although neither decision involved the issuance of construction storm water permits, the State Water Board's Office of Chief Counsel has recommended that the new General Permit address the courts' rulings where feasible[1].

---

[1] In *Texas Independent Producers and Royalty Owners Assn. v. USEPA* (7th Cir. 2005) 410 F.3d 964, the Seventh Circuit Court of Appeals held that the USEPA's construction general permit was not required to provide the public with the opportunity for a public hearing on the Notice of Intent or Storm Water Pollution Prevention Plan. The Seventh Circuit briefly discussed why it agreed with the Ninth Circuit's dissent in *Environmental Defense Center*, but generally did not discuss the substantive holdings in *Environmental Defense Center* and *Waterkeeper Alliance*, because neither court addressed the initial question of whether the plaintiffs had standing to challenge the permits at issue. However, notwithstanding the Seventh Circuit's decision, it is not binding or controlling on the State Water Board because California is located within the Ninth Circuit.

The CWA and the USEPA's regulations provide states with the discretion to formulate permit terms, including specifying best management practices (BMPs), to achieve strict compliance with federal technology-based and water quality-based standards. (*Natural Resources Defense Council v. USEPA* (9th Cir. 1992) 966 F.2d 1292, 1308.) Accordingly, this General Permit has developed specific BMPs as well as numeric action levels (NALs) and numeric effluent limitations (NELs) in order to achieve these minimum federal standards. In addition, the General Permit requires a SWPPP and REAP (another dynamic, site-specific plan) to be developed but has removed all language requiring the discharger to implement these plans – instead, the discharger is required to comply with specific requirements. By requiring the dischargers to implement these specific BMPs, NALs, and NELs, this General Permit ensures that the dischargers do not "write their own permits." As a result this General Permit does not require each discharger's SWPPP and REAP to be reviewed and approved by the Regional Water Boards.

This General Permit also requires dischargers to electronically file all permit-related compliance documents. These documents include, but are not limited to, NOIs, SWPPPs, annual reports, Notice of Terminations (NOTs), and numeric action level (NAL) exceedance reports. Electronically submitted compliance information is immediately available to the public, as well as the Regional Water Quality Control Board (Regional Water Board) offices, via the Internet. In addition, this General Permit enables public review and hearings on permit applications when appropriate. Under this General Permit, the public clearly has a meaningful opportunity to participate in the permitting process.

C. Blue Ribbon Panel of Experts and Feasibility of Numeric Effluent Limitations

In 2005 and 2006, the State Water Board convened an expert panel (panel) to address the feasibility of numeric effluent limitations (NELs) in California's storm water permits. Specifically, the panel was asked to address:

"Is it technically feasible to establish numeric effluent limitations, or some other quantifiable limit, for inclusion in storm water permits? How would such limitations or criteria be established, and what information and data would be required?"

"The answers should address industrial general permits, construction general permits, and area-wide municipal permits. The answers should also address both technology-based limitations or criteria and water quality-based limitations or criteria. In evaluating establishment of any objective criteria, the panel should address all of the following:

The ability of the State Water Board to establish appropriate objective limitations or criteria;

How compliance determinations would be made;

The ability of dischargers and inspectors to monitor for compliance; and

The technical and financial ability of dischargers to comply with the limitations or criteria."

Through a series of public participation processes (State Water Board meetings, State Water Board workshops, and the solicitation of written comments), a number of water quality, public process and overall program effectiveness problems were identified. Some of these problems are addressed through this General Permit.

D. Summary of Panel Findings on Construction Activities

The panel's final report can be downloaded and viewed through links at www.waterboards.ca.gov or by clicking here[2].

The panel made the following observations:

"Limited field studies indicate that traditional erosion and sediment controls are highly variable in performance, resulting in highly variable turbidity levels in the site discharge."

"Site-to-site variability in runoff turbidity from undeveloped sites can also be quite large in many areas of California, particularly in more arid regions with less natural vegetative cover and steep slopes."

"Active treatment technologies involving the use of polymers with relatively large storage systems now exist that can provide much more consistent and very low discharge turbidity. However, these technologies have as yet only been applied to larger construction sites, generally five acres or greater. Furthermore, toxicity has been observed at some locations, although at the vast majority of sites, toxicity has not occurred. There is also the potential for an accidental large release of such chemicals with their use."

"To date most of the construction permits have focused on TSS and turbidity, but have not addressed other, potentially significant pollutants such as phosphorus and an assortment of chemicals used at construction sites."

"Currently, there is no required training or certification program for contractors, preparers of soil erosion and sediment control Storm Water Pollution Prevention Plans, or field inspectors."

"The quality of storm water discharges from construction sites that effectively employ BMPs likely varies due to site conditions such as climate, soil, and topography."

"The States of Oregon and Washington have recently adopted similar concepts to the Action Levels described earlier."

In addition, the panel made the following conclusions:

"It is the consensus of the Panel that active treatment technologies make Numeric Limits technically feasible for pollutants commonly associated with storm water discharges from construction sites (e.g. TSS and turbidity) for larger construction sites. Technical practicalities and cost-effectiveness may make these technologies less feasible for smaller sites, including small drainages within a larger site, as these technologies have seen limited use at small construction sites. If chemical addition is not permitted, then Numeric Limits are not likely feasible."

"The Board should consider Numeric Limits or Action Levels for other pollutants of relevance to construction sites, but in particular pH. It is of particular concern where fresh concrete or wash water from cement mixers/equipment is exposed to storm water."

"The Board should consider the phased implementation of Numeric Limits and Action Levels, commensurate with the capacity of the dischargers and support industry to respond."

---

[2] http://www.waterboards.ca.gov/stormwtr/docs/numeric/swpanel_final_report.pdf

E. How the Panel's Findings are Used in this General Permit

The State Water Board carefully considered the findings of the panel and related public comments. The State Water Board also reviewed and considered the comments regarding statewide storm water policy and the reissuance of the Industrial General Permit. From the input received the State Water Board identified some permit and program performance gaps that are addressed in this General Permit. The Summary of Significant Changes (below) in this General Permit are a direct result of this process.

F. Summary of Significant Changes in This General Permit

The State Water Board has significant changes to Order 99-08-DWQ. This General Permit differs from Order 99-08-DWQ in the following significant ways:

Rainfall Erosivity Waiver: this General Permit includes the option allowing a small construction site (>1 and <5 acres) to self-certify if the rainfall erosivity value (R value) for their site's given location and time frame compute to be less than or equal to 5.

Technology-Based Numeric Action Levels: this General Permit includes NALs for pH and turbidity.

Technology-Based Numeric Effluent Limitations: this General Permit contains daily average NELs for pH during any construction phase where there is a high risk of pH discharge and daily average NELs turbidity for all discharges in Risk Level 3. The daily average NEL for turbidity is set at 500 NTU to represent the minimum technology that sites need to employ (to meet the traditional Best Available Technology Economically Achievable (BAT)/ Best Conventional Pollutant Control Technology (BCT) standard) and the traditional, numeric receiving water limitations for turbidity.

Risk-Based Permitting Approach: this General Permit establishes three levels of risk possible for a construction site. Risk is calculated in two parts: 1) Project Sediment Risk, and 2) Receiving Water Risk.

Minimum Requirements Specified: this General Permit imposes more minimum BMPs and requirements that were previously only required as elements of the SWPPP or were suggested by guidance.

Project Site Soil Characteristics Monitoring and Reporting: this General Permit provides the option for dischargers to monitor and report the soil characteristics at their project location. The primary purpose of this requirement is to provide better risk determination and eventually better program evaluation.

Effluent Monitoring and Reporting: this General Permit requires effluent monitoring and reporting for pH and turbidity in storm water discharges. The purpose of this monitoring is to determine compliance with the NELs and evaluate whether NALs included in this General Permit are exceeded.

Receiving Water Monitoring and Reporting: this General Permit requires some Risk Level 3 dischargers to monitor receiving waters and conduct bioassessments.

Post-Construction Storm Water Performance Standards: this General Permit specifies runoff reduction requirements for all sites not covered by a Phase I or Phase II MS4 NPDES permit, to avoid, minimize and/or mitigate post-construction storm water runoff impacts.

Rain Event Action Plan: this General Permit requires certain sites to develop and implement a Rain Event Action Plan (REAP) that must be designed to protect all exposed portions of the site within 48 hours prior to any likely precipitation event.

Annual Reporting: this General Permit requires all projects that are enrolled for more than one continuous three-month period to submit information and annually certify that their site is in compliance

with these requirements. The primary purpose of this requirement is to provide information needed for overall program evaluation and pubic information.

Certification/Training Requirements for Key Project Personnel: this General Permit requires that key personnel (e.g., SWPPP preparers, inspectors, etc.) have specific training or certifications to ensure their level of knowledge and skills are adequate to ensure their ability to design and evaluate project specifications that will comply with General Permit requirements.

Linear Underground/Overhead Projects: this General Permit includes requirements for all Linear Underground/Overhead Projects (LUPs).

II. RATIONALE

A. General Permit Approach

A general permit for construction activities is an appropriate permitting approach for the following reasons:

1. A general permit is an efficient method to establish the essential regulatory requirements for a broad range of construction activities under differing site conditions;

2. A general permit is the most efficient method to handle the large number of construction storm water permit applications;

3. The application process for coverage under a general permit is far less onerous than that for individual permit and hence more cost effective;

4. A general permit is consistent with USEPA's four-tier permitting strategy, the purpose of which is to use the flexibility provided by the CWA in designing a workable and efficient permitting system; and

5. A general permit is designed to provide coverage for a group of related facilities or operations of a specific industry type or group of industries. It is appropriate when the discharge characteristics are sufficiently similar, and a standard set of permit requirements can effectively provide environmental protection and comply with water quality standards for discharges. In most cases, the general permit will provide sufficient and appropriate management requirements to protect the quality of receiving waters from discharges of storm water from construction sites.

There may be instances where a general permit is not appropriate for a specific construction project. A Regional Water Board may require any discharger otherwise covered under the General Permit to apply for and obtain an Individual Permit or apply for coverage under a more specific General Permit. The Regional Water Board must determine that this General Permit does not provide adequate assurance that water quality will be protected, or that there is a site-specific reason why an individual permit should be required.

B. Construction Activities Covered

1. **Construction activity subject to this General Permit:**

Any construction or demolition activity, including, but not limited to, clearing, grading, grubbing, or excavation, or any other activity that results in a land disturbance of equal to or greater than one acre.

Construction activity that results in land surface disturbances of less than one acre if the construction activity is part of a larger common plan of development or sale of one or more acres of disturbed land surface.

Construction activity related to residential, commercial, or industrial development on lands currently used for agriculture including, but not limited to, the construction of buildings related to agriculture that are considered industrial pursuant to USEPA regulations, such as dairy barns or food processing facilities.

Construction activity associated with LUPs including, but not limited to, those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities) and include, but are not limited to, underground utility mark-out, potholing, concrete

and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/or pavement repair or replacement, and stockpile/borrow locations.

Discharges of sediment from construction activities associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities.[3]

Storm water discharges from dredge spoil placement that occur outside of U.S. Army Corps of Engineers jurisdiction[4] (upland sites) and that disturb one or more acres of land surface from construction activity are covered by this General Permit. Construction projects that intend to disturb one or more acres of land within the jurisdictional boundaries of a CWA § 404 permit should contact the appropriate Regional Water Board to determine whether this permit applies to the project.

2. Linear Underground/Overhead Projects (LUPs) subject to this General Permit:

Underground/overhead facilities typically constructed as LUPs include, but are not limited to, any conveyance, pipe, or pipeline for the transportation of any gaseous, liquid (including water, wastewater for domestic municipal services), liquescent, or slurry substance; any cable line or wire for the transmission of electrical energy; any cable line or wire for communications (e.g., telephone, telegraph, radio or television messages); and associated ancillary facilities. Construction activities associated with LUPs include, but are not limited to, those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities) and include, but are not limited to, underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/or pavement repair or replacement, and stockpile/borrow locations.

Water Quality Order 2003-0007-DWQ regulated construction activities associated with small LUPs that resulted in land disturbances greater than one acre, but less than five acres. These projects were considered non-traditional construction projects. Attachment A of this Order now regulates all construction activities from LUPs resulting in land disturbances greater than one acre.

3. Common Plan of Development or Sale

USEPA regulations include the term “common plan of development or sale” to ensure that acreage within a common project does not artificially escape the permit requirements because construction activities are phased, split among smaller parcels, or completed by different owners/developers. In the absence of an exact definition of “common plan of development or sale,” the State Water Board is required to exercise its regulatory discretion in providing a common sense interpretation of the term as it applies to construction projects and permit coverage. An overbroad interpretation of the term would render meaningless the clear “one acre” federal permitting threshold and would potentially trigger permitting of

---

[3] Pursuant to the Ninth Circuit Court of Appeals’ decision in *NRDC v. EPA* (9th Cir. 2008) 526 F.3d 591, and subsequent denial of the USEPA’s petition for reconsideration in November 2008, oil and gas construction activities discharging storm water contaminated only with sediment are no longer exempt from the NPDES program.

[4] A construction site that includes a dredge and/or fill discharge to any water of the United States (e.g., wetland, channel, pond, or marine water) requires a CWA Section 404 permit from the U.S. Army Corps of Engineers and a CWA Section 401 Water Quality Certification from the Regional Water Board or State Water Board.

almost any construction activity that occurs within an area that had previously received area-wide utility or road improvements.

Construction projects generally receive grading and/or building permits (Local Permits) from local authorities prior to initiating construction activity. These Local Permits spell out the scope of the project, the parcels involved, the type of construction approved, etc. Referring to the Local Permit helps define "common plan of development or sale." In cases such as tract home development, a Local Permit will include all phases of the construction project including rough grading, utility and road installation, and vertical construction. All construction activities approved in the Local Permit are part of the common plan and must remain under the General Permit until construction is completed. For custom home construction, Local Permits typically only approve vertical construction as the rough grading, utilities, and road improvements were already independently completed under the a previous Local Permit. In the case of a custom home site, the homeowner must submit plans and obtain a distinct and separate Local Permit from the local authority in order to proceed. It is not the intent of the State Water Board to require permitting for an individual homeowner building a custom home on a private lot of less than one acre if it is subject to a separate Local Permit. Similarly, the installation of a swimming pool, deck, or landscaping that disturbs less than one acre that was not part of any previous Local Permit are not required to be permitted.

The following are several examples of construction activity of less than one acre that would require permit coverage:

a. A landowner receives a building permit(s) to build tract homes on a 100-acre site split into 200 one-third acre parcels, (the remaining acreage consists of streets and parkways) which are sold to individual homeowners as they are completed. The landowner completes and sells all the parcels except for two. Although the remaining two parcels combined are less than one acre, the landowner must continue permit coverage for the two parcels.

b. One of the parcels discussed above is sold to another owner who intends to complete the construction as already approved in the Local Permit. The new landowner must file Permit Registration Documents (PRDs) to complete the construction even if the new landowner is required to obtain a separate Local Permit.

c. Landowner in (1) above purchases 50 additional one half-acre parcels adjacent to the original 200-acre project. The landowner seeks a Local Permit (or amendment to existing Local permit) to build on 20 parcels while leaving the remaining 30 parcels for future development. The landowner must amend PRDs to include the 20 parcels 14 days prior to commencement of construction activity on those parcels.

C. Construction Activities Not Covered

1. Traditional Construction Projects Not Covered

This General Permit does not apply to the following construction activity:

a. Routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

b. Disturbances to land surfaces solely related to agricultural operations such as disking, harrowing, terracing and leveling, and soil preparation.

c. Discharges of storm water from areas on tribal lands; construction on tribal lands is regulated by a federal permit.

d. Discharges of storm water within the Lake Tahoe Hydrologic Unit. The Lahontan Regional Water Board has adopted its own permit to regulate storm water discharges from construction activity in the Lake Tahoe Hydrologic Unit (Regional Water Board 6SLT). Owners of construction projects in this watershed must apply for the Lahontan Regional Water Board permit rather than the statewide Construction General Permit. Construction projects within the Lahontan region must also comply with the Lahontan Region Project Guideline for Erosion Control (R6T-2005-0007 Section), which can be found at **http://www.waterboards.ca.gov/lahontan/Adopted_Orders/2005/r6t_2005_0007.pdf**

e. Construction activity that disturbs less than one acre of land surface, unless part of a larger common plan of development or the sale of one or more acres of disturbed land surface.

f. Construction activity covered by an individual NPDES Permit for storm water discharges.

g. Landfill construction activity that is subject to the Industrial General Permit.

h. Construction activity that discharges to Combined Sewer Systems.

i. Conveyances that discharge storm water runoff combined with municipal sewage.

j. Discharges of storm water identified in CWA § 402(*l*)(2), 33 U.S.C. § 1342(*l*)(2).

2. **Linear Projects Not Covered**

a. LUP construction activity does not include linear routine maintenance projects. Routine maintenance projects are projects associated with operations and maintenance activities that are conducted on existing lines and facilities and within existing right-of-way, easements, franchise agreements, or other legally binding agreements of the discharger. Routine maintenance projects include, but are not limited to projects that are conducted to:

i. Maintain the original purpose of the facility or hydraulic capacity.

ii. Update existing lines[5] and facilities to comply with applicable codes, standards, and regulations regardless if such projects result in increased capacity.

iii. Repairing leaks.

Routine maintenance does not include construction of new[6] lines or facilities resulting from compliance with applicable codes, standards, and regulations.

Routine maintenance projects do not include those areas of maintenance projects that are outside of an existing right-of-way, franchise, easements, or agreements. When a project must secure new areas,

---

[5]Update existing lines includes replacing existing lines with new materials or pipes.
[6]New lines are those that are not associated with existing facilities and are not part of a project to update or replace existing lines.

those areas may be subject to this General Permit based on the area of disturbed land outside the original right-of-way, easement, or agreement.

b. LUP construction activity does not include field activities associated with the planning and design of a project (e.g., activities associated with route selection).

c. Tie-ins conducted immediately adjacent to "energized" or "pressurized" facilities by the discharger are not considered construction activities where all other LUP construction activities associated with the tie-in are covered by an NOI and SWPPP of a third party or municipal agency.

3. **EPA's Small Construction Rainfall Erosivity Waiver**

EPA's Storm Water Phase II Final Rule provides the option for a Small Construction Rainfall Erosivity Waiver. This waiver applies to small construction sites between 1 and 5 acres, and allows permitting authorities to waive those sites that do not have adverse water quality impacts.

Dischargers eligible for this waiver are exempt from Construction General Permit Coverage. In order to obtain the waiver, the discharger must certify to the State Water Board that small construction activity will occur only when the rainfall erosivity factor is less than 5 ("R" in the Revised Universal Soil Loss Equation). The period of construction activity begins at initial earth disturbance and ends with final stabilization. Where vegetation will be used for final stabilization, the date of installation of a practice that provides interim non-vegetative stabilization can be used for the end of the construction period. The operator must agree (as a condition waiver eligibility) to periodically inspect and properly maintain the area until the criteria for final stabilization as defined in the General Permit have been met. If use of this interim stabilization eligibility condition was relied on to qualify for the waiver, signature on the waiver with a certification statement constitutes acceptance of and commitment to complete the final stabilization process. The discharger must submit a waiver certification to the State Board prior to commencing construction activities.

USEPA funded a cooperative agreement with Texas A&M University to develop an online rainfall erosivity calculator. Dischargers can access the calculator from EPA's website at: www.epa.gov/npdes/stormwater/cgp. Use of the calculator allows the discharger to determine potential eligibility for the rainfall erosivity waiver. It may also be useful in determining the time periods during which construction activity could be waived from permit coverage.

D. Obtaining and Terminating Permit Coverage

The Legally Responsible Person (LRP) must obtain coverage under this General Permit, except in two limited circumstances. First, where the construction of pipelines, utility lines, fiber-optic cables, or other linear underground/overhead projects will occur across several properties, the utility company, municipality, or other public or private company or agency that owns or operates the linear underground/overhead project is responsible for obtaining coverage under the General Permit. Second, where there is a lease of a mineral estate (oil, gas, geothermal, aggregate, precious metals, and/or industrial metals), the lessee is responsible for obtaining coverage under the General Permit. To obtain coverage, the LRP or other entity described above must file Permit Registration Documents (PRDs) prior to the commencement of construction activity. Failure to obtain coverage under this General Permit for storm water discharges to waters of the United States is a violation of the CWA and the California Water Code.

To obtain coverage under this General Permit, LRPs must electronically file the PRDs, which include a Notice of Intent (NOI), Storm Water Pollution Prevention Plan (SWPPP), and other documents required by this General Permit, and mail the appropriate permit fee to the State Water Board. It is expected that as the storm water program develops, the Regional Water Boards may issue General Permits or

Individual Permits that contain more specific permit provisions. When this occurs, this General Permit will no longer regulate those dischargers that obtain coverage under Individual Permits.

Any information provided to the Regional Water Board shall comply with the Homeland Security Act and any other federal law that concerns security in the United States; any information that does not comply should not be submitted.

The application requirements of the General Permit establish a mechanism to clearly identify the responsible parties, locations, and scope of operations of dischargers covered by the General Permit and to document the discharger's knowledge of the General Permit's requirements.

This General Permit provides a grandfathering exception to existing dischargers subject to Water Quality Order No. 99-08-DWQ. Construction projects covered under Water Quality Order No. 99-08-DWQ shall obtain permit coverage at Risk Level 1. LUP projects covered under Water Quality Order No. 2003-0007-DWQ shall obtain permit coverage at LUP Type 1. The Regional Water Boards have the authority to require Risk Determination to be performed on projects currently covered under Water Quality Order No. 99-08-DWQ and 2003-0007-DWQ where they deem necessary.

LRPs must file a Notice of Termination (NOT) with the Regional Water Board when construction is complete and final stabilization has been reached or ownership has been transferred. The discharger must certify that all State and local requirements have been met in accordance with this General Permit. In order for construction to be found complete, the discharger must install post-construction storm water management measures and establish a long-term maintenance plan. This requirement is intended to ensure that the post-construction conditions at the project site do not cause or contribute to direct or indirect water quality impacts (i.e., pollution and/or hydromodification) upstream and downstream. Specifically, the discharger must demonstrate compliance with the post-construction standards set forth in this General Permit (Section XIII). The discharger is responsible for all compliance issues including all annual fees until the NOT has been filed and approved by the local Regional Water Board.

E. Discharge Prohibitions

This General Permit authorizes the discharge of storm water to surface waters from construction activities that result in the disturbance of one or more acres of land, provided that the discharger satisfies all permit conditions set forth in the Order. This General Permit prohibits the discharge of pollutants other than storm water and non-storm water discharges authorized by this General Permit or another NPDES permit. This General Permit also prohibits all discharges which contain a hazardous substance in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges. In addition, this General Permit incorporates discharge prohibitions contained in water quality control plans, as implemented by the nine Regional Water Boards. Discharges to Areas of Special Biological Significance (ASBS) are prohibited unless covered by an exception that the State Water Board has approved.

Non-storm water discharges include a wide variety of sources, including improper dumping, spills, or leakage from storage tanks or transfer areas. Non-storm water discharges may contribute significant pollutant loads to receiving waters. Measures to control spills, leakage, and dumping, and to prevent illicit connections during construction must be addressed through structural as well as non-structural BMPs. The State Water Board recognizes, however, that certain non-storm water discharges may be necessary for the completion of construction projects. Authorized non-storm water discharges may include those from de-chlorinated potable water sources such as: fire hydrant flushing, irrigation of vegetative erosion control measures, pipe flushing and testing, water to control dust, uncontaminated ground water dewatering, and other discharges not subject to a separate general NPDES permit adopted by a region. Therefore this General Permit authorizes such discharges provided they meet the following conditions.

These authorized non-storm water discharges must:

1. be infeasible to eliminate;
2. comply with BMPs as described in the SWPPP;
3. filter or treat, using appropriate technology, all dewatering discharges from sedimentation basins;
4. meet the NELs and NALs for pH and turbidity; and
5. not cause or contribute to a violation of water quality standards.

Additionally, authorized non-storm water discharges must not be used to clean up failed or inadequate construction or post-construction BMPs designed to keep materials onsite. Authorized non-storm water dewatering discharges may require a permit because some Regional Water Boards have adopted General Permits for dewatering discharges.

This General Permit prohibits the discharge of storm water that causes or threatens to cause pollution, contamination, or nuisance.

F. Effluent Standards for All Types of Discharges

1. Technology-Based Effluent Limitations

Permits for storm water discharges associated with construction activity must meet all applicable provisions of Sections 301 and 402 of the CWA. These provisions require controls of pollutant discharges that utilize best available technology economically achievable (BAT) for toxic pollutants and non conventional pollutants and best conventional pollutant control technology (BCT) for conventional pollutants. Additionally, these provisions require controls of pollutant discharges to reduce pollutants and any more stringent controls necessary to meet water quality standards. The USEPA has already established such limitations, known as effluent limitation guidelines (ELGs), for some industrial categories. This is not the case with construction discharges. In instances where there are no ELGs the permit writer is to use best professional judgment (BPJ) to establish requirements that the discharger must meet using BAT/BCT technology. This General Permit contains both narrative effluent limitations and new numeric effluent limitations for pH and turbidity, set using the best professional judgment (BPJ) equivalent to BAT and BCT (respectively).

BAT/BCT technologies not only include passive systems such as conventional runoff and sediment control, but also treatment systems such as coagulation/flocculation using sand filtration, when appropriate. Such technologies allow for effective treatment of soil particles less 0.02 mm (medium silt) in diameter. The discharger must install structural controls, as necessary, such as erosion and sediment controls that meet BAT and BCT to achieve compliance with water quality standards. The narrative effluent limitations constitute compliance with the requirements of the CWA.

The numeric effluent limitations for pH and turbidity are based upon BPJ, which authorizes the State Water Board to issue a permit containing “such conditions as the Administrator determines are necessary to carry out the provisions of this Chapter” (CWA § 402(a)(1), 33 U.S.C. § 1342(a)(1).) Because the USEPA has not yet issued an effluent limit guideline for storm water, the State Water Board must use BPJ to consider the appropriate technology for the category or class of point sources, based upon all available information and any unique factors relating to the sources. In addition, the permitting authority must consider a number of factors including the cost of achieving effluent reductions in relation to the effluent reduction benefits, the age of the equipment and facilities, the processes employed and any required process changes, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements), and other such other factors as the State Water Board deems appropriate (CWA 304(b)(1)(B)).

Because the permit is an NPDES permit, there is no legal requirement to address the factors set forth in Water Code sections 13241 and 13263, unless the permit is more stringent than what federal law requires. (See *City of Burbank v. State Water Resources Control Bd.* (2005) 35 Cal.4th 613, 618, 627.) None of the requirements in this permit are more stringent than the minimum federal requirements, which include technology-based requirements achieving BAT/BCT and strict compliance with water quality standards. The inclusion of numeric effluent limitations (NELs) in the permit do not cause the permit to be more stringent than current federal law. NELs and best management practices are simply two different methods of achieving the same federal requirement: strict compliance with state water quality standards. Federal law authorizes both narrative and numeric effluent limitations to meet state water quality standards. The use of NELs to achieve compliance with water quality standards is not a more stringent requirement than the use of BMPs. (State Water Board Order No. WQ 2006-0012 (*Boeing*).) Accordingly, the State Water Board does not need to take into account the factors in Water Code sections 13241 and 13263.

The State Water Board has concluded that the establishment of BAT/BCT will not create or aggravate other environmental problems through increases in air pollution, solid waste generation, or energy consumption. While there may be a slight increase in non-water quality impacts due to the implementation of additional monitoring or the construction of additional BMPs, these impacts will be negligible in comparison with the construction activities taking place on site and would be justified by the water quality benefits associated with compliance.

Considerations related to the processes employed and the changes necessitated by the adoption of the BAT/BCT effluent limits have been assessed throughout the stakeholder process (e.g., the Blue Ribbon Panel and the March 2007 preliminary draft) and are discussed in detail in Section I.C of this Fact Sheet. The following sections set forth the engineering aspects of the control technologies and the rationale for the determination of the numeric effluents for pH and turbidity.

In consideration of the costs for the establishment of BAT and BCT limits for pH and turbidity, existing requirements for the control of storm water pollution from construction sites have been established by USEPA and the previous Construction General Permit (State Water Board Order No. 99-08-DWQ) issued by the State Water Board. The General Permit establishes one, consistent set of performance standards for all levels and types of discharges (i.e., risk, linear utility, and ATS).The only difference is that for each level or type of discharge there may be more or less specific effluent limitations (e.g., the addition of numeric effluent limitations for turbidity applies to level/type 3 discharges). And the numeric effluent limitations themselves represent a minimum technology standard. In other words, the additional numeric effluent limitations, compared to the existing permit's narrative effluent limitations, do not increase compliance requirements; rather, they simply represent a point where one can quantitatively measure compliance with the lower end of the range of required technologies. Therefore, the compliance costs associated with the BAT/BCT numeric effluent limitations in this permit only differ by the costs required to measure compliance with the NELs when compared to the baseline compliance costs to comply with the limitations already established through EPA regulations and the existing Construction General Permit.

The State Water Board estimates these measurement costs to be approximately $1000 per construction site for the duration of the project. This represents the estimated cost of purchasing (or renting) monitoring equipment, in this case a turbidimeter (~$600) and a pH meter (~$400). In some cases the costs may be higher or lower. Costs could be lower if the discharger chooses to design and implement the project in a manner where effluent monitoring is likely to be avoided (e.g., no exposure during wet weather seasons, no discharge due to containment, etc.). Costs could be more if the project is subject to many effluent monitoring events or if the discharger exceeds NALs and/or NELs, resulting in additional monitoring requirements.

i. *pH NEL*

Given the potential contaminants, the minimum standard method for control of pH in runoff requires the use of preventive measures such as avoiding concrete pours during rainy weather, covering concrete and directing flow away from fresh concrete if a pour occurs during rain, covering scrap drywall and stucco

materials when stored outside and potentially exposed to rain, and other housekeeping measures. If necessary, pH-impaired storm water from construction sites can be treated in a filter or settling pond or basin, with additional natural or chemical treatment required to meet pH limits set forth in this permit. The basin or pond acts as a collection point and holds storm water for a sufficient period for the contaminants to be settled out, either naturally or artificially, and allows any additional treatment to take place. The State Water Board considers these techniques to be equivalent to BCT. In determining the pH concentration limit for discharges, the State Water Board used BPJ to set these limitations.

The chosen limits were established by calculating three standard deviations above and below the mean pH of runoff from highway construction sites[7] in California. Proper implementation of BMPs should result in discharges that are within the range of 6.0 to 9.0 pH Units.

ii. ***Turbidity NEL***

The Turbidity NEL of 500 NTU is a technology-based numeric effluent limitation and was developed using three different analyses aimed at finding the appropriate threshold to set the technology-based limit to ensure environmental protection, effluent quality and cost-effectiveness. The analyses fell into three, main types: (1) an ecoregion-specific dataset developed by Simon et. al. (2004) [8]; (2) Statewide Regional Water Quality Control Board enforcement data; and (3) published, peer-reviewed studies and reports on in-situ performance of best management practices in terms of erosion and sediment control on active construction sites.

A 1:3 relationship between turbidity (expressed as NTU) and suspended sediment concentration (expressed as mg/L) is assumed based on a review of suspended sediment and turbidity data from three gages used in the USGS National Water Quality Assessment Program:

USGS 11074000 SANTA ANA R BL PRADO DAM CA
USGS 11447650 SACRAMENTO R A FREEPORT CA
USGS 11303500 SAN JOAQUIN R NR VERNALIS CA

The turbidity NEL represents a feasible and cost effective performance standard that is demonstrated to be achievable. Although data has been collected to demonstrate that lower effluent levels may be achievable at some sites, staff cannot conclude at this time that a lower NEL is achievable within all the ecoregions of the state. The NEL represents staff determination that the NEL is the most practicable based on available data. The turbidity NEL represents a bridge between the narrative effluent limitations and receiving water limitations. The NEL limit may be considered an interim performance standard as additional data becomes available for evaluation during the next permit cycle. To support this NEL, State Water Board staff analyzed construction site discharge information (monitoring data, estimates) and receiving water monitoring information.

Since the turbidity NEL represents an appropriate threshold level expected at a site, compliance with this value does not necessarily represent compliance with either the narrative effluent limitations (as enforced through the BAT/BCT standard) or the receiving water limitations. In the San Diego region, some inland surface waters have a receiving water objective for turbidity equal to 20 NTU. Obviously a discharge up to, but not exceeding, the turbidity NEL of 500 NTU may still cause or contribute to the exceedance of the 20 NTU standard. Most of the waters of the State are protected by turbidity objectives based on background conditions**.**

---

[7] Caltrans Construction Sites Runoff Characterization Study, 2002. Available at: http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-02-055.pdf.
[8] Simon, A., W.D. Dickerson, and A. Heins. 2004. Suspended-sediment transport rates at the 1.5-year recurrence interval for ecoregions of the United States: transport conditions at the bankfull and effective discharge. Geomorphology 58: pp. 243-262.

Table 1 - Regional Water Board Basin Plans, Water Quality Objectives for Turbidity

REGIONAL WATER BOARD	WQ Objective	Background/Natural Turbidity	Maximum Increase
1 Based	on background	All levels	20%
2 Based	on background	> 50 NTU	10%
3 Based	on background	0-50 JTU 50-100 JTU > 100 JTU	20% 10 NTU 10%
4 Based	on background	0-50 NTU > 50 NTU	20% 10%
5 Based	on background	0-5 NTU 5-50 NTU 50-100 NTU >100 NTU	1 NTU 20% 10 NTU 10%
6 Based	on background	All levels	10%
7 Based	on background	N/A N/A	
8 Based	on background	0-50 NTU 50-100 NTU >100 NTU	20% 10 NTU 10%
9 Inland	Surface Waters, 20 NTU All others, based on background	0-50 NTU 50-100 NTU >100 NTU	20% 10 NTU 10%

Table 2 shows the suspended sediment concentrations at the 1.5 year flow recurrence interval for the 12 ecoregions in California from Simon et. al (2004).

Table 2 - Results of Ecoregion Analysis

Ecoregion	Percent of California Land Area	Median Suspended Sediment Concentration (mg/L)
1 9.1		874
4 0.2		120
5 8.8		35.6
6 20.7		1530
7 7.7		122
8 3.0		47.4
9 9.4		284
13 5.2		143
14 21.7		5150
78 8.1		581
80 2.4		199
81 3.7		503
Area-weighted average		1633

If a 1:3 relationship between turbidity and suspended sediment is assumed, the median turbidity is 544 NTU.

The following table is composed of turbidity readings measured in NTUs from administrative civil liberty (ACL) actions for construction sites from 2003 - 2009. This data was derived from the complete listing of construction-related ACLs for the six year period. All ACLs were reviewed and those that included turbidimeter readings at the point of storm water discharge were selected for this dataset.

Table 3 – ACL Sampling Data taken by Regional Water Board Staff

WDID#	Region	Discharger	Turbidity (NTU)
5S34C331884	5S Bradshaw	Interceptor Section 6B	1800
5S05C325110	5S Bridalwood	Subdivision	1670
5S48C336297	5S Cheyenne	at Browns Valley	1629
5R32C314271	5R Grizzly	Ranch Construction	1400
6A090406008	6T	El Dorado County Department of Transportation, Angora Creek	97.4
5S03C346861	5S	TML Development, LLC	1600
6A31C325917	6T	Northstar Village	See Subdata Set

Subdata Set - Turbidity for point of storm water runoff discharge at Northstar Village

Date	Turbidity (NTU)	Location
10/5/2006	900	Middle Martis Creek
11/2/2006	190	Middle Martis Creek
01/04/2007	36	West Fork, West Martis Creek
02/08/2007	180	Middle Martis Creek
02/09/2007	130	Middle Martis Creek
02/09/2007	290	Middle Martis Creek
02/09/2007	100	West Fork, West Martis Creek
02/10/2007	28	Middle Martis Creek
02/10/2007	23	Middle Martis Creek
02/10/2007	32	Middle Martis Creek
02/10/2007	12	Middle Martis Creek
02/10/2007	60	West Fork, West Martis Creek
02/10/2007	34	West Fork, West Martis Creek

A 95% confidence interval for mean turbidity in an ACL order was constructed. The data set used was a small sample size, so the 500 NTU (the value derived as the NEL for this General Permit) needed to be verified as a possible population mean. In this case, the population refers to a hypothetical population of turbidity measurements of which our sample of 20 represents. A t-distribution was assumed due to the small sample size:

Mean: 512.23 NTU
Standard Deviation: 686.85
Margin of Error: 321.45
Confidence Interval: 190.78 NTU (Low)
833.68 NTU (High)

Based on a constructed 95% confidence interval, an ACL order turbidity measurement will be between 190.78 – 833.68 NTU. 500 NTU falls within this range. Using the same data set, a small-sample hypothesis test was also performed to test if the ACL turbidity data set contains enough information to cast doubt on choosing a 500 NTU as a mean. 500 NTU was again chosen due to its proposed use as an acceptable NEL value. The test was carried out using a 95% confidence interval. Results indicated that the ACL turbidity data set *does not* contain significant sample evidence to reject the claim of 500 NTU as an acceptable mean for the ACL turbidity population.

There are not many published, peer-reviewed studies and reports on in-situ performance of best management practices in terms of erosion and sediment control on active construction sites. The most often cited study is a report titled, "Improving the Cost Effectiveness of Highway Construction Site Erosion and Pollution Control" (Horner, Guedry, and Kortenhof 1990, http://www.wsdot.wa.gov/Research/Reports/200/200.1.htm). In a comment letter summarizing this report sent to the State Water Board, the primary author, Dr. Horner, states:

"The most effective erosion control product was wood fiber mulch applied at two different rates along with a bonding agent and grass seed in sufficient time before the tests to achieve germination. Plots treated in this way reduced influent turbidity by more than 97 percent and discharged effluent exhibiting mean and maximum turbidity values of 21 and 73 NTU, respectively. Some other mulch and blanket materials performed nearly as well. These tests demonstrated the control ability of widely available BMPs over a very broad range of erosion potential."

Other technologies studied in this report produced effluent quality at or near 100 NTU. It is the BPJ of the State Water Board staff that erosion control, while preferred, is not always an option on construction sites and that technology performance in a controlled study showing effluent quality directly leaving a BMP is always easier and cheaper to control than effluent being discharged from the project (edge of property, etc.). As a result, it is the BPJ of the State Water Board staff that it is not cost effective or feasible, at this time, for all risk level and type 3 sites in California to achieve effluent discharges with turbidity values that are less than 100 NTU.

To summarize, the analysis showed that: (1) results of the Simon et. al dataset reveals turbidity values in background receiving water in California's ecoregions range from 16 NTU to 1716 NTU (with a mean of 544 NTU); (2) based on a constructed 95% confidence interval, construction sites will be subject to administrative civil liability (ACL) when their turbidity measurement falls between 190.78 – 833.68 NTU; and (3) sites with highly controlled discharges employing and maintaining good erosion control practices can discharge effluent from the BMP with turbidity values less than 100 NTU. Therefore, the appropriate threshold to set the technology-based limit to ensure environmental protection, effluent quality, and cost-effectiveness ranges from 100 NTU to over 1700 NTU. To keep this parameter and the costs of compliance as low as possible, State Water Board staff has determined, using its BPJ, that it is most cost effective to set the numeric effluent limitation for turbidity at 500 NTU.

a. Compliance Storm Event

In response to public comments on the last draft and the recommendations of the expert panel, this General Permit contains "compliance storm event" exceptions from the technology-based NELs. The rationale is that technology-based requirements are developed assuming a certain design storm (defined as the storm producing a rainfall amount for a specified BMPs capacity). Compliance thresholds are needed for storm events above and beyond the design storms assumed to determine the technology-based NELs. For Risk Level 3 project sites applicable to NELs, this General Permit establishes a compliance storm event as the equivalent rainfall in a 5-year, 24-hour storm. This compliance storm was

chosen due to its relative infrequent occurrence and the fact that the runoff volume associated with it is not as large as a 10-year, 24-hour storm event. The discharger shall determine this value using Western Regional Climate Center Precipitation Frequency Maps[9] for 5-year 24-hour storm events in Northern and Southern California (note that these are expressed in tenths of inches – divide by 10 to get inches).

b. TMDLs and Waste Load Allocations

Dischargers located within the watershed of a CWA § 303(d) impaired water body, for which a TMDL for sediment has been adopted by the Regional Water Board or USEPA, must comply with the approved TMDL if it identifies "construction activity" or land disturbance as a source of sediment. If it does, the TMDL should include a specific waste load allocation for this activity/source. The discharger, in this case, may be required by a separate Regional Water Board order to implement additional BMPs, conduct additional monitoring activities, and/or comply with an applicable waste load allocation and implementation schedule. If a specific waste load allocation has been established that would apply to a specific discharge, the Regional Water Board may adopt an order requiring specific implementation actions necessary to meet that allocation. In the instance where an approved TMDL has specified a general waste load allocation to construction storm water discharges, but no specific requirements for construction sites have been identified in the TMDL, dischargers must consult with the state TMDL authority[10] to confirm that adherence to a SWPPP that meets the requirements of the General Permit will be consistent with the approved TMDL.

2. Determining Compliance with Effluent Standards

a. Technology-Based Numeric Action Levels (NALs)

This General Permit contains technology-based NALs for pH and turbidity, and requirements for effluent monitoring at all Risk level 2 & 3, and LUP Type 2 & 3 sites. Numeric action levels are essentially numeric benchmark values for certain parameters that, if exceeded in effluent sampling, trigger the discharger to take actions. Exceedance of an NAL does not itself constitute a violation of the General Permit. If the discharger fails to take the corrective action required by the General Permit, though, that may consititute a violation.

The primary purpose of NALs is to assist dischargers in evaluating the effectiveness of their on-site measures. Construction sites need to employ many different systems that must work together to achieve compliance with the permit's requirements. The NALs chosen should indicate whether the systems are working as intended.

Another purpose of NALs is to provide information regarding construction activities and water quality impacts. This data will provide the State and Regional Water Boards and the rest of the storm water community with more information about levels and types of pollutants present in runoff and how effective the dischargers BMPs are at reducing pollutants in effluent. The State Water Board also hopes to learn more about the linkage between effluent and receiving water quality. In addition, these requirements will provide information on the mechanics needed to establish compliance monitoring programs at construction sites in future permit deliberations.

i. *pH*

[9] http://www.wrcc.dri.edu/pcpnfreq/nca5y24.gif & http://www.wrcc.dri.edu/pcpnfreq/sca5y24.gif .
[10] http://www.waterboards.ca.gov/tmdl/tmdl.html.

The chosen limits were established by calculating one standard deviation above and below the mean pH of runoff from highway construction sites[11] in California. Proper implementation of BMPs should result in discharges that are within the range of 6.5 to 8.5 pH Units.

The Caltrans study included 33 highway construction sites throughout California over a period of four years, which included 120 storm events. All of these sites had BMPs in place that would be generally implemented at all types of construction sites in California.

ii. ***Turbidity***

BPJ was used to develop an NAL that can be used as a learning tool to help dischargers improve their site controls, and to provide meaningful information on the effectiveness of storm water controls. A statewide turbidity NAL has been set at 250 NTU.

G. Receiving Water Limitations

Construction-related activities that cause or contribute to an exceedance of water quality standards must be addressed. The dynamic nature of construction activity gives the discharger the ability to quickly identify and monitor the source of the exceedances. This is because when storm water mobilizes sediment, it provides visual cues as to where corrective actions should take place and how effective they are once implemented.

This General Permit requires that storm water discharges and authorized non-storm water discharges must not contain pollutants that cause or contribute to an exceedance of any applicable water quality objective or water quality standards. The monitoring requirements in this General Permit for sampling and analysis procedures will help determine whether BMPs installed and maintained are preventing pollutants in discharges from the construction site that may cause or contribute to an exceedance of water quality standards.

Water quality standards consist of designated beneficial uses of surface waters and the adoption of ambient criteria necessary to protect those uses. When adopted by the State Water Board or a Regional Water Board, the ambient criteria are termed “water quality objectives.” If storm water runoff from construction sites contains pollutants, there is a risk that those pollutants could enter surface waters and cause or contribute to an exceedance of water quality standards. For that reason, dischargers should be aware of the applicable water quality standards in their receiving waters. (The best method to ensure compliance with receiving water limitations is to implement BMPs that prevent pollutants from contact with storm water or from leaving the construction site in runoff.)

In California, water quality standards are published in the Basin Plans adopted by each Regional Water Board, the California Toxics Rule (CTR), the National Toxics Rule (NTR), and the Ocean Plan.

Dischargers can determine the applicable water quality standards by contacting Regional Water Board staff or by consulting one of the following sources. The actual Basin Plans that contain the water quality standards can be viewed at the website of the appropriate Regional Water Board. (http://www.waterboards.ca.gov/regions.html), the State Water Board site for statewide plans (http://www.waterboards.ca.gov/plnspols/index.html), or the USEPA regulations for the NTR and CTR (40 C.F.R. §§ 131.36-38). Basin Plans and statewide plans are also available by mail from the appropriate Regional Water Board or the State Water Board. The USEPA regulations are available at http://www.epa.gov/. Additional information concerning water quality standards can be accessed through http://www.waterboards.ca.gov/stormwtr/gen_const.html.

---

[11] Caltrans Construction Sites Runoff Characterization Study, 2002. Available at: http://www.dot.ca.gov/hq/env/stormwater/pdf/CTSW-RT-02-055.pdf.

H. Training Qualifications and Requirements

The Blue Ribbon Panel (BRP) made the following observation about the lack of industry-specific training requirements:

"Currently, there is no required training or certification program for contractors, preparers of soil erosion and sediment control Storm Water Pollution Prevention Plans, or field inspectors."

Order 99-08-DWQ required that all dischargers train their employees on how to comply with the permit, but it did not specificy a curriculum or certification program. This has resulted in inconsistent implementation by all affected parties - the dischargers, the local governments where the construction activity occurs, and the regulators required to enforce 99-08-DWQ. This General Permit requires Qualified SWPPP Developers and practitioners to obtain appropriate training, and makes this curriculum mandatory two years after adoption, to allow time for course completion. The State and Regional Water Board are working with many stakeholders to develop the curriculum and mechanisms needed to develop and deliver the courses.

To ensure that the preparation, implementation, and oversight of the SWPPP is sufficient for effective pollution prevention, the Qualified SWPPP Developer and Qualified SWPPP Practitioners responsible for creating, revising, overseeing, and implementing the SWPPP must attend a State Water Board-sponsored or approved Qualified SWPPP Developer and Qualified SWPPP Practitioner training course.

I. Sampling, Monitoring, Reporting and Record Keeping

1. Traditional Construction Monitoring Requirements

This General Permit requires visual monitoring at all sites, and effluent water quality at all Risk Level 2 & 3 sites. It requires receiving water monitoring at some Risk Level 3 sites. All sites are required to submit annual reports, which contain various types of information, depending on the site characteristics and events. A summary of the monitoring and reporting requirements is found in Table 4.

Table 4 - Required Monitoring Elements for Risk Levels

	Visual	Non-visible Pollutant	Effluent	Receiving Water
Risk Level 1	three types required for all Risk Levels: non-storm water, pre-rain and post-rain	As needed for all Risk Levels (see below)	where applicable	not required
Risk Level 2			pH, turbidity	not required
Risk Level 3			(if NEL exceeded) pH, turbidity and SSC	(if NEL exceeded) pH, turbidity and SSC. Bioassessment for sites 30 acres or larger.

a. Visual

All dischargers are required to conduct quarterly, non-storm water visual inspections. For these inspections, the discharger must visually observe each drainage area for the presence of (or indications of prior) unauthorized and authorized non-storm water discharges and their sources. For storm-related inspections, dischargers must visually observe storm water discharges at all discharge locations within two business days after a qualifying event. For this requirement, a qualifying rain event is one producing precipitation of ½ inch or more of discharge. Dischargers must conduct a post-storm event inspection to

(1) identify whether BMPs were adequately designed, implemented, and effective, and (2) identify any additional BMPs necessary and revise the SWPPP accordingly. Dischargers must maintain on-site records of all visual observations, personnel performing the observations, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations.

b. Non-Visible Pollutant Monitoring

This General Permit requires that all dischargers develop a sampling and analysis strategy for monitoring pollutants that are not visually detectable in storm water. Monitoring for non-visible pollutants must be required at any construction site when the exposure of construction materials occurs and where a discharge can cause or contribute to an exceedance of a water quality objective.

Of significant concern for construction discharges are the pollutants found in materials used in large quantities at construction sites throughout California and exposed throughout the rainy season, such as cement, flyash, and other recycled materials or by-products of combustion. The water quality standards that apply to these materials will depend on their composition. Some of the more common storm water pollutants from construction activity are not CTR pollutants. Examples of non-visible pollutants include glyphosate (herbicides), diazinon and chlorpyrifos (pesticides), nutrients (fertilizers), and molybdenum (lubricants). The use of diazinon and chlorpyrifos is a common practice among landscaping professionals and may trigger sampling and analysis requirements if these materials come into contact with storm water. High pH values from cement and gypsum, high pH and SSC from wash waters, and chemical/fecal contamination from portable toilets, also are not CTR pollutants. Although some of these constituents do have numeric water quality objectives in individual Basin Plans, many do not and are subject only to narrative water quality standards (i.e. not causing toxicity). Dischargers are encouraged to discuss these issues with Regional Water Board staff and other storm water quality professionals.

The most effective way to avoid the sampling and analysis requirements, and to ensure permit compliance, is to avoid the exposure of construction materials to precipitation and storm water runoff. Materials that are not exposed do not have the potential to enter storm water runoff, and therefore receiving waters sampling is not required. Preventing contact between storm water and construction materials is one of the most important BMPs at any construction site.

Preventing or eliminating the exposure of pollutants at construction sites is not always possible. Some materials, such as soil amendments, are designed to be used in a manner that will result in exposure to storm water. In these cases, it is important to make sure that these materials are applied according to the manufacturer's instructions and at a time when they are unlikely to be washed away. Other construction materials can be exposed when storage, waste disposal or the application of the material is done in a manner not protective of water quality. For these situations, sampling is required unless there is capture and containment of all storm water that has been exposed. In cases where construction materials may be exposed to storm water, but the storm water is contained and is not allowed to run off the site, sampling will only be required when inspections show that the containment failed or is breached, resulting in potential exposure or discharge to receiving waters.

The discharger must develop a list of potential pollutants based on a review of potential sources, which will include construction materials soil amendments, soil treatments, and historic contamination at the site. The discharger must review existing environmental and real estate documentation to determine the potential for pollutants that could be present on the construction site as a result of past land use activities.

Good sources of information on previously existing pollution and past land uses include:

i. Environmental Assessments;

ii. Initial Studies;

iii. Phase 1 Assessments prepared for property transfers; and

iv. Environmental Impact Reports or Environmental Impact Statements prepared under the requirements of the National Environmental Policy Act or the California Environmental Quality Act.

In some instances, the results of soil chemical analyses may be available and can provide additional information on potential contamination.

The potential pollutant list must include all non-visible pollutants that are known or should be known to occur on the construction site including, but not limited to, materials that:

i. are being used in construction activities;

ii. are stored on the construction site;

iii. were spilled during construction operations and not cleaned up;

iv. were stored (or used) in a manner that created the potential for a release of the materials during past land use activities;

v. were spilled during previous land use activities and not cleaned up; or

vi. were applied to the soil as part of past land use activities.

C. Effluent Monitoring

Federal regulations[12] require effluent monitoring for discharges subject to NALs and NELs. Subsequently, all Risk Level 2 and 3 dischargers must perform sampling and analysis of effluent discharges to characterize discharges associated with construction activity from the entire area disturbed by the project. Dischargers must collect samples of stored or contained storm water that is discharged subsequent to a storm event producing precipitation of ½ inch or more at the time of discharge.

Table 5 - Storm Water Effluent Monitoring Requirements by Risk Level

	Frequency	Effluent Monitoring (Section E, below)
Risk Level 1	when applicable	non-visible pollutant parameters (if applicable)
Risk Level 2	Minimum of 3 samples per day during qualifying rain event characterizing discharges associated with construction activity from the entire project disturbed area.	pH, turbidity, and non-visible pollutant parameters (if applicable)
Risk Level 3	Minimum of 3 samples per day during qualifying rain event characterizing discharges associated with construction activity from the entire project disturbed area.	If NEL exceeded: pH, turbidity and suspended sediment concentration (SSC)., Plus non-visible pollutant parameters if applicable

Risk Level 1 dischargers must analyze samples for:

[12] 40 C.F.R. § 122.44.

i. any parameters indicating the presence of pollutants identified in the pollutant source assessment required in Attachment C contained in the General Permit.

Risk Level 2 dischargers must analyze samples for:

i. pH and turbidity;

ii. any parameters indicating the presence of pollutants identified in the pollutant source assessment required in Attachment D contained in the General Permit, and

iii. any additional parameters for which monitoring is required by the Regional Water Board.

Risk Level 3 dischargers must analyze samples for:

i. pH, turbidity and SSC;

ii. any parameters indicating the presence of pollutants identified in the pollutant source assessment required in Attachment E contained in the General Permit, and

iii. any additional parameters for which monitoring is required by the Regional Water Board.

2. **Linear Monitoring and Sampling Requirements**

Attachment A, establishes minimum monitoring and reporting requirements for all LUPs. It establishes different monitoring requirements depending on project complexity and risk to water quality. The monitoring requirements for Type 1 LUPs are less than Type 2 & 3 projects because Type 1 projects have a lower potential to impact water quality.

A discharger shall prepare a monitoring program prior to the start of construction and immediately implement the program at the start of construction for LUPs. The monitoring program must be implemented at the appropriate level to protect water quality at all times throughout the life of the project.

a. **Type 1 LUP Monitoring Requirements**

A discharger must conduct daily visual inspections of Type 1 LUPs during working hours while construction activities are occurring. Inspections are to be conducted by qualified personnel and can be conducted in conjunction with other daily activities. Inspections will be conducted to ensure the BMPs are adequate, maintained, and in place at the end of the construction day. The discharger will revise the SWPPP, as appropriate, based on the results of the daily inspections. Inspections can be discontinued in non-active construction areas where soil disturbing activities have been completed and final stabilization has been achieved (e.g., trench has been paved, substructures have been installed, and successful final vegetative cover or other stabilization criteria have been met).

A discharger shall implement the monitoring program for inspecting Type 1 LUPs. This program requires temporary and permanent stabilization BMPs after active construction is completed. Inspection activities will continue until adequate permanent stabilization has been established and will continue in areas where re-vegetation is chosen until minimum vegetative coverage has been established. Photographs shall be taken during site inspections and submitted to the State Water Board.

b. Type 2 & 3 LUP Monitoring Requirements

A discharger must conduct daily visual inspections of Type 2 & 3 LUPs during working hours while construction activities are occurring. Inspections are to be conducted by qualified personnel and can be in conjunction with other daily activities.

All dischargers of Type 2 & 3 LUPs are required to conduct inspections by qualified personnel of the construction site during normal working hours prior to all anticipated storm events and after actual storm events. During extended storm events, the discharger shall conduct inspections during normal working hours for each 24-hour period. Inspections can be discontinued in non-active construction areas where soil disturbing activities have been completed and final stabilization has been achieved (e.g., trench has been paved, substructures installed, and successful vegetative cover or other stabilization criteria have been met).

The goals of these inspections are (1) to identify areas contributing to a storm water discharge; (2) to evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate and properly installed and functioning in accordance with the terms of the General Permit; and (3) to determine whether additional control practices or corrective maintenance activities are needed. Equipment, materials, and workers must be available for rapid response to failures and emergencies. All corrective maintenance to BMPs shall be performed as soon as possible, depending upon worker safety.

All dischargers shall develop and implement a monitoring program for inspecting Type 2 & 3 LUPs that require temporary and permanent stabilization BMPs after active construction is completed. Inspections will be conducted to ensure the BMPs are adequate and maintained. Inspection activities will continue until adequate permanent stabilization has been established and will continue in areas where revegetation is chosen until minimum vegetative coverage has been established.

A log of inspections conducted before, during, and after the storm events must be maintained in the SWPPP. The log will provide the date and time of the inspection and who conducted the inspection. Photographs must be taken during site inspections and submitted to the State Water Board.

c. Sampling Requirements for all LUP Project Types

LUPs are also subject to sampling and analysis requirements for visible pollutants (i.e., sedimentation/siltation, turbidity) and for non-visible pollutants.

Sampling for visible pollutants is required for Type 2 & 3 LUPs.

Non-visible pollutant monitoring is required for pollutants associated with construction sites and activities that (1) are not visually detectable in storm water discharges, and (2) are known or should be known to occur on the construction site, and (3) could cause or contribute to an exceedance of water quality objectives in the receiving waters. Sample collection for non-visible pollutants must only be required (1) during a storm event when pollutants associated with construction activities may be discharged with storm water runoff due to a spill, or in the event there was a breach, malfunction, failure, and/or leak of any BMP, and (2) when the discharger has failed to adequately clean the area of material and pollutants. Failure to implement appropriate BMPs will trigger the same sampling requirements as those required for a breach, malfunction and/or leak, or when the discharger has failed to implement appropriate BMPs prior to the next storm event.

Additional monitoring parameters may be required by the Regional Water Boards.

It is not anticipated that many LUPs will be required to collect samples for pollutants not visually detected in runoff due to the nature and character of the construction site and activities as previously described in this fact sheet. Most LUPs are constructed in urban areas with public access (e.g., existing roadways, road shoulders, parking areas, etc.). This raises a concern regarding the potential contribution of pollutants from vehicle use and/or from normal activities of the public (e.g., vehicle washing, landscape fertilization, pest spraying, etc.) in runoff from the project site. Since the dischargers are not the land

owners of the project area and are not able to control the presence of these pollutants in the storm water that runs through their projects, it is not the intent of this General Permit to require dischargers to sample for these pollutants. This General Permit does not require the discharger to sample for these types of pollutants except where the discharger has brought materials onsite that contain these pollutants and when a condition (e.g., breach, failure, etc.) described above occurs.

3. Receiving Water Monitoring

In order to ensure that receiving water limitations are met, discharges subject to numeric effluent limitations (i.e., Risk Level 3, LUP Type 3, and ATS with direct discharges into receiving waters) must also monitor the downstream receiving water(s) for turbidity, SSC, and pH (if applicable) when an NEL is exceeded.

a. Bioassessment Monitoring

This General Permit requires a bioassessment of receiving waters for dischargers of Risk Level 3 or LUP Type 3 construction projects equal to or larger than 30 acres with direct discharges into receiving waters. Benthic macroinvertebrate samples will be taken upstream and downstream of the site's discharge point in the receiving water. Bioassessments measure the quality of the stream by analyzing the aquatic life present. Higher levels of appropriate aquatic species tend to indicate a healthy stream; whereas low levels of organisms can indicate stream degradation. Active construction sites have the potential to discharge large amounts of sediment and pollutants into receiving waters. Requiring a bioassessment for large project sites, with the most potential to impact water quality, provides a snapshot of the health of the receiving water prior to initiation of construction activities. This snapshot can be used in comparison to the health of the receiving water after construction has commenced.

Each ecoregion (biologically and geographically related area) in the State has a specific yearly peak time where stream biota is in a stable and abundant state. This time of year is called an Index Period. The bioassessment requirements in this General Permit, requires benthic macroinvertebrate sampling within a sites index period. The State Water Board has developed a map designating index periods for the ecoregions in the State (see State Water Board Website).

This General Permit requires the bioassessment methods to be in accordance with the Surface Water Ambient Monitoring Program (SWAMP) in order to provide data consistency within the state as well as generate useable biological stream data.

Table 6 - Receiving Water Monitoring Requirements

	Receiving Water Monitoring Parameters
Risk Level 1 /LUP Type 1	not required
Risk Level 2 / LUP Type 2	not required
Risk Level 3 / LUP Type 3	If NEL exceeded: pH (if applicable), turbidity, and SSC. Bioassessment for sites 30 acres or larger.

4. Reporting Requirements

a. NEL Violation Report

All Risk Level 3 and LUP Type 3 dischargers must electronically submit all storm event sampling results to the State and Regional Water Boards, via SMARTS, no later than 5 days after the conclusion of the storm event. The purpose of the electronic filing of the NEL Violation Report is to 1) inform stakeholder agencies and organizations and the general public, and 2) notify the State and Regional Water Boards of

the exceedance so that they can determine whether any follow-up (e.g., inspection, enforcement, etc.) is necessary to bring the site into compliance.

In the event that an applicable NEL has been exceeded during a storm event equal to or larger than the Compliance Storm Event, Risk level 3/LUP Type 3 dischargers shall report the on-site rain gauge reading and nearby governmental rain gauge readings for verification. Specifically, the NEL Exceedance Report is required to contain:

- the analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit are to be reported as "less than the method detection limit or <MDL");
- the date, place, and time of sampling;
- any visual observation (inspections);
- any measurements, including precipitation; and
- a description of the current BMPs associated with the effluent sample that exceeded the NEL and any proposed corrective actions taken.

b. **NAL Exceedance Report**

All Risk Level 3 and LUP Type 3 dischargers must electronically submit all storm event sampling results to the State and Regional Water Boards, via the electronic data system, no later than 5 days after the conclusion of the storm event. In the event that any effluent sample exceeds an applicable NAL, all Risk Level 2 and LUP Type 2 dischargers must electronically submit all storm event sampling results to the State and Regional Water Boards no later than 10 days after the conclusion of the storm event. The Regional Water Boards have the authority to require the submittal of an NAL Exceedance Report.

Specifically, the NAL Exceedance Report is required to contain:

- the analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit are to be reported as "less than the method detection limit or <MDL");
- the date, place, and time of sampling;
- any visual observation (inspections);
- any measurements, including precipitation; and
- a description of the current BMPs associated with the effluent sample that exceeded the NAL and any proposed corrective actions taken.

c. **Annual Report**

All dischargers must prepare and electronically submit an annual report no later than September 1 of each year using the Storm water Multi-Application Reporting and Tracking System (SMARTS). The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, chain of custody forms, a summary of all corrective actions taken during the compliance year, and identification of any compliance activities or corrective actions that were not implemented.

5. Record Keeping

According to 40 C.F.R. Parts 122.21(p) and 122.41(j), the discharger is required to retain paper or electronic copies of all records required by this General Permit for a period of at least three years from the date generated or the date submitted to the State Water Board or Regional Water Boards. A discharger must retain records for a period beyond three years as directed by Regional Water Board.

J. Risk Determination

1. Traditional Projects

a. Overall Risk Determination

There are two major requirements related to site planning and risk determination in this General Permit. The project's overall risk is broken up into two elements – (1) project sediment risk (the relative amount of sediment that can be discharged, given the project and location details) and (2) receiving water risk (the risk sediment discharges pose to the receiving waters).

Project Sediment Risk:
Project Sediment Risk is determined by multiplying the R, K, and LS factors from the Revised Universal Soil Loss Equation (RUSLE) to obtain an estimate of project-related bare ground soil loss expressed in tons/acre. The RUSLE equation is as follows:

A = (R)(K)(LS)(C)(P)

Where: A = the rate of sheet and rill erosion
R = rainfall-runoff erosivity factor
K = soil erodibility factor
LS = length-slope factor
C = cover factor (erosion controls)
P = management operations and support practices (sediment controls)

The C and P factors are given values of 1.0 to simulate bare ground conditions.

There is a map option and a manual calculation option for determining soil loss. For the map option, the R factor for the project is calculated using the online calculator at http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm. The product of K and LS are shown on Figure 1. To determine soil loss in tons per acre, the discharger multiplies the R factor times the value for K times LS from the map.

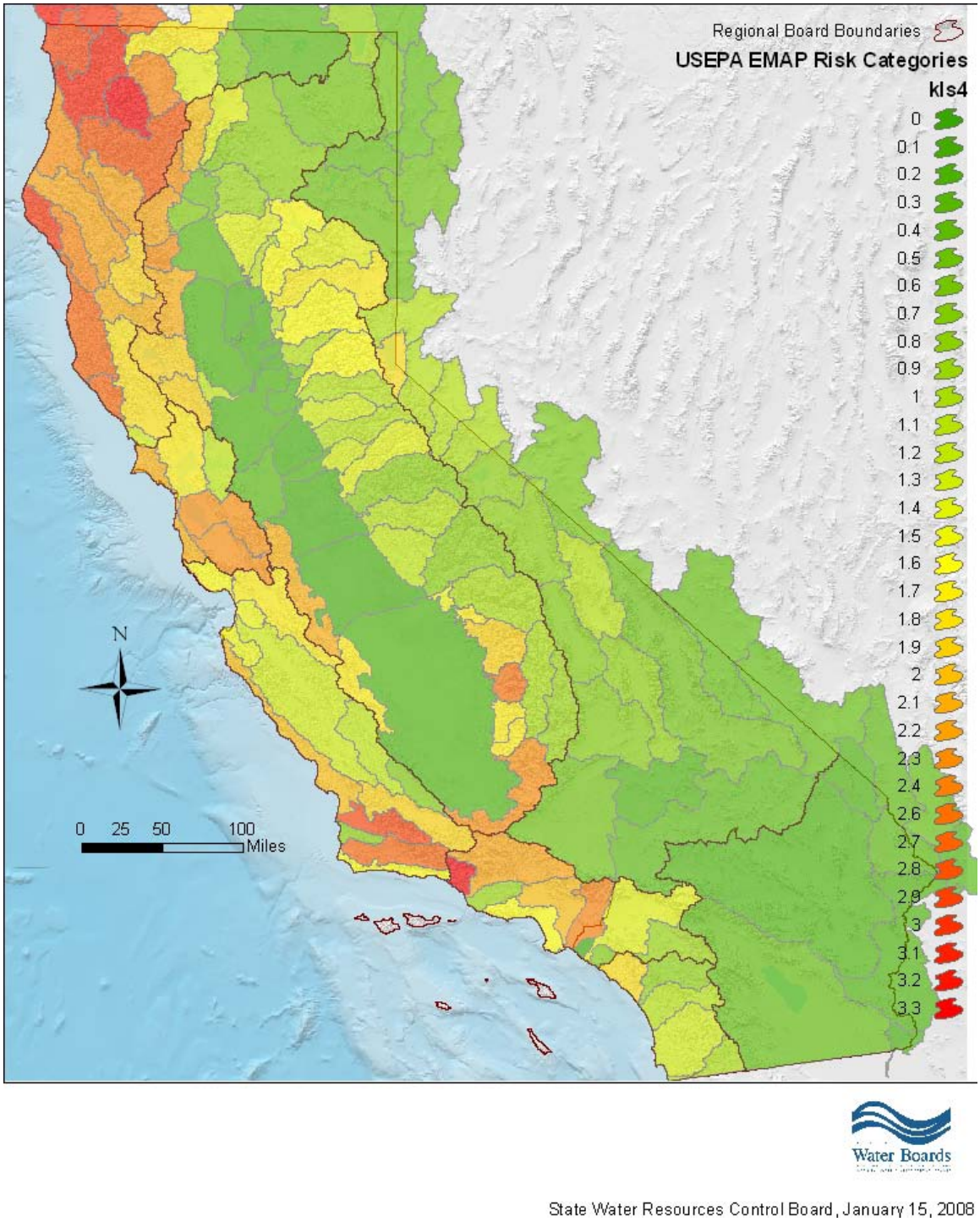


Figure 1 -Statewide Map of K * LS

For the manual calculation option, the R factor for the project is calculated using the online calculator at http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm. The K and LS factors are determined using Appendix 1.

Soil loss of less than 15 tons/acre is considered **low** sediment risk.
Soil loss between 15 and 75 tons/acre is **medium** sediment risk.
Soil loss over 75 tons/acre is considered **high** sediment risk.

The soil loss values and risk categories were obtained from mean and standard deviation RKLS values from the USEPA EMAP program. High risk is the mean RKLS value plus two standard deviations. Low risk is the mean RKLS value minus two standard deviations.

Receiving Water Risk:
Receiving water risk is based on whether a project drains to a sediment-sensitive waterbody. A sediment-sensitive waterbody is either

on the most recent 303d list for waterbodies impaired for sediment;
has a USEPA-approved Total Maximum Daily Load implementation plan for sediment; **or**
has the beneficial uses of COLD, SPAWN, and MIGRATORY.

A project that meets at least one of the three criteria has a high receiving water risk. A list of sediment-sensitive waterbodies will be posted on the State Water Board's website. It is anticipated that an interactive map of sediment sensitive water bodies in California will be available in the future.

The Risk Levels have been altered by eliminating the possibility of a Risk Level 4, and expanding the constraints for Risk Levels 1, 2, and 3. Therefore, projects with high receiving water risk and high sediment risk will be considered a Risk Level 3 risk to water quality.

In response to public comments, the Risk Level requirements have also been changed such that Risk Level 1 projects will be subject to minimum BMP and visual monitoring requirements, Risk Level 2 projects will be subject to NALs and some additional monitoring requirements, and Risk Level 3 projects will be subject to NELs, and more rigorous monitoring requirements such as receiving water monitoring and in some cases bioassessment.

Table 7 - Combined Risk Level Matrix

Combined Risk Level Matrix				
Receiving Water Risk		Sediment Risk		
		Low Medium		High
	Low	Level 1	Level 2	
	High	Level 2		Level 3

b. Effluent Standards

All dischargers are subject to the narrative effluent limitations specified in the General Permit. The narrative effluent limitations require storm water discharges associated with construction activity to meet all applicable provisions of Sections 301 and 402 of the CWA. These provisions require controls of pollutant discharges that utilize BAT and BCT to reduce pollutants and any more stringent controls necessary to meet water quality standards.

Risk Level 2, and 3 dischargers are subject to numeric effluent standards comparable to the project's risk to water quality. Risk Level 2 dischargers that pose a medium risk to water quality are subject to technology-based NALs for pH and turbidity. Risk Level 3 dischargers that pose a high risk to water quality are subject to technology-based NALs and technology-based NELs for pH and turbidity.

c. Good Housekeeping

Proper handling and managing of construction materials can help minimize threats to water quality. The discharger must consider good housekeeping measures for: construction materials, waste management, vehicle storage & maintenance, landscape materials, and potential pollutant sources. Examples include; conducting an inventory of products used, implementing proper storage & containment, and properly cleaning all leaks from equipment and vehicles.

d. Non-Storm Water Management

Non-storm water discharges directly connected to receiving waters or the storm drain system have the potential to negatively impact water quality. The discharger must implement measures to control all non-storm water discharges during construction, and from dewatering activities associated with construction. Examples include; properly washing vehicles in contained areas, cleaning streets, and minimizing irrigation runoff.

e. Erosion Control

The best way to minimize the risk of creating erosion and sedimentation problems during construction is to disturb as little of the land surface as possible by fitting the development to the terrain. When development is tailored to the natural contours of the land, little grading is necessary and, consequently, erosion potential is lower.[14] Other effective erosion control measures include: preserving existing vegetation where feasible, limiting disturbance, and stabilizing and re-vegetating disturbed areas as soon as possible after grading or construction activities. Particular attention must be paid to large, mass-graded sites where the potential for soil exposure to the erosive effects of rainfall and wind is great and where there is potential for significant sediment discharge from the site to surface waters. Until permanent vegetation is established, soil cover is the most cost-effective and expeditious method to protect soil particles from detachment and transport by rainfall. Temporary soil stabilization can be the single most important factor in reducing erosion at construction sites. The discharger is required to consider measures such as: covering disturbed areas with mulch, temporary seeding, soil stabilizers, binders, fiber rolls or blankets, temporary vegetation, and permanent seeding. These erosion control measures are only examples of what should be considered and should not preclude new or innovative approaches currently available or being developed. Erosion control BMPs should be the primary means of preventing storm water contamination, and sediment control techniques should be used to capture any soil that becomes eroded.[13]

Risk Level 3 dischargers pose a higher risk to water quality and are therefore additionally required to ensure that post-construction soil loss is equivalent to or less than the pre-construction levels.

f. Sediment Control

Sediment control BMPs should be the secondary means of preventing storm water contamination. When erosion control techniques are ineffective, sediment control techniques should be used to capture any soil that becomes eroded. The discharger is required to consider perimeter control measures such as: installing silt fences or placing straw wattles below slopes. These sediment control measures are only examples of what should be considered and should not preclude new or innovative approaches currently available or being developed.

Because Risk Level 2 and 3 dischargers pose a higher risk to water quality, additional requirements for the application of sediment controls are imposed on these projects. This General Permit also authorizes the Regional Water Boards to require Risk Level 3 dischargers to implement additional site-specific

---

[13] U.S. Environmental Protection Agency. 2007. Developing Your Storm Water Pollution Prevention Plan: A Guide for Construction Sites.

sediment control requirements if the implementation of other erosion or sediment controls are not adequately protecting the receiving waters.

g. Run-on and Runoff Control

Inappropriate management of run-on and runoff can result in excessive physical impacts to receiving waters from sediment and increased flows. The discharger is required to manage all run-on and runoff from a project site. Examples include: installing berms and other temporary run-on and runoff diversions.

Risk Level 1 dischargers with lower risks to impact water quality are not subject to the run-on and runoff control requirements unless an evaluation deems them necessary or visual inspections show that such controls are required.

h. Inspection, Maintenance and Repair

All measures must be periodically inspected, maintained and repaired to ensure that receiving water quality is protected. Frequent inspections coupled with thorough documentation and timely repair is necessary to ensure that all measures are functioning as intended.

i. Rain Event Action Plan (REAP)

A Rain Event Action Plan (REAP) is a written document, specific for each rain event. A REAP should be designed that when implemented it protects all exposed portions of the site within 48 hours of any likely precipitation event forecast of 50% or greater probability.

This General Permit requires Risk Level 2 and 3 dischargers to develop and implement a REAP designed to protect all exposed portions of their sites within 48 hours prior to any likely precipitation event. The REAP requirement is designed to ensure that the discharger has adequate materials, staff, and time to implement erosion and sediment control measures that are intended to reduce the amount of sediment and other pollutants generated from the active site. A REAP must be developed when there is likely a forecast of 50% or greater probability of precipitation in the project area. (The National Oceanic and Atmospheric Administration (NOAA) defines a chance of precipitation as a probability of precipitation of 30% to 50% chance of producing precipitation in the project area.[14] NOAA defines the probability of precipitation (PoP) as the likelihood of occurrence (expressed as a percent) of a measurable amount (0.01 inch or more) of liquid precipitation (or the water equivalent of frozen precipitation) during a specified period of time at any given point in the forecast area.) Forecasts are normally issued for 12-hour time periods. Descriptive terms for uncertainty and aerial coverage are used as follows:

Table 8 -National Oceanic and Atmospheric Administration (NOAA) Definition of Probability of Precipitation (PoP)

PoP	Expressions of Uncertainty	Aerial Coverage
0%	none used	none used
10%	none used	isolated
20%	slight chance	isolated
30-50%	chance	scattered

[14] http://www.crh.noaa.gov/lot/severe/wxterms.php.

60-70%	likely	numerous
80-100%	none used	none used

The discharger must obtain the precipitation forecast information from the National Weather Service Forecast Office (http://www.srh.noaa.gov/).

2. Linear Projects

a. Linear Risk Determination

LUPs vary in complexity and water quality concerns based on the type of project. This General Permit has varying application requirements based on the project's risk to water quality. Factors that lead to the characterization of the project include location, sediment risk, and receiving water risk.

Based on the location and complexity of a project area or project section area, LUPs are separated into project types. As described below, LUPs have been categorized into three project types.

i. *Type 1 LUPs*

Type 1 LUPs are those construction projects where:

(1) 70 percent or more of the construction activity occurs on a paved surface and where areas disturbed during construction will be returned to preconstruction conditions or equivalent protection established at the end of the construction activities for the day, or

(2) greater than 30 percent of construction activities occur within the non-paved shoulders or land immediately adjacent to paved surfaces, or where construction occurs on unpaved improved roads, including their shoulders or land immediately adjacent to them where:

Areas disturbed during construction will be returned to pre-construction conditions or equivalent protection established at the end of the construction activities for the day to minimize the potential for erosion and sediment deposition, and

Areas where established vegetation was disturbed during construction will be stabilized and re-vegetated by the end of project. When required, adequate temporary stabilization Best Management Practices (BMPs) will be installed and maintained until vegetation is established to meet minimum cover requirements established in this General Permit for final stabilization.

Type 1 LUPs typically do not have a high potential to impact storm water quality because (1) these construction activities are not typically conducted during a rain event, (2) these projects are normally constructed over a short period of time[15], minimizing the duration that pollutants could potentially be exposed to rainfall; and (3) disturbed soils such as those from trench excavation are required to be hauled away, backfilled into the trench, and/or covered (e.g., metal plates, pavement, plastic covers over spoil piles) at the end of the construction day.

[15] Short period of time refers to a project duration of weeks to months, but typically less than one year in duration.

Type 1 LUPs are determined during the risk assessment found in Attachment A.1 to be 1) low sediment risk and low receiving water risk; 2) low sediment risk and medium receiving water risk; and 3) medium sediment risk and low receiving water risk.

This General Permit requires the discharger to ensure a SWPPP is developed for these construction activities that is specific to project type, location and characteristics.

ii. ***Type 2 LUPs:***

Type 2 projects are determined to have a combination of High, Medium, and Low project sediment risk along with High, Medium, and Low receiving water risk. Like Type 1 projects, Type 2 projects are typically constructed over a short period of time. However, these projects have a higher potential to impact water quality because they:

(1) typically occur outside the more urban/developed areas;

(2) have larger areas of soil disturbance that are not closed or restored at the end of the day;

(3) may have onsite stockpiles of soil, spoil and other materials;

(4) cross or occur in close proximity to a wide variety of sensitive resources that may include, but are not limited to, steep topography and/or water bodies; and

(5) have larger areas of disturbed soils that may be exposed for a longer time interval before final stabilization, cleanup and/or reclamation occurs.

This General Permit requires the discharger to develop and implement a SWPPP for these construction activities that are specific for project type, location and characteristics.

iii. ***Type 3 LUPs:***

Type 3 projects are determined to have a combination of High and Medium project sediment risk along with High and Medium receiving water risk. Similar to Type 2 projects, Type 3 projects have a higher potential to impact water quality because they:

(1) typically occur outside of the more urban/developed areas;

(2) have larger areas of soil disturbance that are not closed or restored at the end of the day;

(3) may have onsite stockpiles of soil, spoil and other materials;

(4) cross or occur in close proximity to a wide variety of sensitive resources that may include, but are not limited to, steep topography and/or water bodies; and

(5) have larger areas of disturbed soils that may be exposed for a longer time interval before final stabilization, cleanup and/or reclamation occurs.

This General Permit requires the discharger to develop and implement a SWPPP for these construction activities that are specific for project type, location, and characteristics.

b. **Linear Effluent Standards**

All LUPs are subject to the narrative effluent limitations specified in the General Permit.

Type 2 and 3 LUPs are subject to NELs comparable to the project type's risk to water quality. Type 2 projects that pose an intermediate risk to water quality are subject to technology-based NALs for pH and turbidity. Type 3 projects posing a high risk to water quality are subject to technology-based NALs and NELs for pH and turbidity.

c. Linear Good Housekeeping

Improper use and handling of construction materials could potentially cause a threat to water quality. In order to ensure proper site management of these construction materials, all LUP dischargers must comply with a minimum set of Good Housekeeping measures specified in Attachment A of this General Permit.

d. Linear Non-Storm Water Management

In order to ensure control of all non-storm water discharges during construction, all LUP dischargers must comply with the Non-Storm Water Management measures specified in Attachment A of this General Permit.

e. Linear Erosion Control

This General Permit requires all LUP dischargers to implement effective wind erosion control measures, and soil cover for inactive areas. Type 3 LUPs posing a higher risk to water quality are additionally required to ensure the post-construction soil loss is equivalent to or less than the pre-construction levels.

f. Linear Sediment Control

In order to ensure control and containment of all sediment discharges, all LUP dischargers must comply with the general Sediment Control measures specified in Attachment A or this General Permit. Additional requirements for sediment controls are imposed on Type 2 & 3 LUPs due to their higher risk to water quality.

g. Linear Run-on and Runoff Control

Discharges originating outside of a project's perimeter and flowing onto the property can adversely affect the quantity and quality of discharges originating from a project site. In order to ensure proper management of run-on and runoff, all LUPs must comply with the run-on and runoff control measures specified in Attachment A of this General Permit. Due to the lower risk of impacting water quality, Type 1 LUPs are not required to implement run-on and runoff controls unless deemed necessary by the discharger.

h. Linear Inspection, Maintenance and Repair

Proper inspection, maintenance, and repair activities are important to ensure the effectiveness of on-site measures to control water quality. In order to ensure that inspection, maintenance, and repair activities are adequately performed, the all LUP dischargers a re required to comply with the Inspection, Maintenance, and Repair requirements specified in Attachment A of this General Permit.

K. ATS[16] Requirements

There are instances on construction sites where traditional erosion and sediment controls do not effectively control accelerated erosion. Under such circumstances, or under circumstances where storm water discharges leaving the site may cause or contribute to an exceedance of a water quality standard, the use of an Active Treatment System (ATS) may be necessary. Additionally, it may be appropriate to use an ATS when site constraints inhibit the ability to construct a correctly sized sediment basin, when clay and/or highly erosive soils are present, or when the site has very steep or long slope lengths.[17]

Although treatment systems have been in use in some form since the mid-1990s, the ATS industry in California is relatively young, and detailed regulatory standards have not yet been developed. Many developers are using these systems to treat storm water discharges from their construction sites. The new ATS requirements set forth in this General Permit are based on those in place for small wastewater treatment systems, ATS regulations from the Central Valley Regional Water Quality Control Board (September 2005 memorandum "2005/2006 Rainy Season – Monitoring Requirements for Storm Water Treatment Systems that Utilize Chemical Additives to Enhance Sedimentation"), the Construction Storm Water Program at the State of Washington's Department of Ecology, as well as recent advances in technology and knowledge of coagulant performance and aquatic safety.

The effective design of an ATS requires a detailed survey and analysis of site conditions. With proper planning, ATS performance can provide exceptional water quality discharge and prevent significant impacts to surface water quality, even under extreme environmental conditions.

These systems can be very effective in reducing the sediment in storm water runoff, but the systems that use additives/polymers to enhance sedimentation also pose a potential risk to water quality (e.g., operational failure, equipment failure, additive/polymer release, etc.). The State Water Board is concerned about the potential acute and chronic impacts that the polymers and other chemical additives may have on fish and aquatic organisms if released in sufficient quantities or concentrations. In addition to anecdotal evidence of polymer releases causing aquatic toxicity in California, the literature supports this concern.[18] For example, cationic polymers have been shown to bind with the negatively charged gills of fish, resulting in mechanical suffocation.[19] Due to the potential toxicity impacts, which may be caused by the release of additives/polymers into receiving waters, this General Permit establishes residual polymer monitoring and toxicity testing requirements have been established in this General Permit for discharges from construction sites that utilize an ATS in order to protect receiving water quality and beneficial uses.

The primary treatment process in an ATS is coagulation/flocculation. ATS's operate on the principle that the added coagulant is bound to suspended sediment, forming floc, which is gravitationally settled in tanks or a basin, or removed by sand filters. A typical installation utilizes an injection pump upstream from the clarifier tank, basin, or sand filters, which is electronically metered to both flow rate and suspended solids level of the influent, assuring a constant dose. The coagulant mixes and reacts with the influent, forming a dense floc. The floc may be removed by gravitational setting in a clarifier tank or basin, or by filtration. Water from the clarifier tank, basin, or sand filters may be routed through cartridge(s) and/or bag filters for final polishing. Vendor-specific systems use various methods of dose control, sediment/floc removal, filtration, etc., that are detailed in project-specific documentation. The

---

[16] An ATS is a treatment system that employs chemical coagulation, chemical flocculation, or electrocoagulation in order to reduce turbidity caused by fine suspended sediment.
[17] Pitt, R., S. Clark, and D. Lake. 2006. Construction Site Erosion and Sediment Controls: Planning, Design, and Performance. DEStech Publications. Lancaster, PA. 370pp.
[18] RomØen, K., B. Thu, and Ø. Evensen. 2002. Immersion delivery of plasmid DNA II. A study of the potentials of a chitosan based delivery system in rainbow trout (*Oncorhynchus mykiss*) fry. *Journal of Controlled Release* **85**: 215-225.
[19] Bullock, G., V. Blazer, S. Tsukuda, and S. Summerfelt. 2000. Toxicity of acidified chitosan for cultured rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* **185**:273-280.

particular coagulant/flocculant to be used for a given project is determined based on the water chemistry of the site because the coagulants are specific in their reactions with various types of sediments. Appropriate selection of dosage must be carefully matched to the characteristics of each site.

ATS's are operated in two differing modes, either Batch or Flow-Through. Batch treatment can be defined as Pump-Treat-Hold-Test-Release. In Batch treatment, water is held in a basin or tank, and is not discharged until treatment is complete. Batch treatment involves holding or recirculating the treated water in a holding basin or tank(s) until treatment is complete or the basin or storage tank(s) is full. In Flow-Through treatment, water is pumped into the ATS directly from the runoff collection system or storm water holding pond, where it is treated and filtered as it flows through the system, and is then directly discharged. "Flow-Through Treatment" is also referred to as "Continuous Treatment."

1. Effluent Standards

This General Permit establishes NELs for discharges from construction sites that utilize an ATS. These systems lend themselves to NELs for turbidity and pH because of their known reliable treatment. Advanced systems have been in use in some form since the mid-1990s. An ATS is considered reliable, can consistently produce a discharge of less than 10 NTU, and has been used successfully at many sites in several states since 1995 to reduce turbidity to very low levels.[20]

This General Permit contains "compliance storm event" exceptions from the technology-based NELs for ATS discharges. The rationale is that technology-based requirements are developed assuming a certain design storm. In the case of ATS the industry-standard design storm is 10-year, 24-hour (as stated in Attachment F of this General Permit), so the compliance storm event has been established as the 10-year 24-hour event as well to provide consistency.

2. Training

Operator training is critical to the safe and efficient operation and maintenance of the ATS, and to ensure that all State Water Board monitoring and sampling requirements are met. The General Permit requires that all ATS operators have training specific to using ATS's liquid coagulants.

L. Post-Construction Requirements

Under past practices, new and redevelopment construction activities have resulted in modified natural watershed and stream processes. This is caused by altering the terrain, modifying the vegetation and soil characteristics, introducing impervious surfaces such as pavement and buildings, increasing drainage density through pipes and channels, and altering the condition of stream channels through straightening, deepening, and armoring. These changes result in a drainage system where sediment transport capacity is increased and sediment supply is decreased. A receiving channel's response is dependent on dominant channel materials and its stage of adjustment.

Construction activity can lead to impairment of beneficial uses in two main ways. First, during the actual construction process, storm water discharges can negatively affect the chemical, biological, and physical properties of downstream receiving waters. Due to the disturbance of the landscape, the most likely pollutant is sediment, however pH and other non-visible pollutants are also of great concern. Second, after most construction activities are completed at a construction site, the finished project may result in significant modification of the site's response to precipitation. New development and redevelopment

[20] Currier, B., G. Minton, R. Pitt, L. Roesner, K. Schiff, M. Stenstrom, E. Strassler, and E. Strecker. 2006. The Feasibility of Numeric Effluent Limits Applicable to Discharges of Storm Water Associated with Municipal, Industrial and Construction Activities.

projects have almost always resulted in permanent post-construction water quality impacts because more precipitation ends up as runoff and less precipitation is intercepted, evapotranspired, and infiltrated.

General Permit 99-08-DWQ required the SWPPP to include a description of all post-construction BMPs on a site and a maintenance schedule. An effective storm water management strategy must address the full suite of storm events (water quality, channel protection, overbank flood protection, extreme flood protection) (Figure 2).

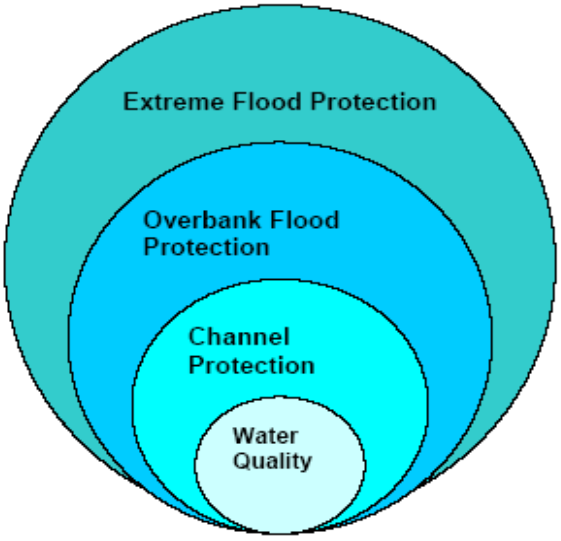


Figure 2 - Suite of Storm Events

The post-construction storm water performance standards in this General Permit specifically address water quality and channel protection events. Overbank flood protection and extreme flood protection events are traditionally dealt with in local drainage and flood protection ordinances. However, measures in this General Permit to address water quality and channel protection also reduce overbank and extreme flooding impacts. This General Permit aims to match post-construction runoff to pre-construction runoff for the 85th percentile storm event, which not only reduces the risk of impact to the receiving water's channel morphology but also provides some protection of water quality.

This General Permit clarifies that its runoff reduction requirements only apply to projects that lie outside of jurisdictions covered by a Standard Urban Storm water Management Plan (SUSMP) (or other more protective) post-construction requirements in either Phase I or Phase II permits.

Figures 3 and 4, below, show the General Permit enrollees (to Order 99-08-DWQ, as of March 10, 2008) overlaid upon a map with SUSMP (or more protective) areas in blue and purple. Areas without blue or purple indicate where the General Permit's runoff reduction requirements would actually apply.

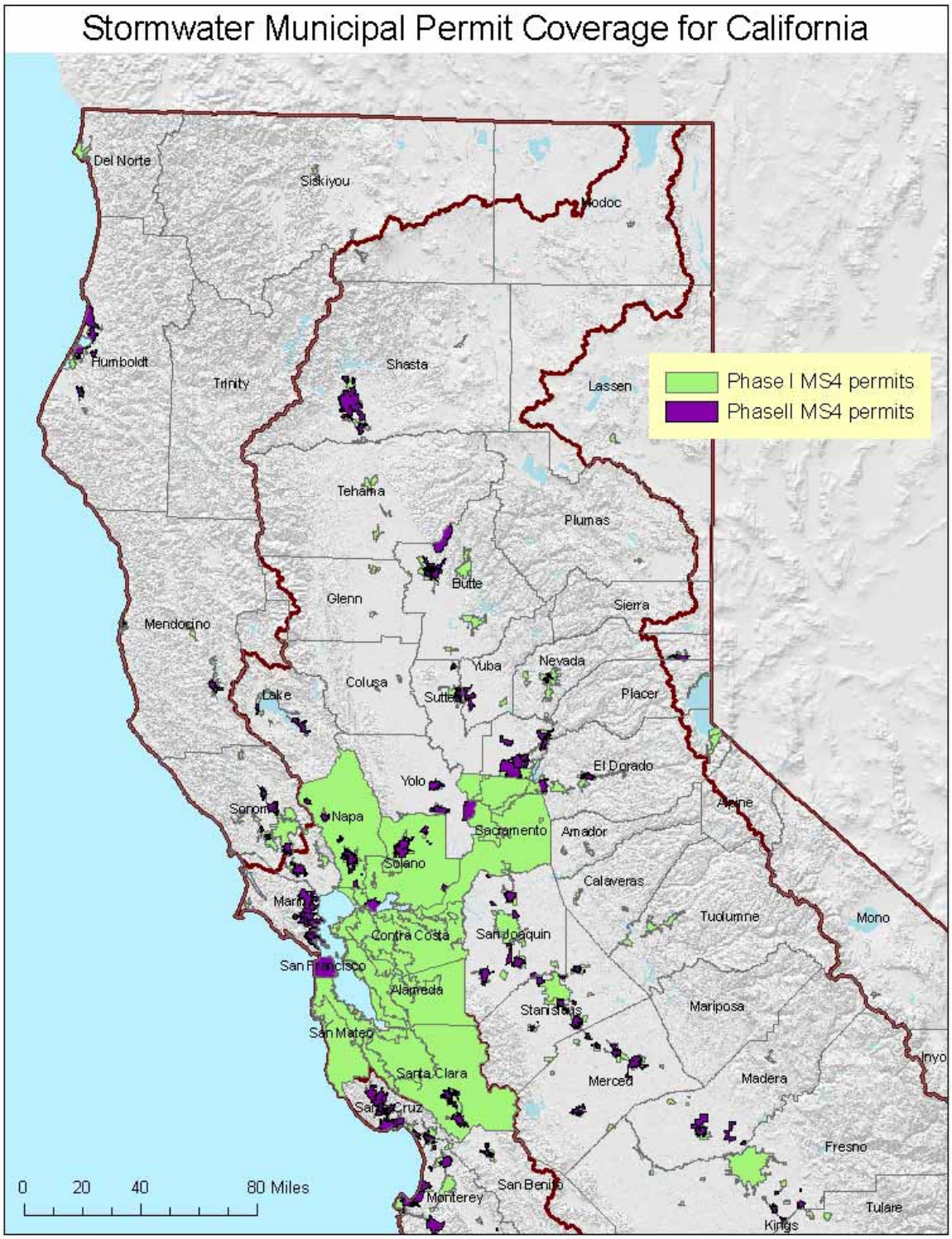
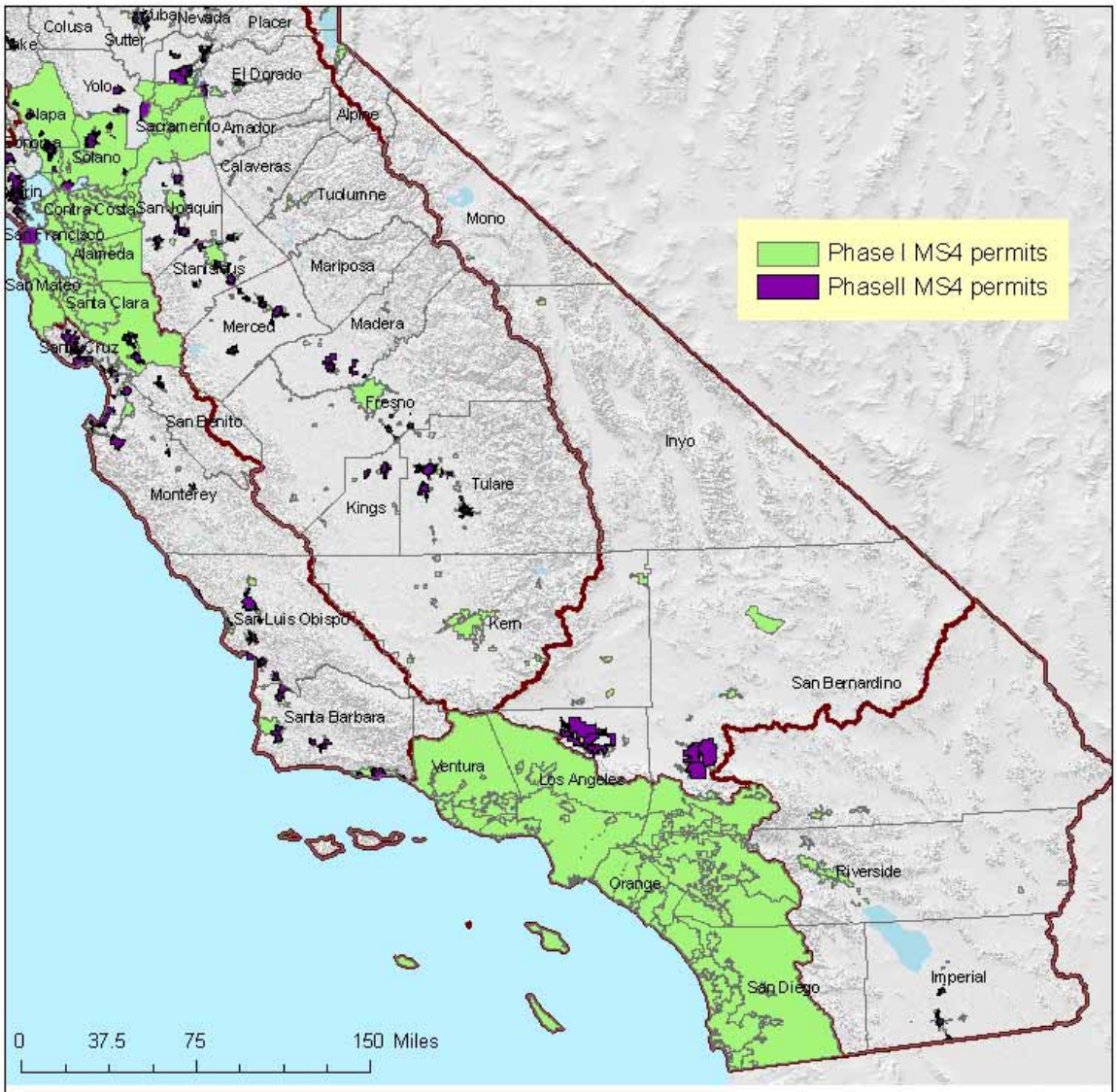


Figure 3 - Northern CA (2009) Counties / Cities With SUSMP-Plus Coverage



Stormwater Municipal Permit Coverage for California

Figure 4 - Southern CA (2009) Counties / Cities With SUSMP-Plus Coverage

Water Quality:
This General Permit requires dischargers to replicate the pre-project runoff water balance (defined as the amount of rainfall that ends up as runoff) for the smallest storms up to the 85th percentile storm event, or the smallest storm event that generates runoff, whichever is larger. Contemporary storm water management generally routes these flows directly to the drainage system, increasing pollutant loads and potentially causing adverse effects on receiving waters. These smaller water quality events happen much more frequently than larger events and generate much higher pollutant loads on an annual basis. There are other adverse hydrological impacts that result from not designing according to the site's pre-construction water balance. In Maryland, Klein[21] noted that baseflow decreases as the extent of urbanization increases. Ferguson and Suckling[22] noted a similar relation in watersheds in Georgia. On Long Island, Spinello and Simmons[23] noted substantial decreases in base flow in intensely urbanized watersheds.

The permit emphasizes runoff reduction through on-site storm water reuse, interception, evapo-transpiration and infiltration through non-structural controls and conservation design measures (e.g., downspout disconnection, soil quality preservation/enhancement, interceptor trees). Employing these measures close to the source of runoff generation is the easiest and most cost-effective way to comply with the pre-construction water balance standard. Using low-tech runoff reduction techniques close to the source is consistent with a number of recommendations in the literature.[24] In many cases, BMPs implemented close to the source of runoff generation cost less than end-of the pipe measures.[25] Dischargers are given the option of using Appendix 2 to calculate the required runoff volume or a watershed process-based, continuous simulation model such as the EPA's Storm Water Management Model (SWMMM) or Hydrologic Simulation Program Fortran (HSPF). Such methods used by the discharger will be reviewed by the Regional Water Board upon NOT application.

Channel Protection:
In order to address channel protection, a basic understanding of fluvial geomorphic concepts is necessary. A dominant paradigm in fluvial geomorphology holds that streams adjust their channel dimensions (width and depth) in response to long-term changes in sediment supply and bankfull discharge (1.5 to 2 year recurrence interval). The bankfull stage corresponds to the discharge at which channel maintenance is the most effective, that is, the discharge at which the moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels.[26] Lane (1955 as cited in Rosgen 1996[27]) showed the generalized relationship between sediment load, sediment size, stream discharge and stream slope in Figure 5. A change in any one of these variables sets up a series of mutual adjustments in the companion variables with a resulting direct change in the physical characteristics of the stream channel.

---

[21] Klein 1979 as cited in Delaware Department of Natural Resources (DDNR). 2004. Green Technology: The Delaware Urban Runoff Management Approach. Dover, DE. 117 pp.
[22] Ferguson and Suckling 1990 as cited Delaware Department of Natural Resources (DDNR). 2004. Green Technology: The Delaware Urban Runoff Management Approach. Dover, DE. 117 pp.
[23] Center for Watershed Protection (CWP). 2000. The Practice of Watershed Protection: Techniques for protecting our nation's streams, lakes, rivers, and estuaries. Ellicott City, MD. 741 pp.
[24] Bay Area Storm Water Management Agencies Association (BASMAA). 1997. Start at the Source: Residential Site Planning and Design Guidance Manual for Storm Water Quality Protection. Palo Alto, CA;
McCuen, R.H. 2003 Smart Growth: hydrologic perspective. Journal of Professional Issues in Engineering Education and Practice. Vol (129), pp.151-154;
Moglen, G.E. and S. Kim. 2007. Impervious imperviousness-are threshold based policies a good idea? Journal of the American Planning Association, Vol 73 No. 2. pp 161-171.
[25] Delaware Department of natural Resources (DDNR). 2004. Green technology: The Delaware urban Runoff Management Approcah. Dover, DE. 117 pp.
[26] Dunne, T and L.B. Leopold. 1978. Water in Environmental Planning. San Francisco W.H. Freeman and Company
[27] Rosgen. D.L. 1996. Applied River Morphology. Pagosa Springs. Wildland Hydrology

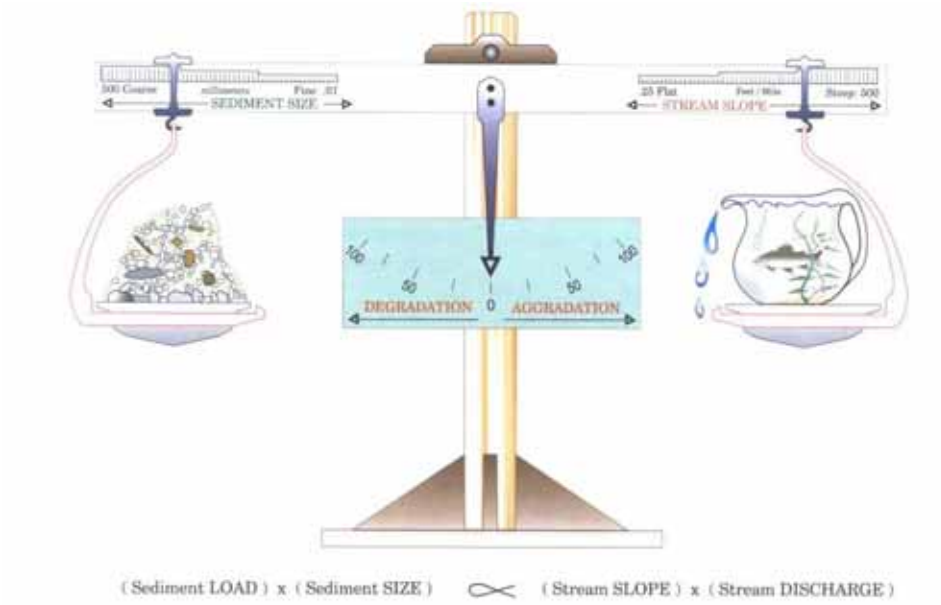


Figure 5 - Schematic of the Lane Relationship

After Lane (1955) as cited in Rosgen (1996)

Stream slope multiplied by stream discharge (the right side of the scale) is essentially an approximation of stream power, a unifying concept in fluvial geomorphology (Bledsoe 1999). Urbanization generally increases stream power and affects the resisting forces in a channel (sediment load and sediment size represented on the left side of the scale).

During construction, sediment loads can increase from 2 to 40,000 times over pre-construction levels.[28] Most of this sediment is delivered to stream channels during large, episodic rain events.[29] This increased sediment load leads to an initial aggradation phase where stream depths may decrease as sediment fills the channel, leading to a decrease in channel capacity and increase in flooding and overbank deposition. A degradation phase initiates after construction is completed.

Schumm et. al (1984) developed a channel evolution model that describes the series of adjustments from initial downcutting, to widening, to establishing new floodplains at lower elevations (Figure 6).

---

[28] Goldman S.J., K. Jackson, and T.A. Bursztynsky. 1986. Erosion and Sediment Control Handbook. McGraw Hill. San Francisco.

[29] Wolman 1967 as cited in Paul, M.P. and J.L. Meyer. 2001. Streams in the Urban Landscape. *Annu. Rev.Ecol. Syst.* 32: 333-365.

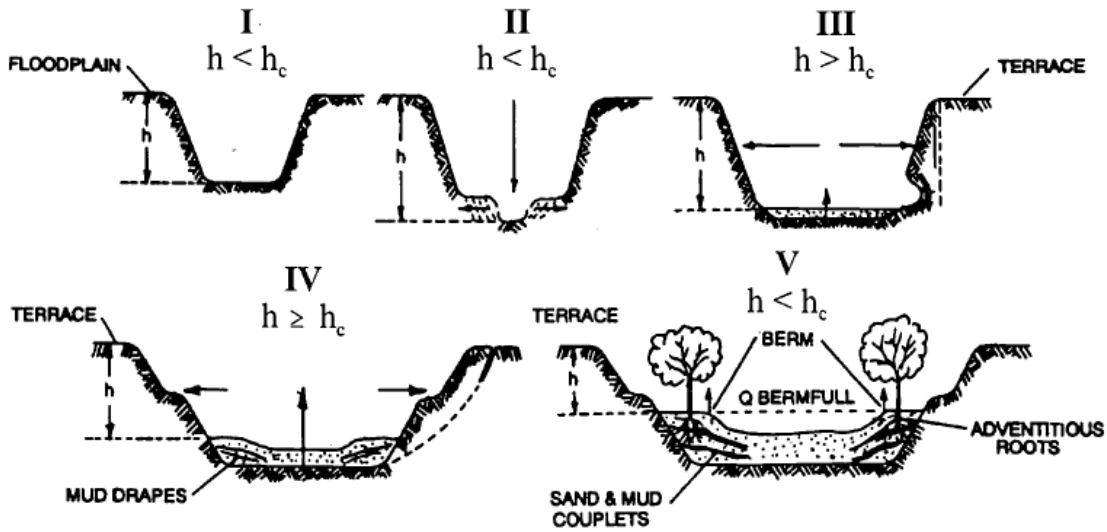


Figure 6 - Channel Changes Associated with Urbanization

After Incised Channel Evolution Sequence in Schumm et. al 1984

Channel incision (Stage II) and widening (Stages III and to a lesser degree, Stage IV) are due to a number of fundamental changes on the landscape. Connected impervious area and compaction of pervious surfaces increase the frequency and volume of bankfull discharges.[30] Increased drainage density (miles of stream length per square mile of watershed) also negatively impacts receiving stream channels.[31] Increased drainage density and hydraulic efficiency leads to an increase in the frequency and volume of bankfull discharges because the time of concentration is shortened. Flows from engineered pipes and channels are also often "sediment starved" and seek to replenish their sediment supply from the channel.

Encroachment of stream channels can also lead to an increase in stream slope, which leads to an increase in stream power. In addition, watershed sediment loads and sediment size (with size generally represented as the median bed and bank particle size, or d_{50}) decrease during urbanization.[32] This means that even if pre- and post-development stream power are the same, more erosion will occur in the post-development stage because the smaller particles are less resistant (provided they are non-cohesive).

---

[30] Booth, D. B. and C. R. Jackson. 1997. Urbanization of Aquatic Systems: Degradation Thresholds, Storm Water Detection, and the Limits of Mitigation. Journal of the American Water Resources Association Vol. 33, No.5, pp. 1077-1089.

[31] May, C.W. 1998. Cumulative effects of urbanization on small streams in the Puget Sound Lowland ecoregion. Conference proceedings from Puget Sound Research '98 held March 12, 13 1998 in Seattle, WA;
Santa Clara Valley Urban Runoff Pollution Prevention Program. 2002. Hydromodification Management Plan Literature Review. 80 pp.

[32] Finkenbine, J.K., D.S. Atwater, and D.S. Mavinic. 2000. Stream health after urbanization. *J. Am. Water Resour. Assoc.* 36:1149-60;
Pizzuto, J.E. W.S. Hession, and M. McBride. 2000. Comparing gravel-bed rivers in paired urban and rural catchments of southeastern Pennsylvania. *Geology* 28:79-82.

As shown in Stages II and III, the channel deepens and widens to accommodate the increased stream power [33]and decrease in sediment load and sediment size. Channels may actually narrow as entrained sediment from incision is deposited laterally in the channel. After incised channels begin to migrate laterally (Stage III), bank erosion begins, which leads to general channel widening.[34] At this point, a majority of the sediment that leaves a drainage area comes from within the channel, as opposed to the background and construction related hillslope contribution. Stage IV is characterized by more aggradation and localized bank instability. Stage V represents a new quasi-equilibrium channel morphology in balance with the new flow and sediment supply regime. In other words, stream power is in balance with sediment load and sediment size.

The magnitude of the channel morphology changes discussed above varies along a stream network as well as with the age of development, slope, geology (sand-bedded channels may cycle through the evolution sequence in a matter of decades whereas clay-dominated channels may take much longer), watershed sediment load and size, type of urbanization, and land use history. It is also dependent on a channel's stage in the channel evolution sequence when urbanization occurs. Management strategies must take into account a channel's stage of adjustment and account for future changes in the evolution of channel form (Stein and Zaleski 2005). [35]

Traditional structural water quality BMPs (e.g. detention basins and other devices used to store volumes of runoff) unless they are highly engineered to provide adequate flow duration control, do not adequately protect receiving waters from accelerated channel bed and bank erosion, do not address post-development increases in runoff volume, and do not mitigate the decline in benthic macroinvertebrate communities in the receiving waters[36] suggest that structural BMPs are not as effective in protecting aquatic communities as a continuous riparian buffer of native vegetation. This is supported by the findings of Zucker and White[37], where instream biological metrics were correlated with the extent of forested buffers.

This General Permit requires dischargers to maintain pre-development drainage densities and times of concentration in order to protect channels and encourages dischargers to implement setbacks to reduce channel slope and velocity changes that can lead to aquatic habitat degradation.

There are a number of other approaches for modeling fluvial systems, including statistical and physical models and simpler stream power models.[38] The use of these models in California is described in Stein and Zaleski (2005).[39] Rather than prescribe a specific one-size-fits-all modeling method in this permit, the State Water Board intends to develop a stream power and channel evolution model-based framework to assess channels and develop a hierarchy of suitable analysis methods and management strategies. In time, this framework may become a State Water Board water quality control policy.

---

[33] Hammer 1973 as cited in Delaware Department of Natural Resources (DDNR). 2004. Green Technology: The Delaware Urban Runoff Management Approach. Dover, DE. 117 pp;
Booth, D.B. 1990. Stream Channel Incision Following Drainage Basin Urbanization. *Water Resour. Bull.* 26:407-417.
[34] Trimble, S.W. 1997. Contribution of Stream Channel Erosion to Sediment Yield from an Urbanizing Watershed. *Science*: Vol. 278 (21), pp. 1442-1444.
[35] Stein, E.S. and S. Zaleski. 2005.Managing runoff to protect natural stream: the latest developments on investigation and management of hydromodification in California. Southern California Coastal Water Research Project Technical Report 475. 26 pp.
[36] Horner, R.R. 2006. Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices (LID) for the San Diego Region. Available at: http://www.projectcleanwater.org/pdf/permit/case-study_lid.pdf.
[37] Delaware Department of Natural Resources (DDNR). 2004. Green Technology: The Delaware Urban Runoff Management Approach. Dover, DE. 117 pp.
[38] Finlayson, D.P. and D.R. Montgomery. 2003. Modeling large-scale fluvial erosion in geographic information systems. Geomorphology (53), pp. 147-164).
[39] Stein, E.S. and S. Zaleski. 2005.Managing runoff to protect natural stream: the latest developments on investigation and management of hydromodification in California. Southern California Coastal Water Research Project Technical Report 475. 26 pp.

Permit Linkage to Overbank and Extreme Flood Protection
Site design BMPs (e.g. rooftop and impervious disconnection, vegetated swales, setbacks and buffers) filter and settle out pollutants and provide for more infiltration than is possible for traditional centralized structural BMPs placed at the lowest point in a site. They provide source control for runoff and lead to a reduction in pollutant loads. When implemented, they also help reduce the magnitude and volume of larger, less frequent storm events (e.g., 10-yr, 24-hour storm and larger), thereby reducing the need for expensive flood control infrastructure. Nonstructural BMPs can also be a landscape amenity, instead of a large isolated structure requiring substantial area for ancillary access, buffering, screening and maintenance facilities.[25] The multiple benefits of using non-structural benefits will be critically important as the state's population increases and imposes strains upon our existing water resources.

Maintaining predevelopment drainage densities and times of concentration will help reduce post-development peak flows and volumes in areas not covered under a municipal permit. The most effective way to preserve drainage areas and maximize time of concentration is to implement landform grading, incorporate site design BMPs and implement distributed structural BMPs (e.g., bioretention cells, rain gardens, rain cisterns).

M. Storm Water Pollution Prevention Plans

USEPA's Construction General Permit requires that qualified personnel conduct inspections. USEPA defines qualified personnel as "a person knowledgeable in the principles and practice of erosion and sediment controls who possesses the skills to assess conditions at the construction site that could impact storm water quality and to assess the effectiveness of any sediment and erosion control measures selected to control the quality of storm water discharges from the construction activity."[40] USEPA also suggests that qualified personnel prepare SWPPPs and points to numerous states that require certified professionals to be on construction sites at all times. States that currently have certification programs are Washington, Georgia, Florida, Delaware, Maryland, and New Jersey. The Permit 99-08-DWQ did not require that qualified personnel prepare SWPPPs or conduct inspections. However, to ensure that water quality is being protected, this General Permit requires that all SWPPPs be written, amended, and certified by a Qualified SWPPP Developer. A Qualified SWPPP Developer must possess one of the eight certifications and or registrations specified in this General Permit and effective two years after the adoption date of this General Permit, must have attended a State Water Board-sponsored or approved Qualified SWPPP Developer training course. Table 9 provides an overview of the criteria used in determining qualified certification titles for a QSD and QSP.

---

40 US Environmental Protection Agency. Stormwater Pollution Prevention Plans for Construction Activities. <http://cfpub.epa.gov/npdes/stormwater/swppp.cfm> and <http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf>.

Table 9 - Qualified SWPPP Developer/ Qualified SWPPP Practitioner Certification Criteria

Certification/ Title	Registered By	QSD/QSP	Certification Criteria
Professional Civil Engineer	California	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites
Professional Geologist or Engineering Geologist	California	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites
Landscape Architect	California	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites
Professional Hydrologist	American Institute of Hydrology	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites
Certified Professional in Erosion and Sediment Control™ (CPESC)	Enviro Cert International Inc.	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites 5. Continuing Education
Certified Inspector of Sediment and Erosion Control™ (CISEC)	Certified Inspector of Sediment and Erosion Control, Inc.	QSP	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites 5. Continuing Education
Certified Erosion, Sediment and Storm Water Inspector™ (CESSWI)	Enviro Cert International Inc.	QSP	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites 5. Continuing Education
Certified Professional in Storm Water Quality™ (CPSWQ)	Enviro Cert International Inc.	Both	1. Approval Process 2. Code of Ethics 3. Accountability 4. Pre-requisites 5. Continuing Education

The previous versions of the General Permit required development and implementation of a SWPPP as the primary compliance mechanism. The SWPPP has two major objectives: (1) to help identify the sources of sediment and other pollutants that affect the quality of storm water discharges; and (2) to describe and ensure the implementation of BMPs to reduce or eliminate sediment and other pollutants in storm water and non-storm water discharges. The SWPPP must include BMPs that address source control, BMPs that address pollutant control, and BMPs that address treatment control.

This General Permit shifts some of the measures that were covered by this general requirement to specific permit requirements, each individually enforceable as a permit term. This General Permit emphasizes the use of appropriately selected, correctly installed and maintained pollution reduction BMPs. This approach provides the flexibility necessary to establish BMPs that can effectively address source control of pollutants during changing construction activities. These specific requirements also improve both the clarity and the enforceability of the General Permit so that the dischargers understand, and the public can determine whether the discharges are in compliance with, permit requirements.

The SWPPP must be implemented at the appropriate level to protect water quality at all times throughout the life of the project. The SWPPP must remain on the site during construction activities, commencing with the initial mobilization and ending with the termination of coverage under the General Permit. For LUPs the discharger shall make the SWPPP available at the construction site during working hours while construction is occurring and shall be made available upon request by a State or Municipal inspector. When the original SWPPP is retained by a crewmember in a construction vehicle and is not currently at the construction site, current copies of the BMPs and map/drawing will be left with the field crew and the original SWPPP shall be made available via a request by radio or telephone. Once construction activities are complete, until stabilization is achieved, the SWPPP shall be available from the SWPPP contact listed in the PRDs

A SWPPP must be appropriate for the type and complexity of a project and will be developed and implemented to address project specific conditions. Some projects may have similarities or complexities, yet each project is unique in its progressive state that requires specific description and selection of BMPs needed to address all possible generated pollutants

N. Regional Water Board Authorities

Because this General Permit will be issued to thousands of construction sites across the State, the Regional Water Boards retain discretionary authority over certain issues that may arise from the discharges in their respective regions. This General Permit does not grant the Regional Water Boards any authority they do not otherwise have; rather, it merely emphasizes that the Regional Water Boards can take specific actions related to this General Permit. For example, the Regional Water Boards will be enforcing this General Permit and may need to adjust some requirements for a discharger based on the discharger's compliance history.

Linda S. Adams
Secretary for Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Arnold Schwarzenegger
Governor

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT FOR
STORM WATER DISCHARGES
ASSOCIATED WITH CONSTRUCTION AND LAND DISTURBANCE
ACTIVITIES

ORDER NO. 2009-0009-DWQ
NPDES NO**. CAS000002**

This Order was adopted by the State Water Resources Control Board on:	**September 2, 2009**
This Order shall become effective on:	**July 1, 2010**
This Order shall expire on:	**September 2, 2014**

IT IS HEREBY ORDERED, that this Order supersedes Order No. 99-08-DWQ except for enforcement purposes. The Discharger shall comply with the requirements in this Order to meet the provisions contained in Division 7 of the California Water Code (commencing with section 13000) and regulations adopted thereunder, and the provisions of the federal Clean Water Act and regulations and guidelines adopted thereunder.

I, Jeanine Townsend, Clerk to the Board, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the State Water Resources Control Board, on September 2, 2009.

AYE: Vice Chair Frances Spivy-Weber
Board Member Arthur G. Baggett, Jr.
Board Member Tam M. Doduc

NAY: Chairman Charles R. Hoppin

ABSENT: None

ABSTAIN: None

Jeanine Townsend

Jeanine Townsend
Clerk to the Board

TABLE OF CONTENTS

I. FINDINGS 1
II. CONDITIONS FOR PERMIT COVERAGE 14
III. DISCHARGE PROHIBITIONS 20
IV. SPECIAL PROVISIONS 22
V. EFFLUENT STANDARDS 29
VI. RECEIVING WATER LIMITATIONS 32
VII. TRAINING QUALIFICATIONS AND CERTIFICATION REQUIREMENTS 33
VIII. RISK DETERMINATION 34
IX. RISK LEVEL 1 REQUIREMENTS 35
X. RISK LEVEL 2 REQUIREMENTS 35
XI. RISK LEVEL 3 REQUIREMENTS 35
XII. ACTIVE TREATMENT SYSTEMS (ATS) 35
XIII. POST-CONSTRUCTION STANDARDS 36
XIV. SWPPP REQUIREMENTS 38
XV. REGIONAL WATER BOARD AUTHORITIES 39
XVI. ANNUAL REPORTING REQUIREMENTS 40

LIST OF ATTACHMENTS

Attachment A – Linear Underground/Overhead Requirements
Attachment A.1 – LUP Type Determination
Attachment A.2 – LUP Permit Registration Documents
Attachment B – Permit Registration Documents
Attachment C – Risk Level 1 Requirements
Attachment D – Risk Level 2 Requirements
Attachment E – Risk Level 3 Requirements
Attachment F – Active Treatment System (ATS) Requirements

LIST OF APPENDICES

Appendix 1 – Risk Determination Worksheet
Appendix 2 – Post-Construction Water Balance Performance Standard
Appendix 2.1 – Post-Construction Water Balance Performance Standard Spreadsheet
Appendix 3 – Bioassessment Monitoring Guidelines
Appendix 4 – Adopted/Implemented Sediment TMDLs
Appendix 5 – Glossary
Appendix 6 – Acronyms
Appendix 7 – State and Regional Water Resources Control Board Contacts

STATE WATER RESOURCES CONTROL BOARD
ORDER NO. 2009-0009-DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
GENERAL PERMIT NO. CAS000002

WASTE DISCHARGE REQUIREMENTS
FOR
DISCHARGES OF STORM WATER RUNOFF ASSOCIATED WITH CONSTRUCTION AND LAND DISTURBANCE ACTIVITIES

I. FINDINGS

A. General Findings

The State Water Resources Control Board (State Water Board) finds that:

1. The federal Clean Water Act (CWA) prohibits certain discharges of storm water containing pollutants except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit (Title 33 United States Code (U.S.C.) §§ 1311 and 1342(p); also referred to as Clean Water Act (CWA) §§ 301 and 402(p)). The U.S. Environmental Protection Agency (U.S. EPA) promulgates federal regulations to implement the CWA's mandate to control pollutants in storm water runoff discharges. (Title 40 Code of Federal Regulations (C.F.R.) Parts 122, 123, and 124). The federal statutes and regulations require discharges to surface waters comprised of storm water associated with construction activity, including demolition, clearing, grading, and excavation, and other land disturbance activities (except operations that result in disturbance of less than one acre of total land area and which are not part of a larger common plan of development or sale), to obtain coverage under an NPDES permit. The NPDES permit must require implementation of Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or eliminate pollutants in storm water runoff. The NPDES permit must also include additional requirements necessary to implement applicable water quality standards.

2. This General Permit authorizes discharges of storm water associated with construction activity so long as the dischargers comply with all requirements, provisions, limitations and prohibitions in the permit. In addition, this General Permit regulates the discharges of storm water associated with construction activities from all Linear Underground/Overhead Projects resulting in the disturbance of greater than or equal to one acre (Attachment A).

3. This General Permit regulates discharges of pollutants in storm water associated with construction activity (storm water discharges) to waters of the United States from construction sites that disturb one or more acres of land surface, or that are part of a common plan of development or sale that disturbs more than one acre of land surface.

4. This General Permit does not preempt or supersede the authority of local storm water management agencies to prohibit, restrict, or control storm water discharges to municipal separate storm sewer systems or other watercourses within their jurisdictions.

5. This action to adopt a general NPDES permit is exempt from the provisions of Chapter 3 of the California Environmental Quality Act (CEQA) (Public Resources Code Section 21100, et seq.), pursuant to Section 13389 of the California Water Code.

6. Pursuant to 40 C.F.R. § 131.12 and State Water Board Resolution No. 68-16,[1] which incorporates the requirements of § 131.12 where applicable, the State Water Board finds that discharges in compliance with this General Permit will not result in the lowering of water quality standards, and are therefore consistent with those provisions. Compliance with this General Permit will result in improvements in water quality.

7. This General Permit serves as an NPDES permit in compliance with CWA § 402 and will take effect on July 1, 2010 by the State Water Board provided the Regional Administrator of the U.S. EPA has no objection. If the U.S. EPA Regional Administrator objects to its issuance, the General Permit will not become effective until such objection is withdrawn.

8. Following adoption and upon the effective date of this General Permit, the Regional Water Quality Control Boards (Regional Water Boards) shall enforce the provisions herein.

9. Regional Water Boards establish water quality standards in Basin Plans. The State Water Board establishes water quality standards in various statewide plans, including the California Ocean Plan. U.S. EPA establishes water quality standards in the National Toxic Rule (NTR) and the California Toxic Rule (CTR).

[1] Resolution No. 68-16 generally requires that existing water quality be maintained unless degradation is justified based on specific findings.

10. This General Permit does not authorize discharges of fill or dredged material regulated by the U.S. Army Corps of Engineers under CWA § 404 and does not constitute a waiver of water quality certification under CWA § 401.

11. The primary storm water pollutant at construction sites is excess sediment. Excess sediment can cloud the water, which reduces the amount of sunlight reaching aquatic plants, clog fish gills, smother aquatic habitat and spawning areas, and impede navigation in our waterways. Sediment also transports other pollutants such as nutrients, metals, and oils and greases.

12. Construction activities can impact a construction site's runoff sediment supply and transport characteristics. These modifications, which can occur both during and after the construction phase, are a significant cause of degradation of the beneficial uses established for water bodies in California. Dischargers can avoid these effects through better construction site design and activity practices.

13. This General Permit recognizes four distinct phases of construction activities. The phases are Grading and Land Development Phase, Streets and Utilities Phase, Vertical Construction Phase, and Final Landscaping and Site Stabilization Phase. Each phase has activities that can result in different water quality effects from different water quality pollutants. This General Permit also recognizes inactive construction as a category of construction site type.

14. Compliance with any specific limits or requirements contained in this General Permit does not constitute compliance with any other applicable requirements.

15. Following public notice in accordance with State and Federal laws and regulations, the State Water Board heard and considered all comments and testimony in a public hearing on 06/03/2009. The State Water Board has prepared written responses to all significant comments.

16. Construction activities obtaining coverage under the General Permit may have multiple discharges subject to requirements that are specific to general, linear, and/or active treatment system discharge types.

17. The State Water Board may reopen the permit if the U.S. EPA adopts a final effluent limitation guideline for construction activities.

B. Activities Covered Under the General Permit

18. Any construction or demolition activity, including, but not limited to, clearing, grading, grubbing, or excavation, or any other activity that results in a land disturbance of equal to or greater than one acre.

19. Construction activity that results in land surface disturbances of less than one acre if the construction activity is part of a larger common plan of development or the sale of one or more acres of disturbed land surface.

20. Construction activity related to residential, commercial, or industrial development on lands currently used for agriculture including, but not limited to, the construction of buildings related to agriculture that are considered industrial pursuant to U.S. EPA regulations, such as dairy barns or food processing facilities.

21. Construction activity associated with Linear Underground/Overhead Utility Projects (LUPs) including, but not limited to, those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities) and include, but are not limited to, underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/or pavement repair or replacement, and stockpile/borrow locations.

22. Discharges of sediment from construction activities associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities.[2]

23. Storm water discharges from dredge spoil placement that occur outside of U.S. Army Corps of Engineers jurisdiction (upland sites) and that disturb one or more acres of land surface from construction activity are covered by this General Permit. Construction sites that intend to disturb one or more acres of land within the jurisdictional boundaries of a CWA § 404 permit should contact the appropriate Regional Water Board to determine whether this permit applies to the site.

[2] Pursuant to the Ninth Circuit Court of Appeals' decision in *NRDC v. EPA* (9th Cir. 2008) 526 F.3d 591, and subsequent denial of the U.S. EPA's petition for reconsideration in November 2008, oil and gas construction activities discharging storm water contaminated only with sediment are no longer exempt from the NPDES program.

C. Activities Not Covered Under the General Permit

24. Routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

25. Disturbances to land surfaces solely related to agricultural operations such as disking, harrowing, terracing and leveling, and soil preparation.

26. Discharges of storm water from areas on tribal lands; construction on tribal lands is regulated by a federal permit.

27. Construction activity and land disturbance involving discharges of storm water within the Lake Tahoe Hydrologic Unit. The Lahontan Regional Water Board has adopted its own permit to regulate storm water discharges from construction activity in the Lake Tahoe Hydrologic Unit (Regional Water Board 6SLT). Owners of construction sites in this watershed must apply for the Lahontan Regional Water Board permit rather than the statewide Construction General Permit.

28. Construction activity that disturbs less than one acre of land surface, and that is not part of a larger common plan of development or the sale of one or more acres of disturbed land surface.

29. Construction activity covered by an individual NPDES Permit for storm water discharges.

30. Discharges from small (1 to 5 acre) construction activities with an approved Rainfall Erosivity Waiver authorized by U.S. EPA Phase II regulations certifying to the State Board that small construction activity will occur only when the Rainfall Erosivity Factor is less than 5 (“R” in the Revised Universal Soil Loss Equation).

31. Landfill construction activity that is subject to the Industrial General Permit.

32. Construction activity that discharges to Combined Sewer Systems.

33. Conveyances that discharge storm water runoff combined with municipal sewage.

34. Discharges of storm water identified in CWA § 402(*l*)(2), 33 U.S.C. § 1342(*l*)(2).

35. Discharges occurring in basins that are not tributary or hydrologically connected to waters of the United States (for more information contact your Regional Water Board).

D. Obtaining and Modifying General Permit Coverage

36. This General Permit requires all dischargers to electronically file all Permit Registration Documents (PRDs), Notices of Termination (NOT), changes of information, annual reporting, and other compliance documents required by this General Permit through the State Water Board's Storm water Multi-Application and Report Tracking System (SMARTS) website.

37. Any information provided to the Regional Water Board shall comply with the Homeland Security Act and any other federal law that concerns security in the United States; any information that does not comply should not be submitted.

38. This General Permit grants an exception from the Risk Determination requirements for existing sites covered under Water Quality Orders No. 99-08-DWQ, and No. 2003-0007-DWQ. For certain sites, adding additional requirements may not be cost effective. Construction sites covered under Water Quality Order No. 99-08-DWQ shall obtain permit coverage at the Risk Level 1. LUPs covered under Water Quality Order No. 2003-0007-DWQ shall obtain permit coverage as a Type 1 LUP. The Regional Water Boards have the authority to require Risk Determination to be performed on sites currently covered under Water Quality Orders No. 99-08-DWQ and No. 2003-0007-DWQ where they deem it necessary. The State Water Board finds that there are two circumstances when it may be appropriate for the Regional Water Boards to require a discharger that had filed an NOI under State Water Board Order No. 99-08-DWQ to recalculate the site's risk level. These circumstances are: (1) when the discharger has a demonstrated history of noncompliance with State Water Board Order No. 99-08-DWQ or; (2) when the discharger's site poses a significant risk of causing or contributing to an exceedance of a water quality standard without the implementation of the additional Risk Level 2 or 3 requirements.

E. Prohibitions

39. All discharges are prohibited except for the storm water and non-storm water discharges specifically authorized by this General Permit or another NPDES permit. Non-storm water discharges include a wide variety of sources, including improper dumping, spills, or leakage from storage tanks or transfer areas. Non-storm water discharges may

contribute significant pollutant loads to receiving waters. Measures to control spills, leakage, and dumping, and to prevent illicit connections during construction must be addressed through structural as well as non-structural Best Management Practices (BMPs)[3]. The State Water Board recognizes, however, that certain non-storm water discharges may be necessary for the completion of construction.

40. This General Permit prohibits all discharges which contain a hazardous substance in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

41. This General Permit incorporates discharge prohibitions contained in water quality control plans, as implemented by the State Water Board and the nine Regional Water Boards.

42. Pursuant to the Ocean Plan, discharges to Areas of Special Biological Significance (ASBS) are prohibited unless covered by an exception that the State Water Board has approved.

43. This General Permit prohibits the discharge of any debris[4] from construction sites. Plastic and other trash materials can cause negative impacts to receiving water beneficial uses. The State Water Board encourages the use of more environmentally safe, biodegradable materials on construction sites to minimize the potential risk to water quality.

F. Training

44. In order to improve compliance with and to maintain consistent enforcement of this General Permit, all dischargers are required to appoint two positions - the Qualified SWPPP Developer (QSD) and the Qualified SWPPP Practitioner (QSP) - who must obtain appropriate training. Together with the key stakeholders, the State and Regional Water Boards are leading the development of this curriculum through a collaborative organization called The Construction General Permit (CGP) Training Team.

45. The Professional Engineers Act (Bus. & Prof. Code section 6700, et seq.) requires that all engineering work must be performed by a California licensed engineer.

---

[3] BMPs are scheduling of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants to waters of the United States. BMPs also include treatment requirements, operating procedures, and practice to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

[4] Litter, rubble, discarded refuse, and remains of destroyed inorganic anthropogenic waste.

G. Determining and Reducing Risk

46. The risk of accelerated erosion and sedimentation from wind and water depends on a number of factors, including proximity to receiving water bodies, climate, topography, and soil type.

47. This General Permit requires dischargers to assess the risk level of a site based on both sediment transport and receiving water risk. This General Permit contains requirements for Risk Levels 1, 2 and 3, and LUP Risk Type 1, 2, and 3 (Attachment A). Risk levels are established by determining two factors: first, calculating the site's sediment risk; and second, receiving water risk during periods of soil exposure (i.e. grading and site stabilization). Both factors are used to determine the site-specific Risk Level(s). LUPs can be determined to be Type 1 based on the flowchart in Attachment A.1.

48. Although this General Permit does not mandate specific setback distances, dischargers are encouraged to set back their construction activities from streams and wetlands whenever feasible to reduce the risk of impacting water quality (e.g., natural stream stability and habitat function). Because there is a reduced risk to receiving waters when setbacks are used, this General Permit gives credit to setbacks in the risk determination and post-construction storm water performance standards. The risk calculation and runoff reduction mechanisms in this General Permit are expected to facilitate compliance with any Regional Water Board and local agency setback requirements, and to encourage voluntary setbacks wherever practicable.

49. Rain events can occur at any time of the year in California. Therefore, a Rain Event Action Plan (REAP) is necessary for Risk Level 2 and 3 traditional construction projects (LUPs exempt) to ensure that active construction sites have adequate erosion and sediment controls implemented prior to the onset of a storm event, even if construction is planned only during the dry season.

50. Soil particles smaller than 0.02 millimeters (mm) (i.e., finer than medium silt) do not settle easily using conventional measures for sediment control (i.e., sediment basins). Given their long settling time, dislodging these soils results in a significant risk that fine particles will be released into surface waters and cause unacceptable downstream impacts. If operated correctly, an Active Treatment System (ATS[5]) can prevent or reduce the release of fine particles from construction sites.

[5] An ATS is a treatment system that employs chemical coagulation, chemical flocculation, or electro coagulation in order to reduce turbidity caused by fine suspended sediment.

Use of an ATS can effectively reduce a site's risk of impacting receiving waters.

51. Dischargers located in a watershed area where a Total Maximum Daily Load (TMDL) has been adopted or approved by the Regional Water Board or U.S. EPA may be required by a separate Regional Water Board action to implement additional BMPs, conduct additional monitoring activities, and/or comply with an applicable waste load allocation and implementation schedule. Such dischargers may also be required to obtain an individual Regional Water Board permit specific to the area.

H. Effluent Standards

52. The State Water Board convened a blue ribbon panel of storm water experts that submitted a report entitled, “The Feasibility of Numeric Effluent Limits Applicable to Discharges of Storm Water Associated with Municipal, Industrial and Construction Activities,” dated June 19, 2006. The panel concluded that numeric limits or action levels are technically feasible to control construction storm water discharges, provided that certain conditions are considered. The panel also concluded that numeric effluent limitations (NELs) are feasible for discharges from construction sites that utilize an ATS. The State Water Board has incorporated the expert panel’s suggestions into this General Permit, which includes both numeric action levels (NALs) and NELs for pH and turbidity, and special numeric limits for ATS discharges.

Numeric Effluent Limitations

53. Discharges of storm water from construction activities may become contaminated from alkaline construction materials resulting in high pH (greater than pH 7). Alkaline construction materials include, but are not limited to, hydrated lime, concrete, mortar, cement kiln dust (CKD), Portland cement treated base (CTB), fly ash, recycled concrete, and masonry work. This General Permit includes an NEL for pH (6.0-9.0) that applies only at sites that exhibit a "high risk of high pH discharge." A "high risk of high pH discharge" can occur during the complete utilities phase, the complete vertical build phase, and any portion of any phase where significant amounts of materials are placed directly on the land at the site in a manner that could result in significant alterations to the background pH of any discharges.

54. For Risk Level 3 discharges, this General Permit establishes technology-based, numeric effluent limitations (NELs) for turbidity of 500 NTU. Exceedances of the turbidity NEL constitutes a violation of this General Permit.

55. This General Permit establishes a 5 year, 24 hour (expressed in inches of rainfall) Compliance Storm Event exemption from the technology-based NELs for Risk Level 3 dischargers.

Determining Compliance with Numeric Limitations

56. This General Permit sets a pH NAL of 6.5 to 8.5, and a turbidity NAL of 250 NTU. The purpose of the NAL and its associated monitoring requirement is to provide operational information regarding the performance of the measures used at the site to minimize the discharge of pollutants and to protect beneficial uses and receiving waters from the adverse effects of construction-related storm water discharges. The NALs in this General Permit for pH and turbidity are not directly enforceable and do not constitute NELs.

57. This General Permit requires dischargers with NAL exceedances to immediately implement additional BMPs and revise their Storm Water Pollution Prevention Plans (SWPPPs) accordingly to either prevent pollutants and authorized non-storm water discharges from contaminating storm water, or to substantially reduce the pollutants to levels consistently below the NALs. NAL exceedances are reported in the State Water Boards SMARTS system, and the discharger is required to provide an NAL Exceedance Report when requested by a Regional Water Board.

58. If run-on is caused by a forest fire or any other natural disaster, then NELs do not apply.

59. Exceedances of the NELs are a violation of this Permit. This General Permit requires dischargers with NEL exceedances to implement additional monitoring, BMPs, and revise their SWPPPs accordingly. Dischargers are required to notify the State and Regional Water Boards of the violation through the State Water Boards SMARTs system, and provide an NEL Violation Report sharing additional information concerning the NEL exceedance.

I. Receiving Water Limitations

60. This General Permit requires all enrolled dischargers to determine the receiving waters potentially affected by their discharges and to comply with all applicable water quality standards, including any more stringent standards applicable to a water body.

J. Sampling, Monitoring, Reporting and Record Keeping

61. Visual monitoring of storm water and non-storm water discharges is required for all sites subject to this General Permit.

62. Records of all visual monitoring inspections are required to remain on-site during the construction period and for a minimum of three years.

63. For all Risk Level 3 and Risk Level 2 sites, this General Permit requires effluent monitoring for pH and turbidity. Sampling, analysis and monitoring requirements for effluent monitoring for pH and turbidity are contained in this General Permit.

64. Risk Level 3 sites in violation of the Numeric Effluent Limitations contained in this General Permit and with direct discharges to receiving water are required to conduct receiving water monitoring.

65. For Risk Level 3 sites larger than 30 acres and with direct discharges to receiving waters, this General Permit requires bioassessment sampling before and after site completion to determine if significant degradation to the receiving water's biota has occurred. Bioassessment sampling guidelines are contained in this General Permit.

66. A summary and evaluation of the sampling and analysis results will be submitted in the Annual Reports.

67. This General Permit contains sampling, analysis and monitoring requirements for non-visible pollutants at all sites subject to this General Permit.

68. Compliance with the General Permit relies upon dischargers to electronically self-report any discharge violations and to comply with any Regional Water Board enforcement actions.

69. This General Permit requires that all dischargers maintain a paper or electronic copy of all required records for three years from the date generated or date submitted, whichever is last. These records must be available at the construction site until construction is completed. For LUPs, these documents may be retained in a crew member's vehicle and made available upon request.

K. Active Treatment System (ATS) Requirements

70. Active treatment systems add chemicals to facilitate flocculation, coagulation and filtration of suspended sediment particles. The uncontrolled release of these chemicals to the environment can negatively affect the beneficial uses of receiving waters and/or degrade water quality (e.g., acute and chronic toxicity). Additionally, the batch storage and treatment of storm water through an ATS' can potentially

cause physical impacts on receiving waters if storage volume is inadequate or due to sudden releases of the ATS batches and improperly designed outfalls.

71. If designed, operated and maintained properly an ATS can achieve very high removal rates of suspended sediment (measured as turbidity), albeit at sometimes significantly higher costs than traditional erosion/sediment control practices. As a result, this General Permit establishes NELs consistent with the expected level of typical ATS performance.

72. This General Permit requires discharges of storm water associated with construction activity that undergo active treatment to comply with special operational and effluent limitations to ensure that these discharges do not adversely affect the beneficial uses of the receiving waters or cause degradation of their water quality.

73. For ATS discharges, this General Permit establishes technology-based NELs for turbidity.

74. This General Permit establishes a 10 year, 24 hour (expressed in inches of rainfall) Compliance Storm Event exemption from the technology-based numeric effluent limitations for ATS discharges. Exceedances of the ATS turbidity NEL constitutes a violation of this General Permit.

L. Post-Construction Requirements

75. This General Permit includes performance standards for post-construction that are consistent with State Water Board Resolution No. 2005-0006, "Resolution Adopting the Concept of Sustainability as a Core Value for State Water Board Programs and Directing Its Incorporation," and 2008-0030, “Requiring Sustainable Water Resources Management.“ The requirement for all construction sites to match pre-project hydrology will help ensure that the physical and biological integrity of aquatic ecosystems are sustained. This “runoff reduction” approach is analogous in principle to Low Impact Development (LID) and will serve to protect related watersheds and waterbodies from both hydrologic-based and pollution impacts associated with the post-construction landscape.

76. LUP projects are not subject to post-construction requirements due to the nature of their construction to return project sites to pre-construction conditions.

M. Storm Water Pollution Prevention Plan Requirements

77. This General Permit requires the development of a site-specific SWPPP. The SWPPP must include the information needed to demonstrate compliance with all requirements of this General Permit, and must be kept on the construction site and be available for review. The discharger shall ensure that a QSD develops the SWPPP.

78. To ensure proper site oversight, this General Permit requires a Qualified SWPPP Practitioner to oversee implementation of the BMPs required to comply with this General Permit.

N. Regional Water Board Authorities

79. Regional Water Boards are responsible for implementation and enforcement of this General Permit. A general approach to permitting is not always suitable for every construction site and environmental circumstances. Therefore, this General Permit recognizes that Regional Water Boards must have some flexibility and authority to alter, approve, exempt, or rescind permit authority granted under this General Permit in order to protect the beneficial uses of our receiving waters and prevent degradation of water quality.

IT IS HEREBY ORDERED that all dischargers subject to this General Permit shall comply with the following conditions and requirements (including all conditions and requirements as set forth in Attachments A, B, C, D, E and F)[6]:

II. CONDITIONS FOR PERMIT COVERAGE

A. Linear Underground/Overhead Projects (LUPs)

1. Linear Underground/Overhead Projects (LUPs) include, but are not limited to, any conveyance, pipe, or pipeline for the transportation of any gaseous, liquid (including water and wastewater for domestic municipal services), liquescent, or slurry substance; any cable line or wire for the transmission of electrical energy; any cable line or wire for communications (e.g. telephone, telegraph, radio or television messages); and associated ancillary facilities. Construction activities associated with LUPs include, but are not limited to, (a) those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment, and associated ancillary facilities); and include, but are not limited to, (b) underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/ or pavement repair or replacement, and stockpile/borrow locations.

2. The utility company, municipality, or other public or private company or agency that owns or operates the linear underground/overhead project is responsible for obtaining coverage under the General Permit where the construction of pipelines, utility lines, fiber-optic cables, or other linear underground/overhead projects will occur across several properties unless the LUP construction activities are covered under another construction storm water permit.

3. Only LUPs shall comply with the conditions and requirements in Attachment A, A.1 & A.2 of this Order. The balance of this Order is not applicable to LUPs except as indicated in Attachment A.

B. Obtaining Permit Coverage Traditional Construction Sites

[6] These attachments are part of the General Permit itself and are not separate documents that are capable of being updated independently by the State Water Board.

1. The Legally Responsible Person (LRP) (see Special Provisions, Electronic Signature and Certification Requirements, Section IV.I.1) must obtain coverage under this General Permit.

2. To obtain coverage, the LRP must electronically file Permit Registration Documents (PRDs) prior to the commencement of construction activity. Failure to obtain coverage under this General Permit for storm water discharges to waters of the United States is a violation of the CWA and the California Water Code.

3. PRDs shall consist of:

   a. Notice of Intent (NOI)
   b. Risk Assessment (Section VIII)
   c. Site Map
   d. Storm Water Pollution Prevention Plan (Section XIV)
   e. Annual Fee
   f. Signed Certification Statement

   Any information provided to the Regional Water Board shall comply with the Homeland Security Act and any other federal law that concerns security in the United States; any information that does not comply should not be submitted.

   Attachment B contains additional PRD information. Dischargers must electronically file the PRDs, and mail the appropriate annual fee to the State Water Board.

4. This permit is effective on July 1, 2010.

   a. **Dischargers Obtaining Coverage On or After July 1, 2010:** All dischargers requiring coverage on or after July 1, 2010, shall electronically file their PRDs prior to the commencement of construction activities, and mail the appropriate annual fee no later than seven days prior to the commencement of construction activities. Permit coverage shall not commence until the PRDs and the annual fee are received by the State Water Board, and a WDID number is assigned and sent by SMARTS.

   b. **Dischargers Covered Under 99-08-DWQ and 2003-0007-DWQ:** Existing dischargers subject to State Water Board Order No. 99-08-DWQ (existing dischargers) will continue coverage under 99-08-DWQ until July 1, 2010. After July 1, 2010, all NOIs subject to State Water Board Order No. 99-08-DWQ will be terminated. Existing dischargers shall electronically file their PRDs no later than

July 1, 2010. If an existing discharger's site acreage subject to the annual fee has changed, it shall mail a revised annual fee no less than seven days after receiving the revised annual fee notification, **or else lose permit coverage**. All existing dischargers shall be exempt from the risk determination requirements in Section VIII of this General Permit until two years after permit adoption. All existing dischargers are therefore subject to Risk Level 1 requirements regardless of their site's sediment and receiving water risks. However, a Regional Board retains the authority to require an existing discharger to comply with the Section VIII risk determination requirements.

5. The discharger is only considered covered by this General Permit upon receipt of a Waste Discharger Identification (WDID) number assigned and sent by the State Water Board Storm water Multi-Application and Report Tracking System (SMARTS). In order to demonstrate compliance with this General Permit, the discharger must obtain a WDID number and must present documentation of a valid WDID upon demand.

6. During the period this permit is subject to review by the U.S. EPA, the prior permit (State Water Board Order No. 99-08-DWQ) remains in effect. Existing dischargers under the prior permit will continue to have coverage under State Water Board Order No. 99-08-DWQ until this General Permit takes effect on July 1, 2010. Dischargers who complete their projects and electronically file an NOT prior to July 1, 2010, are not required to obtain coverage under this General Permit.

7. Small Construction Rainfall Erosivity Waiver

   EPA's Small Construction Erosivity Waiver applies to sites between one and five acres demonstrating that there are no adverse water quality impacts.

   Dischargers eligible for a Rainfall Erosivity Waiver based on low erosivity potential shall complete the electronic Notice of Intent (NOI) and Sediment Risk form through the State Water Board's SMARTS system, certifying that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five. Where the LRP changes or another LRP is added during construction, the new LRP must also submit a waiver certification through the SMARTS system.

   If a small construction site continues beyond the projected completion date given on the waiver certification, the LRP shall recalculate the rainfall erosivity factor for the new project duration and submit this

information through the SMARTS system. If the new R factor is below five (5), the discharger shall update through SMARTS all applicable information on the waiver certification and retain a copy of the revised waiver onsite. The LRP shall submit the new waiver certification 30 days prior to the projected completion date listed on the original waiver form to assure exemption from permitting requirements is uninterrupted. If the new R factor is five (5) or above, the LRP shall be required to apply for coverage under this Order.

8. In the case of a public emergency that requires immediate construction activities, a discharger shall submit a brief description of the emergency construction activity within five days of the onset of construction, and then shall submit all PRDs within thirty days.

C. Revising Permit Coverage for Change of Acreage or New Ownership

1. The discharger may reduce or increase the total acreage covered under this General Permit when a portion of the site is complete and/or conditions for termination of coverage have been met (See Section II.D Conditions for Termination of Coverage); when ownership of a portion of the site is sold to a different entity; or when new acreage, subject to this General Permit, is added to the site.

2. Within 30 days of a reduction or increase in total disturbed acreage, the discharger shall electronically file revisions to the PRDs that include:

   a. A revised NOI indicating the new project size;

   b. A revised site map showing the acreage of the site completed, acreage currently under construction, acreage sold/transferred or added, and acreage currently stabilized in accordance with the Conditions for Termination of Coverage in Section II.D below.

   c. SWPPP revisions, as appropriate; and

   d. Certification that any new landowners have been notified of applicable requirements to obtain General Permit coverage. The certification shall include the name, address, telephone number, and e-mail address of the new landowner.

   e. If the project acreage has increased, dischargers shall mail payment of revised annual fees within 14 days of receiving the revised annual fee notification.

3. The discharger shall continue coverage under the General Permit for any parcel that has not achieved "Final Stabilization" as defined in Section II.D.

4. When an LRP owns property with active General Permit coverage, and the LRP sells the property, or a parcel thereof, to another person, that person shall become an LRP with respect to whatever parcel was sold. The existing LRP shall inform the new LRP of the General Permit's requirements. In order for the new LRP to continue the construction activity on its parcel of property, the new LRP, or the new LRP's approved signatory, must submit PRDs in accordance with this General Permit's requirements.

D. Conditions for Termination of Coverage

1. Within 90 days of when construction is complete or ownership has been transferred, the discharger shall electronically file a Notice of Termination (NOT), a final site map, and photos through the State Water Boards SMARTS system. Filing a NOT certifies that all General Permit requirements have been met. The Regional Water Board will consider a construction site complete only when all portions of the site have been transferred to a new owner, or all of the following conditions have been met:

   a. For purposes of "final stabilization," the site will not pose any additional sediment discharge risk than it did prior to the commencement of construction activity;

   b. There is no potential for construction-related storm water pollutants to be discharged into site runoff;

   c. Final stabilization has been reached;

   d. Construction materials and wastes have been disposed of properly;

   e. Compliance with the Post-Construction Standards in Section XIII of this General Permit has been demonstrated;

   f. Post-construction storm water management measures have been installed and a long-term maintenance plan[7] has been established; and

[7] For the purposes of this requirement a long-term maintenance plan will be designed for a minimum of five years, and will describe the procedures to ensure that the post-construction storm water management measures are adequately maintained.

g. All construction-related equipment, materials and any temporary BMPs no longer needed are removed from the site.

2. The discharger shall certify that final stabilization conditions are satisfied in their NOT. Failure to certify shall result in continuation of permit coverage and annual billing.

3. The NOT must demonstrate through photos, RUSLE or RUSLE2, or results of testing and analysis that the site meets all of the conditions above (Section II.D.1) and the final stabilization condition (Section II.D.1.a) is attained by one of the following methods:

   a. "70% final cover method," no computational proof required

      OR:

   b. "RUSLE or RUSLE2 method," computational proof required

      OR:

   c. "Custom method", the discharger shall demonstrate in some other manner than a or b, above, that the site complies with the "final stabilization" requirement in Section II.D.1.a.

III. DISCHARGE PROHIBITIONS

A. Dischargers shall not violate any discharge prohibitions contained in applicable Basin Plans or statewide water quality control plans. Waste discharges to Areas of Special Biological Significance (ASBS) are prohibited by the California Ocean Plan, unless granted an exception issued by the State Water Board.

B. All discharges are prohibited except for the storm water and non-storm water discharges specifically authorized by this General Permit or another NPDES permit.

C. Authorized non-storm water discharges may include those from de-chlorinated potable water sources such as: fire hydrant flushing, irrigation of vegetative erosion control measures, pipe flushing and testing, water to control dust, uncontaminated ground water from dewatering, and other discharges not subject to a separate general NPDES permit adopted by a Regional Water Board. The discharge of non-storm water is authorized under the following conditions:

1. The discharge does not cause or contribute to a violation of any water quality standard;

2. The discharge does not violate any other provision of this General Permit;

3. The discharge is not prohibited by the applicable Basin Plan;

4. The discharger has included and implemented specific BMPs required by this General Permit to prevent or reduce the contact of the non-storm water discharge with construction materials or equipment.

5. The discharge does not contain toxic constituents in toxic amounts or (other) significant quantities of pollutants;

6. The discharge is monitored and meets the applicable NALs and NELs; and

7. The discharger reports the sampling information in the Annual Report.

If any of the above conditions are not satisfied, the discharge is not authorized by this General Permit. The discharger shall notify the Regional Water Board of any anticipated non-storm water discharges not already authorized by this General Permit or another NPDES permit, to determine whether a separate NPDES permit is necessary.

D. Debris resulting from construction activities are prohibited from being discharged from construction sites.

E. When soil contamination is found or suspected and a responsible party is not identified, or the responsible party fails to promptly take the appropriate action, the discharger shall have those soils sampled and tested to ensure proper handling and public safety measures are implemented. The discharger shall notify the appropriate local, State, and federal agency(ies) when contaminated soil is found at a construction site, and will notify the appropriate Regional Water Board.

IV. SPECIAL PROVISIONS

A. Duty to Comply

1. The discharger shall comply with all of the conditions of this General Permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action and/or removal from General Permit coverage.

2. The discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not yet been modified to incorporate the requirement.

B. General Permit Actions

1. This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the discharger for a General Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not annul any General Permit condition.

2. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the dischargers so notified.

C. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this General Permit.

D. Duty to Mitigate

The discharger shall take all responsible steps to minimize or prevent any discharge in violation of this General Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance

The discharger shall at all times properly operate and maintain any facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of this General Permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance may require the operation of backup or auxiliary facilities or similar systems installed by a discharger when necessary to achieve compliance with the conditions of this General Permit.

F. Property Rights

This General Permit does not convey any property rights of any sort or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor does it authorize any infringement of Federal, State, or local laws or regulations.

G. Duty to Maintain Records and Provide Information

1. The discharger shall maintain a paper or electronic copy of all required records, including a copy of this General Permit, for three years from the date generated or date submitted, whichever is last. These records shall be available at the construction site until construction is completed.

2. The discharger shall furnish the Regional Water Board, State Water Board, or U.S. EPA, within a reasonable time, any requested information to determine compliance with this General Permit. The discharger shall also furnish, upon request, copies of records that are required to be kept by this General Permit.

H. Inspection and Entry

The discharger shall allow the Regional Water Board, State Water Board, U.S. EPA, and/or, in the case of construction sites which discharge through a municipal separate storm sewer, an authorized representative of the municipal operator of the separate storm sewer system receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the discharger's premises at reasonable times where a regulated construction activity is being conducted or where records must be kept under the conditions of this General Permit;

2. Access and copy at reasonable times any records that must be kept under the conditions of this General Permit;

3. Inspect at reasonable times the complete construction site, including any off-site staging areas or material storage areas, and the erosion/sediment controls; and

4. Sample or monitor at reasonable times for the purpose of ensuring General Permit compliance.

I. Electronic Signature and Certification Requirements

1. All Permit Registration Documents (PRDs) and Notice of Terminations (NOTs) shall be electronically signed, certified, and submitted via SMARTS to the State Water Board. Either the Legally Responsible Person (LRP) or a person legally authorized to sign and certify PRDs and NOTs on behalf of the LRP (the LRP's Approved Signatory) must submit all information electronically via SMARTS.

   a. The LRP's Approved Signatory must be one of the following:

      i. For a corporation: a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (a) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or (b) the manager of the facility if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

      ii. For a partnership or sole proprietorship: a general partner or the proprietor, respectively;

      iii. For a municipality, State, Federal, or other public agency: either a principal executive officer or ranking elected official. The principal executive officer of a Federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA);

      iv. For the military: Any military officer who has been designated.

      v. For a public university: An authorized university official

b. Changes to Authorization. If an approved signatory's authorization is no longer accurate, a new authorization satisfying the requirements of paragraph (a) of this section must be submitted via SMARTS prior to or together with any reports, information or applications to be signed by an approved signatory.

2. All Annual Reports, or other information required by the General Permit (other than PRDs and NOTs) or requested by the Regional Water Board, State Water Board, U.S. EPA, or local storm water management agency shall be certified and submitted by the LRP or the LRP's approved signatory as described above.

J. Certification

Any person signing documents under Section IV.I above, shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

K. Anticipated Noncompliance

The discharger shall give advance notice to the Regional Water Board and local storm water management agency of any planned changes in the construction activity, which may result in noncompliance with General Permit requirements.

L. Bypass

Bypass[8] is prohibited. The Regional Water Board may take enforcement action against the discharger for bypass unless:

1. Bypass was unavoidable to prevent loss of life, personal injury or severe property damage;[9]

[8] The intentional diversion of waste streams from any portion of a treatment facility

[9] Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

2. There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that could occur during normal periods of equipment downtime or preventative maintenance;

3. The discharger submitted a notice at least ten days in advance of the need for a bypass to the Regional Water Board; or

4. The discharger may allow a bypass to occur that does not cause effluent limitations to be exceeded, but only if it is for essential maintenance to assure efficient operation. In such a case, the above bypass conditions are not applicable. The discharger shall submit notice of an unanticipated bypass as required.

M. Upset

1. A discharger that wishes to establish the affirmative defense of an upset[10] in an action brought for noncompliance shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the discharger can identify the cause(s) of the upset

   b. The treatment facility was being properly operated by the time of the upset

   c. The discharger submitted notice of the upset as required; and

   d. The discharger complied with any remedial measures required

2. No determination made before an action of noncompliance occurs, such as during administrative review of claims that noncompliance was caused by an upset, is final administrative action subject to judicial review.

3. In any enforcement proceeding, the discharger seeking to establish the occurrence of an upset has the burden of proof

[10] An exceptional incident in which there is unintentional and temporary noncompliance the technology based numeric effluent limitations because of factors beyond the reasonable control of the discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

N. Penalties for Falsification of Reports

Section 309(c)(4) of the CWA provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit, including reports of compliance or noncompliance shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years or by both.

O. Oil and Hazardous Substance Liability

Nothing in this General Permit shall be construed to preclude the institution of any legal action or relieve the discharger from any responsibilities, liabilities, or penalties to which the discharger is or may be subject to under Section 311 of the CWA.

P. Severability

The provisions of this General Permit are severable; and, if any provision of this General Permit or the application of any provision of this General Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

Q. Reopener Clause

This General Permit may be modified, revoked and reissued, or terminated for cause due to promulgation of amended regulations, receipt of U.S. EPA guidance concerning regulated activities, judicial decision, or in accordance with 40 Code of Federal Regulations (CFR) 122.62, 122.63, 122.64, and 124.5.

R. Penalties for Violations of Permit Conditions

1. Section 309 of the CWA provides significant penalties for any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the CWA or any permit condition or limitation implementing any such section in a permit issued under Section 402. Any person who violates any permit condition of this General Permit is subject to a civil penalty not to exceed $37,500[11] per calendar day of such violation, as well as any other appropriate sanction provided by Section 309 of the CWA.

[11] May be further adjusted in accordance with the Federal Civil Penalties Inflation Adjustment Act.

2. The Porter-Cologne Water Quality Control Act also provides for civil and criminal penalties, which in some cases are greater than those under the CWA.

S. Transfers

This General Permit is not transferable.

T. Continuation of Expired Permit

This General Permit continues in force and effect until a new General Permit is issued or the SWRCB rescinds this General Permit. Only those dischargers authorized to discharge under the expiring General Permit are covered by the continued General Permit.

V. EFFLUENT STANDARDS

A. Narrative Effluent Limitations

1. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

2. Dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

B. Numeric Effluent Limitations (NELs)

Table 1- Numeric Effluent Limitations, Numeric Action Levels, Test Methods, Detection Limits, and Reporting Units

Parameter	Test Method	Discharge Type	Min. Detection Limit	Units	Numeric Action Level	Numeric Effluent Limitation
pH	Field test with calibrated portable instrument	Risk Level 2	0.2	pH units	lower NAL = 6.5 upper NAL = 8.5	N/A
		Risk Level 3			lower NAL = 6.5 upper NAL = 8.5	lower NEL = 6.0 upper NEL = 9.0
Turbidity	EPA 0180.1 and/or field test with calibrated portable instrument	Risk Level 2	1	NTU	250 NTU	N/A
		Risk Level 3			250 NTU	500 NTU

1. Numeric Effluent Limitations (NELs):

   a. **Storm Event, Daily Average pH Limits –** For Risk Level 3 dischargers, the pH of storm water and non-storm water discharges

shall be within the ranges specified in Table 1 during any site phase where there is a "high risk of pH discharge."[12]

b. **Storm Event Daily Average Turbidity Limit –** For Risk Level 3 dischargers, the turbidity of storm water and non-storm water discharges shall not exceed 500 NTU.

2. If daily average sampling results are outside the range of pH NELs (i.e., is below the lower NEL for pH or exceeds the upper NEL for pH) or exceeds the turbidity NEL (as listed in Table 1), the discharger is in violation of this General Permit and shall electronically file monitoring results in violation within 5 business days of obtaining the results.

3. **Compliance Storm Event**:

   Discharges of storm water from Risk Level 3 sites shall comply with applicable NELs (above) unless the storm event causing the discharges is determined after the fact to be equal to or larger than the Compliance Storm Event (expressed in inches of rainfall). The Compliance Storm Event for Risk Level 3 discharges is the 5 year, 24 hour storm (expressed in tenths of an inch of rainfall), as determined by using these maps:

   http://www.wrcc.dri.edu/pcpnfreq/nca5y24.gif
   http://www.wrcc.dri.edu/pcpnfreq/sca5y24.gif

   Compliance storm event verification shall be done by reporting on-site rain gauge readings as well as nearby governmental rain gauge readings.

4. Dischargers shall not be required to comply with NELs if the site receives run-on from a forest fire or any other natural disaster.

C. Numeric Action Levels (NALs)

1. For Risk Level 2 and 3 dischargers, the lower storm event average NAL for pH is 6.5 pH units and the upper storm event average NAL for pH is 8.5 pH units. The discharger shall take actions as described below if the discharge is outside of this range of pH values.

[12] A period of high risk of pH discharge is defined as a project's complete utilities phase, complete vertical build phase, and any portion of any phase where significant amounts of materials are placed directly on the land at the site in a manner that could result in significant alterations of the background pH of the discharges.

2. For Risk Level 2 and 3 dischargers, the NAL storm event daily average for turbidity is 250 NTU. The discharger shall take actions as described below if the discharge is outside of this range of turbidity values.

3. Whenever the results from a storm event daily average indicate that the discharge is below the lower NAL for pH, exceeds the upper NAL for pH, or exceeds the turbidity NAL (as listed in Table 1), the discharger shall conduct a construction site and run-on evaluation to determine whether pollutant source(s) associated with the site's construction activity may have caused or contributed to the NAL exceedance and shall immediately implement corrective actions if they are needed.

4. The site evaluation shall be documented in the SWPPP and specifically address whether the source(s) of the pollutants causing the exceedance of the NAL:

    a. Are related to the construction activities and whether additional BMPs are required to (1) meet BAT/BCT requirements; (2) reduce or prevent pollutants in storm water discharges from causing exceedances of receiving water objectives; and (3) determine what corrective action(s) were taken or will be taken and with a description of the schedule for completion.

        AND/OR:

    b. Are related to the run-on associated with the construction site location and whether additional BMPs measures are required to (1) meet BAT/BCT requirements; (2) reduce or prevent pollutants in storm water discharges from causing exceedances of receiving water objectives; and (3) what corrective action(s) were taken or will be taken with a description of the schedule for completion.

VI. RECEIVING WATER LIMITATIONS

A. The discharger shall ensure that storm water discharges and authorized non-storm water discharges to any surface or ground water will not adversely affect human health or the environment.

B. The discharger shall ensure that storm water discharges and authorized non-storm water discharges will not contain pollutants in quantities that threaten to cause pollution or a public nuisance.

C. The discharger shall ensure that storm water discharges and authorized non-storm water discharges will not contain pollutants that cause or contribute to an exceedance of any applicable water quality objectives or water quality standards (collectively, WQS) contained in a Statewide Water Quality Control Plan, the California Toxics Rule, the National Toxics Rule, or the applicable Regional Water Board's Water Quality Control Plan (Basin Plan).

D. Dischargers located within the watershed of a CWA § 303(d) impaired water body, for which a TMDL has been approved by the U.S. EPA, shall comply with the approved TMDL if it identifies "construction activity" or land disturbance as a source of the pollution.

VII. TRAINING QUALIFICATIONS AND CERTIFICATION REQUIREMENTS

A. General

The discharger shall ensure that all persons responsible for implementing requirements of this General Permit shall be appropriately trained in accordance with this Section. Training should be both formal and informal, occur on an ongoing basis, and should include training offered by recognized governmental agencies or professional organizations. Those responsible for preparing and amending SWPPPs shall comply with the requirements in this Section VII.

The discharger shall provide documentation of all training for persons responsible for implementing the requirements of this General Permit in the Annual Reports.

B. SWPPP Certification Requirements

1. **Qualified SWPPP Developer:** The discharger shall ensure that SWPPPs are written, amended and certified by a Qualified SWPPP Developer (QSD). A QSD shall have one of the following registrations or certifications, and appropriate experience, as required for:

   a. A California registered professional civil engineer;

   b. A California registered professional geologist or engineering geologist;

   c. A California registered landscape architect;

   d. A professional hydrologist registered through the American Institute of Hydrology;

   e. A Certified Professional in Erosion and Sediment Control (CPESC) ™ registered through Enviro Cert International, Inc.;

   f. A Certified Professional in Storm Water Quality (CPSWQ) ™ registered through Enviro Cert International, Inc.; or

   g. A professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET);

Effective two years after the adoption date of this General Permit, a QSD shall have attended a State Water Board-sponsored or approved QSD training course.

2. The discharger shall list the name and telephone number of the currently designated Qualified SWPPP Developer(s) in the SWPPP.

3. **Qualified SWPPP Practitioner:** The discharger shall ensure that all BMPs required by this General Permit are implemented by a Qualified SWPPP Practitioner (QSP). A QSP is a person responsible for non-storm water and storm water visual observations, sampling and analysis. Effective two years from the date of adoption of this General Permit, a QSP shall be either a QSD or have one of the following certifications:

   a. A certified erosion, sediment and storm water inspector registered through Enviro Cert International, Inc.; or

   b. A certified inspector of sediment and erosion control registered through Certified Inspector of Sediment and Erosion Control, Inc.

   Effective two years after the adoption date of this General Permit, a QSP shall have attended a State Water Board-sponsored or approved QSP training course.

4. The LRP shall list in the SWPPP, the name of any Approved Signatory, and provide a copy of the written agreement or other mechanism that provides this authority from the LRP in the SWPPP.

5. The discharger shall include, in the SWPPP, a list of names of all contractors, subcontractors, and individuals who will be directed by the Qualified SWPPP Practitioner. This list shall include telephone numbers and work addresses. Specific areas of responsibility of each subcontractor and emergency contact numbers shall also be included.

6. The discharger shall ensure that the SWPPP and each amendment will be signed by the Qualified SWPPP Developer. The discharger shall include a listing of the date of initial preparation and the date of each amendment in the SWPPP.

VIII. RISK DETERMINATION

The discharger shall calculate the site's sediment risk and receiving water risk during periods of soil exposure (i.e. grading and site stabilization) and use the calculated risks to determine a Risk Level(s) using the methodology in

Appendix 1. For any site that spans two or more planning watersheds,[13] the discharger shall calculate a separate Risk Level for each planning watershed. The discharger shall notify the State Water Board of the site's Risk Level determination(s) and shall include this determination as a part of submitting the PRDs. If a discharger ends up with more than one Risk Level determination, the Regional Water Board may choose to break the project into separate levels of implementation.

IX. RISK LEVEL 1 REQUIREMENTS

Risk Level 1 Dischargers shall comply with the requirements included in Attachment C of this General Permit.

X. RISK LEVEL 2 REQUIREMENTS

Risk Level 2 Dischargers shall comply with the requirements included in Attachment D of this General Permit.

XI. RISK LEVEL 3 REQUIREMENTS

Risk Level 3 Dischargers shall comply with the requirements included in Attachment E of this General Permit.

XII. ACTIVE TREATMENT SYSTEMS (ATS)

Dischargers choosing to implement an ATS on their site shall comply with all of the requirements in Attachment F of this General Permit.

[13] Planning watershed: defined by the Calwater Watershed documents as a watershed that ranges in size from approximately 3,000 to 10,000 acres http://cain.ice.ucdavis.edu/calwater/calwfaq.html, http://gis.ca.gov/catalog/BrowseRecord.epl?id=22175 .

XIII. POST-CONSTRUCTION STANDARDS

A. All dischargers shall comply with the following runoff reduction requirements unless they are located within an area subject to post-construction standards of an active Phase I or II municipal separate storm sewer system (MS4) permit that has an approved Storm Water Management Plan.

1. This provision shall take effect three years from the adoption date of this permit, or later at the discretion of the Executive Officer of the Regional Board.

2. The discharger shall demonstrate compliance with the requirements of this section by submitting with their NOI a map and worksheets in accordance with the instructions in Appendix 2. The discharger shall use non-structural controls unless the discharger demonstrates that non-structural controls are infeasible or that structural controls will produce greater reduction in water quality impacts.

3. The discharger shall, through the use of non-structural and structural measures as described in Appendix 2, replicate the pre-project water balance (for this permit, defined as the volume of rainfall that ends up as runoff) for the smallest storms up to the 85th percentile storm event (or the smallest storm event that generates runoff, whichever is larger). Dischargers shall inform Regional Water Board staff at least 30 days prior to the use of any structural control measure used to comply with this requirement. Volume that cannot be addressed using non-structural practices shall be captured in structural practices and approved by the Regional Water Board. When seeking Regional Board approval for the use of structural practices, dischargers shall document the infeasibility of using non-structural practices on the project site, or document that there will be fewer water quality impacts through the use of structural practices.

4. For sites whose disturbed area exceeds two acres, the discharger shall preserve the pre-construction drainage density (miles of stream length per square mile of drainage area) for all drainage areas within the area serving a first order stream[14] or larger stream and ensure that post-project time of runoff concentration is equal or greater than pre-project time of concentration.

[14] A first order stream is defined as a stream with no tributaries.

B. All dischargers shall implement BMPs to reduce pollutants in storm water discharges that are reasonably foreseeable after all construction phases have been completed at the site (Post-construction BMPs).

XIV. SWPPP REQUIREMENTS

A. The discharger shall ensure that the Storm Water Pollution Prevention Plans (SWPPPs) for all traditional project sites are developed and amended or revised by a QSD. The SWPPP shall be designed to address the following objectives:

1. All pollutants and their sources, including sources of sediment associated with construction, construction site erosion and all other activities associated with construction activity are controlled;

2. Where not otherwise required to be under a Regional Water Board permit, all non-storm water discharges are identified and either eliminated, controlled, or treated;

3. Site BMPs are effective and result in the reduction or elimination of pollutants in storm water discharges and authorized non-storm water discharges from construction activity to the BAT/BCT standard;

4. Calculations and design details as well as BMP controls for site run-on are complete and correct, and

5. Stabilization BMPs installed to reduce or eliminate pollutants after construction are completed.

B. To demonstrate compliance with requirements of this General Permit, the QSD shall include information in the SWPPP that supports the conclusions, selections, use, and maintenance of BMPs.

C. The discharger shall make the SWPPP available at the construction site during working hours while construction is occurring and shall be made available upon request by a State or Municipal inspector. When the original SWPPP is retained by a crewmember in a construction vehicle and is not currently at the construction site, current copies of the BMPs and map/drawing will be left with the field crew and the original SWPPP shall be made available via a request by radio/telephone.

XV. REGIONAL WATER BOARD AUTHORITIES

A. In the case where the Regional Water Board does not agree with the discharger's self-reported risk level (e.g., they determine themselves to be a Level 1 Risk when they are actually a Level 2 Risk site), Regional Water Boards may either direct the discharger to reevaluate the Risk Level(s) for their site or terminate coverage under this General Permit.

B. Regional Water Boards may terminate coverage under this General Permit for dischargers who fail to comply with its requirements or where they determine that an individual NPDES permit is appropriate.

C. Regional Water Boards may require dischargers to submit a Report of Waste Discharge / NPDES permit application for Regional Water Board consideration of individual requirements.

D. Regional Water Boards may require additional Monitoring and Reporting Program Requirements, including sampling and analysis of discharges to sediment-impaired water bodies.

E. Regional Water Boards may require dischargers to retain records for more than the three years required by this General Permit.

XVI. ANNUAL REPORTING REQUIREMENTS

A. All dischargers shall prepare and electronically submit an Annual Report no later than September 1 of each year.

B. The discharger shall certify each Annual Report in accordance with the Special Provisions.

C. The discharger shall retain an electronic or paper copy of each Annual Report for a minimum of three years after the date the annual report is filed.

D. The discharger shall include storm water monitoring information in the Annual Report consisting of:

1. a summary and evaluation of all sampling and analysis results, including copies of laboratory reports;

2. the analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit");

3. a summary of all corrective actions taken during the compliance year;

4. identification of any compliance activities or corrective actions that were not implemented;

5. a summary of all violations of the General Permit;

6. the names of individual(s) who performed the facility inspections, sampling, visual observation (inspections), and/or measurements;

7. the date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation (rain gauge); and

8. the visual observation and sample collection exception records and reports specified in Attachments C, D, and E.

E. The discharger shall provide training information in the Annual Report consisting of:

1. documentation of all training for individuals responsible for all activities associated with compliance with this General Permit;

2. documentation of all training for individuals responsible for BMP installation, inspection, maintenance, and repair; and

3. documentation of all training for individuals responsible for overseeing, revising, and amending the SWPPP.

ATTACHMENT A
Linear Underground/ Overhead Requirements

A. DEFINITION OF LINEAR UNDERGROUND/OVERHEAD PROJECTS 1
B. LINEAR PROJECT PERMIT REGISTRATION DOCUMENTS (PRDs) 3
C. LINEAR PROJECT TERMINATION OF COVERAGE REQUIREMENTS ..4
D. DISCHARGE PROHIBITIONS 6
E. SPECIAL PROVISIONS.....8
F. EFFLUENT STANDARDS.....13
G. RECEIVING WATER LIMITATIONS 16
H. TRAINING QUALIFICATIONS 17
I. TYPES OF LINEAR PROJECTS 19
J. LUP TYPE-SPECIFIC REQUIREMENTS 20
K. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS 28
L. REGIONAL WATER BOARD AUTHORITIES 29
M. MONITORING AND REPORTING REQUIREMENTS 31

All Linear Underground/Overhead project dischargers who submit permit registration documents (PRDs) indicating their intention to be regulated under the provisions of this General Permit shall comply with the following:

A. DEFINITION OF LINEAR UNDERGROUND/OVERHEAD PROJECTS

1. Linear Underground/Overhead Projects (LUPs) include, but are not limited to, any conveyance, pipe, or pipeline for the transportation of any gaseous, liquid (including water and wastewater for domestic municipal services), liquiescent, or slurry substance; any cable line or wire for the transmission of electrical energy; any cable line or wire for communications (e.g., telephone, telegraph, radio, or television messages); and associated ancillary facilities. Construction activities associated with LUPs include, but are not limited to, (a) those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment, and associated ancillary facilities); and include, but are not limited to, (b) underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/ or pavement repair or replacement, and stockpile/borrow locations.

2. LUP evaluation shall consist of two tasks:

a. Confirm that the project or project section(s) qualifies as an LUP. The State Water Board website contains a project determination guidance flowchart. http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

b. Identify which Type(s) (1, 2 or 3 described in Section I below) are applicable to the project or project sections based on project sediment and receiving water risk. (See Attachment A.1)

3. A Legally Responsible Person (LRP) for a Linear Underground/Overhead project is required to obtain CGP coverage under one or more permit registration document (PRD) electronic submittals to the State Water Board's Storm Water Multi-Application and Report Tracking (SMARTs) system. Attachment A.1 contains a flow chart to be used when determining if a linear project qualifies for coverage and to determine LUP Types. Since a LUP may be constructed within both developed and undeveloped locations and portions of LUPs may be constructed by different contractors, LUPs may be broken into logical permit sections. Sections may be determined based on portions of a project conducted by one contractor. Other situations may also occur, such as the time period in which the sections of a project will be constructed (e.g. project phases), for which separate permit coverage is possible. For projects that are broken into separate sections, a description of how each section relates to the overall project and the definition of the boundaries between sections shall be clearly stated.

4. Where construction activities transverse or enter into different Regional Water Board jurisdictions, LRPs shall obtain permit coverage for each Regional Water Board area involved prior to the commencement of construction activities.

5. Small Construction Rainfall Erosivity Waiver

EPA's Small Construction Erosivity Waiver applies to sites between one and five acres demonstrating that there are no adverse water quality impacts.

Dischargers eligible for a Rainfall Erosivity Waiver based on low erosivity potential shall complete the electronic Notice of Intent (NOI) and Sediment Risk form through the State Water Board's SMARTS system, certifying that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five. Where the LRP changes or another LRP is added during construction, the new LRP must also submit a waiver certification through the SMARTS system.

If a small linear construction site continues beyond the projected completion date given on the waiver certification, the LRP shall recalculate the rainfall erosivity factor for the new project duration and submit this information through the SMARTS system. If the new R factor is below five (5), the discharger shall update through SMARTS all applicable information on the waiver certification and retain a copy of the revised waiver onsite. The LRP shall submit the new waiver certification 30 days prior to the projected completion date listed on the original waiver form to assure exemption from permitting requirements is uninterrupted. If the new R factor is five (5) or above, the LRP shall be required to apply for coverage under this Order.

B. LINEAR PROJECT PERMIT REGISTRATION DOCUMENTS (PRDs)

Any information provided to the Regional Water Board shall comply with the Homeland Security Act and any other federal law that concerns security in the United States; any information that does not comply should not be submitted. PRDs shall consist of the following:

1. Notice of Intent (NOI)

Prior to construction activities, the LRP of a proposed linear underground/overhead project shall utilize the processes and methods provided in Attachment A.2, Permit Registration Documents (PRDs) – General Instructions for Linear Underground/Overhead Projects to comply with the Construction General Permit.

2. Site Maps

LRPs submitting PRDs shall include at least 3 maps. The first map will be a zoomed[1] 1000-1500 ft vicinity map that shows the starting point of the project. The second will be a zoomed map of 1000-1500 ft showing the ending location of the project. The third will be a larger view vicinity map, 1000 ft to 2000 ft, displaying the entire project location depending on the project size, and indicating the LUP type (1, 2 or 3) areas within the total project footprint.

3. Drawings

LRPs submitting PRDs shall include a construction drawing(s) or other appropriate drawing(s) or map(s) that shows the locations of storm drain

[1] An image with a close-up/enhanced detailed view of site features that show minute details such as streets and neighboring structures.
Or: An image with a close-up/enhanced detailed view of the site's surrounding infrastructure.
Or: An image with a close up detailed view of the project and its surroundings.

inlets and waterbodies[2] that may receive discharges from the construction activities and that shows the locations of BMPs to be installed for all those BMPs that can be illustrated on the revisable drawing(s) or map(s). If storm drain inlets, waterbodies, and/or BMPs cannot be adequately shown on the drawing(s) or map(s) they should be described in detail within the SWPPP.

4. Storm Water Pollution Prevention Plan (SWPPP)

LUP dischargers shall comply with the SWPPP Preparation, Implementation, and Oversight requirements in Section K of this Attachment.

5. Contact information

LUP dischargers shall include contact information for all contractors (or subcontractors) responsible for each area of an LUP project. This should include the names, telephone numbers, and addresses of contact personnel. Specific areas of responsibility of each contact, and emergency contact numbers should also be included.

6. In the case of a public emergency that requires immediate construction activities, a discharger shall submit a brief description of the emergency construction activity within five days of the onset of construction, and then shall submit all PRDs within thirty days.

C. LINEAR PROJECT TERMINATION OF COVERAGE REQUIREMENTS

The LRP may terminate coverage of an LUP when construction activities are completed by submitting an electronic notice of termination (NOT) through the State Water Board's SMARTS system. Termination requirements are different depending on the complexity of the LUP. An LUP is considered complete when: (a) there is no potential for construction-related storm water pollution; (b) all elements of the SWPPP have been completed; (c) construction materials and waste have been disposed of properly; (d) the site is in compliance with all local storm water management requirements; and (e) the LRP submits a notice of termination (NOT) and has received approval for termination from the appropriate Regional Water Board office.

1. LUP Stabilization Requirements

The LUP discharger shall ensure that all disturbed areas of the construction site are stabilized prior to termination of coverage under this General Permit. Final stabilization for the purposes of submitting an NOT

[2] Includes basin(s) that the MS4 storm sewer systems may drain to for Hydromodification or Hydrological Conditional of Concerns under the MS4 permits.

is satisfied when all soil disturbing activities are completed and one of the following criteria is met:

a. In disturbed areas that were vegetated prior to construction activities of the LUP, the area disturbed must be re-established to a uniform vegetative cover equivalent to 70 percent coverage of the preconstruction vegetative conditions. Where preconstruction vegetation covers less than 100 percent of the surface, such as in arid areas, the 70 percent coverage criteria is adjusted as follows: if the preconstruction vegetation covers 50 percent of the ground surface, 70 percent of 50 percent (.70 X .50=.35) would require 35 percent total uniform surface coverage; or

b. Where no vegetation is present prior to construction, the site is returned to its original line and grade and/or compacted to achieve stabilization; or

c. Equiva lent stabilization measures have been employed. These measures include, but are not limited to, the use of such BMPs as blankets, reinforced channel liners, soil cement, fiber matrices, geotextiles, or other erosion resistant soil coverings or treatments.

2. LUP Termination of Coverage Requirements

The LRP shall file an NOT through the State Water Board's SMARTS system. By submitting an NOT, the LRP is certifying that construction activities for an LUP are complete and that the project is in full compliance with requirements of this General Permit and that it is now compliant with soil stabilization requirements where appropriate. Upon approval by the appropriate Regional Water Board office, permit coverage will be terminated.

3. Revising Coverage for Change of Acreage

When the LRP of a portion of an LUP construction project changes, or when a phase within a multi-phase project is completed, the LRP may reduce the total acreage covered by this General Permit. In reducing the acreage covered by this General Permit, the LRP shall electronically file revisions to the PRDs that include:

a. a revised NOI indicating the new project size;

b. a revised site map showing the acreage of the project completed, acreage currently under construction, acreage sold, transferred or added, and acreage currently stabilized.

c. SWPPP revisions, as appropriate; and

d. certification that any new LRPs have been notified of applicable requirements to obtain General Permit coverage. The certification shall include the name, address, telephone number, and e-mail address (if known) of the new LRP.

If the project acreage has increased, dischargers shall mail payment of revised annual fees within 14 days of receiving the revised annual fee notification.

D. DISCHARGE PROHIBITIONS

1. LUP dischargers shall not violate any discharge prohibitions contained in applicable Basin Plans or statewide water quality control plans. Waste discharges to Areas of Special Biological Significance (ASBS) are prohibited by the California Ocean Plan, unless granted an exception issued by the State Water Board.

2. LUP dischargers are prohibited from discharging non-storm water that is not otherwise authorized by this General Permit. Non-storm water discharges authorized by this General Permit[3] may include, fire hydrant flushing, irrigation of vegetative erosion control measures, pipe flushing and testing, water to control dust, street cleaning, dewatering,[4] uncontaminated groundwater from dewatering, and other discharges not subject to a separate general NPDES permit adopted by a Regional Water Board. Such discharges are allowed by this General Permit provided they are not relied upon to clean up failed or inadequate construction or post-construction BMPs designed to keep materials on site. These authorized non-storm water discharges:

[3] Dischargers must identify all authorized non-storm water discharges in the LUP's SWPPP and identify BMPs that will be implemented to either eliminate or reduce pollutants in non-storm water discharges. Regional Water Boards may direct the discharger to discontinue discharging such non-storm water discharges if determined that such discharges discharge significant pollutants or threaten water quality.
[4] Dewatering activities may be prohibited or need coverage under a separate permit issued by the Regional Water Boards. Dischargers shall check with the appropriate Regional Water Boards for any required permit or basin plan conditions prior to initial dewatering activities to land, storm drains, or waterbodies.

a. Shall not cause or contribute to a violation of any water quality standard;

b. Shall not violate any other provision of this General Permit;

c. Shall not violate any applicable Basin Plan;

d. Shall comply with BMPs as described in the SWPPP;

e. Shall not contain toxic constituents in toxic amounts or (other) significant quantities of pollutants;

f. Shall be monitored and meets the applicable NALs and NELs; and

g. Shall be reported by the discharger in the Annual Report.

If any of the above conditions are not satisfied, the discharge is not authorized by this General Permit. The discharger shall notify the Regional Water Board of any anticipated non-storm water discharges not authorized by this General Permit to determine the need for a separate NPDES permit.

Additionally, some LUP dischargers may be required to obtain a separate permit if the applicable Regional Water Board has adopted a General Permit for dewatering discharges. Wherever feasible, alternatives, that do not result in the discharge of non-storm water, shall be implemented in accordance with this Attachment's Section K.2 - SWPPP Implementation Schedule.

3. LUP dischargers shall ensure that trench spoils or any other soils disturbed during construction activities that are contaminated[5] are not discharged with storm water or non-storm water discharges into any storm drain or water body except pursuant to an NPDES permit.

When soil contamination is found or suspected and a responsible party is not identified, or the responsible party fails to promptly take the appropriate action, the LUP discharger shall have those soils sampled and tested to ensure that proper handling and public safety measures are

[5] Contaminated soil contains pollutants in concentrations that exceed the appropriate thresholds that various regulatory agencies set for those substances. Preliminary testing of potentially contaminated soils will be based on odor, soil discoloration, or prior history of the site's chemical use and storage and other similar factors. When soil contamination is found or suspected and a responsible party is not identified, or the responsible party fails to promptly take the appropriate action, the discharger shall have those soils sampled and tested to ensure proper handling and public safety measures are implemented. The legally responsible person will notify the appropriate local, State, or federal agency(ies) when contaminated soil is found at a construction site, and will notify the Regional Water Board by submitting an NOT at the completion of the project.

implemented. The LUP discharger shall notify the appropriate local, State, and federal agency(ies) when contaminated soil is found at a construction site, and will notify the appropriate Regional Water Board.

4. Discharging any pollutant-laden water that will cause or contribute to an exceedance of the applicable Regional Water Board's Basin Plan from a dewatering site or sediment basin into any receiving water or storm drain is prohibited.

5. Debris[6] resulting from construction activities are prohibited from being discharged from construction project sites.

E. SPECIAL PROVISIONS

1. Duty to Comply

a. The LUP discharger must comply with all of the conditions of this General Permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action and/or removal from General Permit coverage.

b. The LUP discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not yet been modified to incorporate the requirement.

2. General Permit Actions

a. This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the discharger for a General Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not annul any General Permit condition.

[6] Litter, rubble, discarded refuse, and remains of something destroyed.

b. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the dischargers so notified.

3. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for an LUP discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this General Permit.

4. Duty to Mitigate

The LUP discharger shall take all responsible steps to minimize or prevent any discharge in violation of this General Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

5. Proper Operation and Maintenance

The LUP discharger shall at all times properly operate and maintain any facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of this General Permit and with the requirements of the Storm Water Pollution Prevention Plan (SWPPP). Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance may require the operation of backup or auxiliary facilities or similar systems installed by a discharger when necessary to achieve compliance with the conditions of this General Permit.

6. Property Rights

This General Permit does not convey any property rights of any sort or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor does it authorize any infringement of Federal, State, or local laws or regulations.

7. Duty to Maintain Records and Provide Information

a. The LUP discharger shall maintain a paper or electronic copy of all required records, including a copy of this General Permit, for three years from the date generated or date submitted, whichever is last. These records shall be kept at the construction site or in a crew

member's vehicle until construction is completed, and shall be made available upon request.

b. The LUP discharger shall furnish the Regional Water Board, State Water Board, or USEPA, within a reasonable time, any requested information to determine compliance with this General Permit. The LUP discharger shall also furnish, upon request, copies of records that are required to be kept by this General Permit.

8. Inspection and Entry

The LUP discharger shall allow the Regional Water Board, State Water Board, USEPA, and/or, in the case of construction sites which discharge through a municipal separate storm sewer, an authorized representative of the municipal operator of the separate storm sewer system receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the discharger's premises at reasonable times where a regulated construction activity is being conducted or where records must be kept under the conditions of this General Permit;

b. Access and copy at reasonable times any records that must be kept under the conditions of this General Permit;

c. Inspect at reasonable times the complete construction site, including any off-site staging areas or material storage areas, and the erosion/sediment controls; and

d. Sample or monitor at reasonable times for the purpose of ensuring General Permit compliance.

9. Electronic Signature and Certification Requirements

a. All Permit Registration Documents (PRDs) and Notices of Termination (NOTs) shall be electronically signed, certified, and submitted via SMARTS to the State Water Board. Either the Legally Responsible Person (LRP) or a person legally authorized to sign and certify PRDs and NOTs on behalf of the LRP (the LRP's Approved Signatory) must submit all information electronically via SMARTS. For Linear Underground/Overhead projects, the Legally Responsible Person is the person in charge of the utility company, municipality, or other public or private company or agency that owns or operates the LUP. The LRP's Approved Signatory must be one of the following:

i For a corporation: a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or

(2) the manager of the facility if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

ii For a partnership or sole proprietorship: a general partner or the proprietor, respectively; or

iii For a municipality, State, Federal, or other public agency: either a principal executive officer or ranking elected official. The principal executive officer of a Federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

b. Changes to Authorization. If an approved signatory's authorization is no longer accurate, a new authorization satisfying the requirements of paragraph (a) of this section must be submitted via SMARTS prior to or together with any reports, information or applications to be signed by an approved signatory.

c. All SWPPP revisions, annual reports, or other information required by the General Permit (other than PRDs and NOTs) or requested by the Regional Water Board, State Water Board, USEPA, or local storm water management agency shall be certified and submitted by the LRP or the LRP's approved signatory as described above.

10. Certification

Any person signing documents under Section E.9 above, shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Anticipated Noncompliance

The LUP discharger shall give advance notice to the Regional Water Board and local storm water management agency of any planned changes in the construction activity, which may result in noncompliance with General Permit requirements.

12. Penalties for Falsification of Reports

Section 309(c)(4) of the CWA provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit, including reports of compliance or noncompliance shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years or by both.

13. Oil and Hazardous Substance Liability

Nothing in this General Permit shall be construed to preclude the institution of any legal action or relieve the discharger from any responsibilities, liabilities, or penalties to which the LUP discharger is or may be subject to under Section 311 of the CWA.

14. Severability

The provisions of this General Permit are severable; and, if any provision of this General Permit or the application of any provision of this General Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

15. Reopener Clause

This General Permit may be modified, revoked and reissued, or terminated for cause due to promulgation of amended regulations, receipt of USEPA guidance concerning regulated activities, judicial decision, or in accordance with 40 Code of Federal Regulations (CFR) 122.62, 122.63, 122.64, and 124.5.

16. Penalties for Violations of Permit Conditions

a. Section 309 of the CWA provides significant penalties for any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the CWA or any permit condition or limitation implementing any such section in a permit issued under Section 402. Any person who violates any permit condition of this General Permit is

subject to a civil penalty not to exceed $37,500[7] per calendar day of such violation, as well as any other appropriate sanction provided by Section 309 of the CWA.

b. The Porter-Cologne Water Quality Control Act also provides for civil and criminal penalties, which in some cases are greater than those under the CWA.

17. Transfers

This General Permit is not transferable. A new LRP of an ongoing construction activity must submit PRDs in accordance with the requirements of this General Permit to be authorized to discharge under this General Permit. An LRP who is a property owner with active General Permit coverage who sells a fraction or all the land shall inform the new property owner(s) of the requirements of this General Permit.

18. Continuation of Expired Permit

This General Permit continues in force and effect until a new General Permit is issued or the SWRCB rescinds this General Permit. Only those dischargers authorized to discharge under the expiring General Permit are covered by the continued General Permit.

F. EFFLUENT STANDARDS

1. Narrative Effluent Limitations

a. LUP dischargers shall ensure that storm water discharges and authorized non-storm water discharges regulated by this General Permit do not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

b. LUP dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of structural or non-structural controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

[7] May be further adjusted in accordance with the Federal Civil Penalties Inflation Adjustment Act

2. Numeric Effluent Limitations (NELs)

Table 1. Numeric Effluent Limitations, Numeric Action Levels, Test Methods, Detection Limits, and Reporting Units

Parameter	Test Method	Discharge Type	Min. Detection Limit	Units	Numeric Action Level	Numeric Effluent Limitation
pH	Field test with calibrated portable instrument	LUP Type 2	0.2	pH units	lower NAL = 6.5 upper NAL = 8.5	N/A
		LUP Type 3			lower NAL = 6.5 upper NAL = 8.5	lower NEL = 6.0 upper NEL = 9.0
Turbidity	EPA 0180.1 and/or field test with calibrated portable instrument	LUP Type 2	1 NTU		250 NTU	N/A
		LUP Type 3			250 NTU	500 NTU

a. Numeric Effluent Limitations (NELs):

i **Storm Event, Daily Average pH Limits –** For LUP Type 3 dischargers, the daily average pH of storm water and non-storm water discharges shall be within the ranges specified in Table 1 during any project phase where there is a "high risk of pH discharge."[8]

ii **Storm Event Daily Average Turbidity Limit –** For LUP Type 3 dischargers, the daily average turbidity of storm water and non-storm water discharges shall not exceed 500 NTU.

[8] A period of high risk of pH discharge is defined as a project's complete utilities phase, complete vertical build phase, and any portion of any phase where significant amounts of materials are placed directly on the land at the site in a manner that could result in significant alterations of the background pH of the discharges.

b. If a daily average sample result is outside the range of pH NELs (i.e., is below the lower NEL for pH or exceeds the upper NEL for pH) or exceeds the turbidity NEL (as listed in Table 1), the discharger is in violation of this General Permit and shall electronically file the results in violation within 5 business days of obtaining the results.

c. Compliance Storm Event:

Discharges of storm water from LUP Type 3 sites shall comply with applicable NELs (above) unless the storm event causing the discharges is determined after the fact to be equal to or larger than the Compliance Storm Event (expressed in inches of rainfall). The Compliance Storm Event for LUP Type 3 discharges is the 5-year, 24-hour storm (expressed in tenths of an inch of rainfall), as determined by using these maps:

http://www.wrcc.dri.edu/pcpnfreq/nca5y24.gif
http://www.wrcc.dri.edu/pcpnfreq/sca5y24.gif

Compliance storm event verification shall be done by reporting on-site rain gauge readings as well as nearby governmental rain gauge readings.

d. Dischargers shall not be required to comply with NELs if the site receives run-on from a forest fire or any other natural disaster.

3. Numeric Action Levels (NALs)

a. For LUP Type 2 and 3 dischargers, the lower storm event daily average NAL for pH is 6.5 pH units and the upper storm event daily average NAL for pH is 8.5 pH units. The LUP discharger shall take actions as described below if the storm event daily average discharge is outside of this range of pH values.

b. For LUP Type 2 and 3 dischargers, the storm event daily average NAL for turbidity is 250 NTU. The discharger shall take actions as described below if the storm event daily average discharge is outside of this range of turbidity values.

c. Whenever daily average analytical effluent monitoring results indicate that the discharge is below the lower NAL for pH, exceeds the upper NAL for pH, or exceeds the turbidity NAL (as listed in Table 1), the LUP discharger shall conduct a construction site and run-on evaluation to determine whether pollutant source(s) associated with the site's construction activity may have caused or contributed to the NAL

exceedance and shall immediately implement corrective actions if they are needed.

d. The site evaluation will be documented in the SWPPP and specifically address whether the source(s) of the pollutants causing the exceedance of the NAL:

i Are related to the construction activities and whether additional BMPs or SWPPP implementation measures are required to (1) meet BAT/BCT requirements; (2) reduce or prevent pollutants in storm water discharges from causing exceedances of receiving water objectives; and (3) determine what corrective action(s) were taken or will be taken and with a description of the schedule for completion.

AND/OR:

ii Are related to the run-on associated with the construction site location and whether additional BMPs or SWPPP implementation measures are required to (1) meet BAT/BCT requirements; (2) reduce or prevent pollutants in storm water discharges from causing exceedances of receiving water objectives; and (3) decide what corrective action(s) were taken or will be taken, including a description of the schedule for completion.

G. RECEIVING WATER LIMITATIONS

1. LUP dischargers shall ensure that storm water discharges and authorized non-storm water discharges to any surface or ground water will not adversely affect human health or the environment.

2. LUP dischargers shall ensure that storm water discharges and authorized non-storm water discharges will not contain pollutants in quantities that threaten to cause pollution or a public nuisance.

3. LUP dischargers shall ensure that storm water discharges and authorized non-storm water discharges will not contain pollutants that cause or contribute to an exceedance of any applicable water quality objectives or water quality standards (collectively, WQS) contained in a Statewide Water Quality Control Plan, the California Toxics Rule, the National Toxics Rule, or the applicable Regional Water Board's Water Quality Control Plan (Basin Plan).

H. TRAINING QUALIFICATIONS

1. General

All persons responsible for implementing requirements of this General Permit shall be appropriately trained. Training should be both formal and informal, occur on an ongoing basis, and should include training offered by recognized governmental agencies or professional organizations. Persons responsible for preparing, amending and certifying SWPPPs shall comply with the requirements in this Section H.

2. SWPPP Certification Requirements

a. **Qualified SWPPP Developer:** The LUP discharger shall ensure that all SWPPPs be written, amended and certified by a Qualified SWPPP Developer (QSD). A QSD shall have one of the following registrations or certifications, and appropriate experience, as required for:

i A California registered professional civil engineer;

ii A California registered professional geologist or engineering geologist;

iii A California registered landscape architect;

iv A professional hydrologist registered through the American Institute of Hydrology;

v A certified professional in erosion and sediment control (CPESC) ™ registered through Enviro Cert International, Inc;

vi A certified professional in storm water quality (CPSWQ)™ registered through Enviro Cert International, Inc.; or

vii A certified professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET).

Effective two years after the adoption date of this General Permit, a QSD shall have attended a State Water Board-sponsored or approved QSD training course.

b. The LUP discharger shall ensure that the SWPPP is written and amended, as needed, to address the specific circumstances for each construction site covered by this General Permit prior to commencement of construction activity for any stage.

c. The LUP discharger shall list the name and telephone number of the currently designated Qualified SWPPP Developer(s) in the SWPPP.

d. **Qualified SWPPP Practitioner:** The LUP discharger shall ensure that all elements of any SWPPP for each project will be implemented by a Qualified SWPPP Practitioner (QSP). A QSP is a person responsible for non-storm water and storm water visual observations, sampling and analysis, and for ensuring full compliance with the permit and implementation of all elements of the SWPPP. Effective two years from the date of adoption of this General Permit, a QSP shall be either a QSD or have one of the following certifications:

   i A certified erosion, sediment and storm water inspector registered through Certified Professional in Erosion and Sediment Control, Inc.; or

   ii A certified inspector of sediment and erosion control registered through Certified Inspector of Sediment and Erosion Control, Inc.

   Effective two years after the adoption date of this General Permit, a QSP shall have attended a State Water Board-sponsored or approved QSP training course.

e. The LUP discharger shall ensure that the SWPPP include a list of names of all contractors, subcontractors, and individuals who will be directed by the Qualified SWPPP Practitioner, and who is ultimately responsible for implementation of the SWPPP. This list shall include telephone numbers and work addresses. Specific areas of responsibility of each subcontractor and emergency contact numbers shall also be included.

f. The LUP discharger shall ensure that the SWPPP and each amendment be signed by the Qualified SWPPP Developer. The LUP discharger shall include a listing of the date of initial preparation and the dates of each amendment in the SWPPP.

I. TYPES OF LINEAR PROJECTS

This attachment establishes three types (Type 1, 2 & 3) of complexity for areas within an LUP or project section based on threat to water quality. Project area Types are determined through Attachment A.1.

The Type 1 requirements below establish the baseline requirements for all LUPs subject to this General Permit. Additional requirements for Type 2 and Type 3 LUPs are labeled.

1. Type 1 LUPs*:*

LUP dischargers with areas of a LUP designated as Type 1 shall comply with the requirements in this Attachment. Type 1 LUPs are:

a. Those construction areas where 70 percent or more of the construction activity occurs on a paved surface and where areas disturbed during construction will be returned to preconstruction conditions or equivalent protection established at the end of the construction activities for the day; or

b. Where greater than 30 percent of construction activities occur within the non-paved shoulders or land immediately adjacent to paved surfaces, or where construction occurs on unpaved improved roads, including their shoulders or land immediately adjacent to them where:

   i Areas disturbed during construction will be returned to preconstruction conditions or equivalent protection is established at the end of the construction activities for the day to minimize the potential for erosion and sediment deposition, and

   ii Areas where established vegetation was disturbed during construction will be stabilized and re-vegetated by the end of project. When required, adequate temporary stabilization BMPs will be installed and maintained until vegetation is established to meet minimum cover requirements established in this General Permit for final stabilization.

c. Where the risk determination is as follows:

   i Low sediment risk, low receiving water risk, or

   ii Low sediment risk, medium receiving water risk, or

   iii Medium sediment risk, low receiving water risk

2. Type 2 LUPs:

Type 2 LUPs are determined by the Combined Risk Matrix in Attachment A.1. Type 2 LUPs have the specified combination of risk:

d. High sediment risk, low receiving water risk, or

e. Medium sediment risk, medium receiving water risk, or

f. Low sediment risk, high receiving water risk

Receiving water risk is either considered "Low" for those areas of the project that are not in close proximity to a sensitive receiving watershed, "Medium" for those areas of the project within a sensitive receiving watershed yet outside of the flood plain of a sensitive receiving water body, and "High" where the soil disturbance is within close proximity to a sensitive receiving water body. Project sediment risk is calculated based on the Risk Factor Worksheet in Attachment C of this General Permit.

3. Type 3 LUPs:

Type 3 LUPs are determined by the Combined Risk Matrix in Attachment A.1. Type 3 LUPs have the specified combination of risk:

a. High sediment risk, high receiving water risk, or

b. High sediment risk, medium receiving water risk, or

c. Medium sediment risk, high receiving water risk

Receiving water risk is either considered "Medium" for those areas of the project within a sensitive receiving watershed yet outside of the flood plain of a sensitive receiving water body, or "High" where the soil disturbance is within close proximity to a sensitive receiving water body. Project sediment risk is calculated based on the Risk Factor Worksheet in Attachment C.

J. LUP TYPE-SPECIFIC REQUIREMENTS

1. Effluent Standards

a. Narrative – LUP dischargers shall comply with the narrative effluent standards below.

i Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

ii LUP dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

b. Numeric – LUP Type 1 dischargers are not subject to a numeric effluent standard

c. Numeric –LUP Type 2 dischargers are subject to a pH NAL of 6.5-8.5, and a turbidity NAL of 250 NTU.

d. Numeric – LUP Type 3 dischargers are subject to a pH NAL of 6.5-8.5, and a turbidity NAL of 250 NTU. In addition, LUP Type 3 dischargers are subject to a pH NEL of 6.0-9.0 and a turbidity NEL of 500 NTU.

2. Good Site Management "Housekeeping"

a. LUP dischargers shall implement good site management (i.e., "housekeeping") measures for <u>construction materials</u> that could potentially be a threat to water quality if discharged. At a minimum, the good housekeeping measures shall consist of the following:

i Identify the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

ii Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

iii Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

iv Minimize exposure of construction materials to precipitation (not applicable to materials designed to be outdoors and exposed to the environment).

v Implement BMPs to control the off-site tracking of loose construction and landscape materials.

b. LUP dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

i Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

ii Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.

iii Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

iv Cover waste disposal containers at the end of every business day and during a rain event.

v Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

vi Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.

vii Implement procedures that effectively address hazardous and non-hazardous spills.

viii Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities. The SWPPP shall require that:

(1) Equipment and materials for cleanup of spills shall be available on site and that spills and leaks shall be cleaned up immediately and disposed of properly; and

(2) Appropriate spill response personnel are assigned and trained.

ix Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

c. LUP dischargers shall implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:

   i Prevent oil, grease, or fuel from leaking into the ground, storm drains or surface waters.

   ii Implement appropriate BMPs whenever equipment or vehicles are fueled, maintained or stored.

   iii Clean leaks immediately and disposing of leaked materials properly.

d. LUP dischargers shall implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:

   i Contain stockpiled materials such as mulches and topsoil when they are not actively being used.

   ii Contain fertilizers and other landscape materials when they are not actively being used.

   iii Discontinue the application of any erodible landscape material at least 2 days before a forecasted rain event[9] or during periods of precipitation.

   iv Applying erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.

   v Stacking erodible landscape material on pallets and covering or storing such materials when not being used or applied.

e. LUP dischargers shall conduct an assessment and create a list of potential pollutant sources and identify any areas of the site where additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. This potential pollutant list shall be kept with the SWPPP and shall identify all non-visible pollutants which are known, or should be known, to occur on the construction site. At a minimum, when developing BMPs, LUP dischargers shall do the following:

[9] 50% or greater chance of producing precipitation.

i Consider the quantity, physical characteristics (e.g., liquid, powder, solid), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.

ii Consider the degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.

iii Consider the direct and indirect pathways that pollutants may be exposed to storm water or authorized non-storm water discharges. This shall include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.

iv Ensure retention of sampling, visual observation, and inspection records.

v Ensure effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

f. LUP dischargers shall implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations.

3. Non-Storm Water Management

a. LUP dischargers shall implement measures to control all non-storm water discharges during construction.

b. LUP dischargers shall wash vehicles in such a manner as to prevent non-storm water discharges to surface waters or MS4 drainage systems.

c. LUP dischargers shall clean streets in such a manner as to prevent unauthorized non-storm water discharges from reaching surface water or MS4 drainage systems.

4. Erosion Control

a. LUP dischargers shall implement effective wind erosion control.

b. LUP dischargers shall provide effective soil cover for inactive[10] areas and all finished slopes, and utility backfill.

[10] Areas of construction activity that have been disturbed and are not scheduled to be re-disturbed for at least 14 days

c. LUP dischargers shall limit the use of plastic materials when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

5. Sediment Controls

a. LUP dischargers shall establish and maintain effective perimeter controls as needed, and implement effective BMPs for all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.

b. On sites where sediment basins are to be used, LUP dischargers shall, at minimum, design sediment basins according to the guidance provided in CASQA's Construction BMP Handbook.

c. **Additional LUP Type 2 & 3 Requirement:** LUP Type 2 & 3 dischargers shall apply linear sediment controls along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes to comply with sheet flow lengths[11] in accordance with Table 2 below.

Table 2 – Critical Slope/Sheet Flow Length Combinations

Slope Percentage	Sheet flow length not to exceed
0-25% 20	feet
25-50% 15	feet
Over 50%	10 feet

d. **Additional LUP Type 2 & 3 Requirement:** LUP Type 2 & 3 dischargers shall ensure that construction activity traffic to and from the project is limited to entrances and exits that employ effective controls to prevent off-site tracking of sediment.

e. **Additional LUP Type 2 & 3 Requirement:** LUP Type 2 & 3 dischargers shall ensure that all storm drain inlets and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits (e.g. tire washoff locations) are maintained and protected from activities that reduce their effectiveness.

f. **Additional LUP Type 2 & 3 Requirement:** LUP Type 2 & 3 dischargers shall inspect all immediate access roads. At a minimum daily and prior to any rain event, the discharger shall remove any

[11] Sheet flow length is the length that shallow, low velocity flow travels across a site.

sediment or other construction activity-related materials that are deposited on the roads (by vacuuming or sweeping).

g. **Additional LUP Type 3 Requirement:** The Regional Water Board may require LUP Type 3 dischargers to implement additional site-specific sediment control requirements if the implementation of the other requirements in this section are not adequately protecting the receiving waters.

6. Run-on and Run-off Controls

a. LUP dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off site-shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this Attachment.

b. Run-on and runoff controls are not required for Type 1 LUPs unless the evaluation of quantity and quality of run-on and runoff deems them necessary or visual inspections show that the site requires such controls.

7. Inspection, Maintenance and Repair

a. All inspection, maintenance repair and sampling activities at the discharger's LUP location shall be performed or supervised by a QSP representing the discharger. The QSP may delegate any or all of these activities to an employee trained to do the task(s) appropriately, but shall ensure adequate deployment.

b. LUP dischargers shall conduct visual inspections and observations daily during working hours (not recorded). At least once each 24-hour period during extended storm events, **LUP Type 2 & 3 dischargers** shall conduct visual inspections to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. Inspectors shall be the QSP or be trained by the QSP.

c. Upon identifying failures or other shortcomings, as directed by the QSP, LUP dischargers shall begin implementing repairs or design changes to BMPs within 72 hours of identification and complete the changes as soon as possible.

d. For each pre- and post-rain event inspection required, LUP dischargers shall complete an inspection checklist, using a form provided by the State Water Board or Regional Water Board or in an alternative format that includes the information described below.

e. The LUP discharger shall ensure that the checklist remains on-site or with the SWPPP. At a minimum, an inspection checklist should include:

   i Inspection date and date the inspection report was written.

   ii Weather information, including presence or absence of precipitation, estimate of beginning of qualifying storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall in inches.

   iii Site information, including stage of construction, activities completed, and approximate area of the site exposed.

   iv A description of any BMPs evaluated and any deficiencies noted.

   v If the construction site is safely accessible during inclement weather, list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list the results of visual inspections at all relevant outfalls, discharge points, downstream locations and any projected maintenance activities.

   vi Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.

   vii Any corrective actions required, including any necessary changes to the SWPPP and the associated implementation dates.

   viii Photographs taken during the inspection, if any.

   ix Inspector's name, title, and signature.

K. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS

1. Objectives

SWPPPs for all LUPs shall be developed and amended or revised by a QSD. The SWPPP shall be designed to address the following objectives:

a. All pollutants and their sources, including sources of sediment, associated with construction activities associated with LUP activity are controlled;

b. All non-storm water discharges are identified and either eliminated, controlled, or treated;

c. BMPs are effective and result in the reduction or elimination of pollutants in storm water discharges and authorized non-storm water discharges from LUPs during construction; and

d. Stabilization BMPs installed to reduce or eliminate pollutants after construction is completed are effective and maintained.

2. SWPPP Implementation Schedule

a. LUPs for which PRDs have been submitted to the State Water Board shall develop a site/project location SWPPP prior to the start of land-disturbing activity in accordance with this Section and shall implement the SWPPP concurrently with commencement of soil-disturbing activities.

b. For an ongoing LUP involving a change in the LRP, the new LRP shall review the existing SWPPP and amend it, if necessary, or develop a new SWPPP within 15 calendar days to conform to the requirements set forth in this General Permit.

3. Availability

The SWPPP shall be available at the construction site during working hours while construction is occurring and shall be made available upon request by a State or Municipal inspector. When the original SWPPP is retained by a crewmember in a construction vehicle and is not currently at the construction site, copies of the BMPs and map/drawing will be left with the field crew and the original SWPPP shall be made available via a request by radio/telephone.

L. REGIONAL WATER BOARD AUTHORITIES

1. Regional Water Boards shall administer the provisions of this General Permit. Administration of this General Permit may include, but is not limited to, requesting the submittal of SWPPPs, reviewing SWPPPs, reviewing monitoring and sampling and analysis reports, conducting compliance inspections, gathering site information by any medium including sampling, photo and video documentation, and taking enforcement actions.

2. Regional Water Boards may terminate coverage under this General Permit for dischargers who fail to comply with its requirements or where they determine that an individual NPDES permit is appropriate.

3. Regional Water Boards may issue separate permits for discharges of storm water associated with construction activity to individual dischargers, categories of dischargers, or dischargers in a geographic area. Upon issuance of such permits by a Regional Water Board, dischargers subject to those permits shall no longer be regulated by this General Permit.

4. Regional Water Boards may direct the discharger to reevaluate the LUP Type(s) for the project (or elements/areas of the project) and impose the appropriate level of requirements.

5. Regional Water Boards may terminate coverage under this General Permit for dischargers who negligently or with willful intent incorrectly determine or report their LUP Type (e.g., they determine themselves to be a LUP Type 1 when they are actually a Type 2).

6. Regional Water Boards may review PRDs and reject or accept applications for permit coverage or may require dischargers to submit a Report of Waste Discharge / NPDES permit application for Regional Water Board consideration of individual requirements.

7. Regional Water Boards may impose additional requirements on dischargers to satisfy TMDL implementation requirements or to satisfy provisions in their Basin Plans.

8. Regional Water Boards may require additional Monitoring and Reporting Program Requirements, including sampling and analysis of discharges to sediment-impaired water bodies.

9. Regional Water Boards may require dischargers to retain records for more than the three years required by this General Permit.

10. Based on an LUP's threat to water quality and complexity, the Regional Water Board may determine on a case-by-case basis that an LUP, or a portion of an LUP, is not eligible for the linear project requirements contained in this Attachment, and require that the discharger comply with all standard requirements in this General Permit.

11. The Regional Water Board may require additional monitoring and reporting program requirements including sampling and analysis of discharges to CWA § 303(d)-listed water bodies. Additional requirements imposed by the Regional Water Board shall be consistent with the overall monitoring effort in the receiving waters.

M. MONITORING AND REPORTING REQUIREMENTS

Table 3. LUP Summary of Monitoring Requirements

LUP Type	Visual Inspections				Sample Collection		
	Daily Site BMP	Pre-storm Event / Baseline	Daily Storm BMP	Post Storm	Storm Water Discharge	Receiving Water	Non-Visible (when applicable)
1	X						x
2	X	X	X	X	X		x
3	X	X	X	X	X	X	x

1. Objectives

LUP dischargers shall prepare a monitoring and reporting program (M&RP) prior to the start of construction and immediately implement the program at the start of construction for LUPs. The monitoring program must be implemented at the appropriate level to protect water quality at all times throughout the life of the project. The M&RP must be a part of the SWPPP, included as an appendix or separate SWPPP chapter.

2. M&RP Implementation Schedule

a. LUP dischargers shall implement the requirements of this Section at the time of commencement of construction activity. LUP dischargers are responsible for implementing these requirements until construction activity is complete and the site is stabilized.

b. LUP dischargers shall revise the M&RP when:

i Site conditions or construction activities change such that a change in monitoring is required to comply with the requirements and intent of this General Permit.

ii The Regional Water Board requires the discharger to revise its M&RP based on its review of the document. Revisions may include, but not be limited to, conducting additional site inspections, submitting reports, and certifications. Revisions shall be submitted via postal mail or electronic e-mail.

iii The Regional Water Board may require additional monitoring and reporting program requirements including sampling and analysis of discharges to CWA § 303(d)-listed water bodies. Additional requirements imposed by the Regional Water Board shall be consistent with the overall monitoring effort in the receiving waters.

3. LUP Type 1 Monitoring and Reporting Requirements

a. LUP Type 1 Inspection Requirements

i LUP Type 1 dischargers shall ensure that all inspections are conducted by trained personnel. The name(s) and contact number(s) of the assigned inspection personnel should be listed in the SWPPP.

ii LUP Type 1 dischargers shall ensure that all visual inspections are conducted daily during working hours and in conjunction with other daily activities in areas where active construction is occurring.

iii LUP Type 1 dischargers shall ensure that photographs of the site taken before, during, and after storm events are taken during inspections, and submitted through the State Water Board's SMARTS website once every three rain events.

iv LUP Type 1 dischargers shall conduct daily visual inspections to verify that:

(1) Appropriate BMPs for storm water and non-storm water are being implemented in areas where active construction is occurring (including staging areas);

(2) Project excavations are closed, with properly protected spoils, and that road surfaces are cleaned of excavated material and construction materials such as chemicals by either removing or storing the material in protective storage containers at the end of every construction day;

(3) Land areas disturbed during construction are returned to pre-construction conditions or an equivalent protection is used at the end of each workday to eliminate or minimize erosion and the possible discharge of sediment or other pollutants during a rain event.

v Inspections may be discontinued in non-active construction areas where soil-disturbing activities are completed and final soil stabilization is achieved (e.g., paving is completed, substructures

are installed, vegetation meets minimum cover requirements for final stabilization, or other stabilization requirements are met).

vi Inspection programs are required for LUP Type 1 projects where temporary and permanent stabilization BMPs are installed and are to be monitored after active construction is completed. Inspection activities shall continue until adequate permanent stabilization is established and, in areas where re-vegetation is chosen, until minimum vegetative coverage is established in accordance with Section C.1 of this Attachment.

b. LUP Type 1 Monitoring Requirements for Non-Visible Pollutants

LUP Type 1 dischargers shall implement sampling and analysis requirements to monitor non-visible pollutants associated with (1) construction sites; (2) activities producing pollutants that are not visually detectable in storm water discharges; and (3) activities which could cause or contribute to an exceedance of water quality objectives in the receiving waters.

i Sampling and analysis for non-visible pollutants is only required where the LUP Type 1 discharger believes pollutants associated with construction activities have the potential to be discharged with storm water runoff due to a spill or in the event there was a breach, malfunction, failure and/or leak of any BMP. Also, failure to implement BMPs may require sample collection.

(1) Visual observations made during the monitoring program described above will help the LUP Type 1 discharger determine when to collect samples.

(2) The LUP Type 1 discharger is not required to sample if one of the conditions described above (e.g., breach or spill) occurs and the site is cleaned of material and pollutants and/or BMPs are implemented prior to the next storm event.

ii LUP Type 1 dischargers shall collect samples down-gradient from all discharge locations where the visual observations were made triggering the monitoring, and which can be safely accessed. For sites where sampling and analysis is required, personnel trained in water quality sampling procedures shall collect storm water samples.

iii If sampling for non-visible pollutant parameters is required, LUP Type 1 dischargers shall ensure that samples be analyzed for parameters indicating the presence of pollutants identified in the pollutant source assessment required in Section J.2.a.i.

iv LUP Type 1 dischargers shall collect samples during the first two hours of discharge from rain events that occur during business hours and which generate runoff.

v LUP Type 1 dischargers shall ensure that a sufficiently large sample of storm water that has not come into contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample[12]) will be collected for comparison with the discharge sample. Samples shall be collected during the first two hours of discharge from rain events that occur during daylight hours and which generate runoff.

vi LUP Type 1 dischargers shall compare the uncontaminated sample to the samples of discharge using field analysis or through laboratory analysis. Analyses may include, but are not limited to, indicator parameters such as: pH, specific conductance, dissolved oxygen, conductivity, salinity, and Total Dissolved Solids (TDS).

vii For laboratory analyses, all sampling, sample preservation, and other analyses must be conducted according to test procedures pursuant to 40 C.F.R. Part 136. LUP Type 1 dischargers shall ensure that field samples are collected and analyzed according to manufacturer specifications of the sampling devices employed. Portable meters shall be calibrated according to manufacturer's specification.

viii LUP Type 1 dischargers shall ensure that all field and/or analytical data are kept in the SWPPP document.

c. <u>LUP Type 1 Visual Observation Exceptions</u>

i LUP Type 1 dischargers shall be prepared to collect samples and conduct visual observation (inspections) to meet the minimum visual observation requirements of this Attachment. The Type 1 LUP discharger is not required to physically collect samples or conduct visual observation (inspections) under the following conditions:

(1) During dangerous weather conditions such as flooding and electrical storms;

(2) Outside of scheduled site business hours.

(3) When access to the site is unsafe due to storm events.

[12] Sample collected at a location unaffected by contruction activities.

ii If the LUP Type 1 discharger does not collect the required samples or visual observation (inspections) due to these exceptions, an explanation why the sampling or visual observation (inspections) were not conducted shall be included in both the SWPPP and the Annual Report.

d. Particle Size Analysis for Risk Justification

LUP Type 1 dischargers utilizing justifying an alternative project risk shall report a soil particle size analysis used to determine the RUSLE K-Factor. ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, shall be used to determine the percentages of sand, very fine sand, silt, and clay on the site.

4. LUP Type 2 & 3 Monitoring and Reporting Requirements

a. LUP Type 2 & 3 Inspection Requirements

i LUP Type 2 & 3 dischargers shall ensure that all inspections are conducted by trained personnel. The name(s) and contact number(s) of the assigned inspection personnel should be listed in the SWPPP.

ii LUP Type 2 & 3 dischargers shall ensure that all visual inspections are conducted daily during working hours and in conjunction with other daily activities in areas where active construction is occurring.

iii LUP Type 2 & 3 dischargers shall ensure that photographs of the site taken before, during, and after storm events are taken during inspections, and submitted through the State Water Board's SMARTS website once every three rain events.

iv LUP Type 2 & 3 dischargers shall conduct daily visual inspections to verify that appropriate BMPs for storm water and non-storm water are being implemented and in place in areas where active construction is occurring (including staging areas).

v LUP Type 2 & 3 dischargers shall conduct inspections of the construction site prior to anticipated storm events, during extended storm events, and after actual storm events to identify areas contributing to a discharge of storm water associated with construction activity. Pre-storm inspections are to ensure that BMPs are properly installed and maintained; post-storm inspections are to assure that BMPs have functioned adequately. During

extended storm events, inspections shall be required during normal working hours for each 24-hour period.

vi Inspections may be discontinued in non-active construction areas where soil-disturbing activities are completed and final soil stabilization is achieved (e.g., paving is completed, substructures are installed, vegetation meets minimum cover requirements for final stabilization, or other stabilization requirements are met).

vii LUP Type 2 & 3 dischargers shall implement a monitoring program for inspecting projects that require temporary and permanent stabilization BMPs after active construction is complete. Inspections shall ensure that the BMPs are adequate and maintained. Inspection activities shall continue until adequate permanent stabilization is established and, in vegetated areas, until minimum vegetative coverage is established in accordance with Section C.1 of this Attachment.

viii If possible, LUP Type 2 & 3 dischargers shall install a rain gauge on-site at an accessible and secure location with readings made during all storm event inspections. When readings are unavailable, data from the closest rain gauge with publically available data may be used.

ix LUP Type 2 & 3 dischargers shall Include and maintain a log of the inspections conducted in the SWPPP. The log will provide the date and time of the inspection and who conducted the inspection.

b. <u>LUP Type 2 & 3 Storm Water Effluent Monitoring Requirements</u>

Table 4. LUP Type 2 & 3 Effluent Monitoring Requirements

LUP Type	Frequency	Effluent Monitoring
2	Minimum of 3 samples per day characterizing discharges associated with construction activity from the project active areas of construction.	Turbidity, pH, and non-visible pollutant parameters (if applicable)
3	Minimum of 3 samples per day characterizing discharges associated with construction activity from the project active areas of construction.	turbidity, pH, suspended sediment concentrations (SSC)[13] (only if turbidity NEL exceeded), plus non-visible pollutant parameters (if applicable)

i LUP Type 2 & 3 dischargers shall collect storm water grab samples from sampling locations characterizing discharges associated with

[13] Suspended Sediment Concentration monitoring is required for any Type 3 area that exceeds its turbidity NEL.

activity from the LUP active areas of construction. At a minimum, 3 samples shall be collected per day of discharge.

ii LUP Type 2 & 3 dischargers shall collect samples of stored or contained storm water that is discharged subsequent to a storm event producing precipitation of ½ inch or more at the time of discharge.

iii LUP Type 2 & 3 dischargers shall ensure that storm water grab sample(s) obtained be representative of the flow and characteristics of the discharge.

iv LUP Type 2 & 3 dischargers shall analyze their effluent samples for:

(1) pH and turbidity
(2) Any additional parameter for which monitoring is required by the Regional Water Board.

v LUP Type 3 dischargers that have violated the turbidity daily average NEL shall analyze subsequent effluent samples for turbidity and SSC.

c. <u>LUP Type 2 & 3 Storm Water Effluent Sampling Locations</u>

i LUP Type 2 & 3 dischargers shall perform sampling and analysis of storm water discharges to characterize discharges associated with construction activity from the entire disturbed project or area.

ii LUP Type 2 & 3 dischargers may monitor and report run-on from surrounding areas if there is reason to believe run-on may contribute to exceedance of NALs or NELs (applicable to Type 3).

iii LUP Type 2 & 3 dischargers shall select analytical test methods from the list provided in Table 5 below.

iv LUP Type 2 & 3 dischargers shall ensure that all storm water sample collection preservation and handling shall be conducted in accordance with the “Storm Water Sample Collection and Handling Instructions” below.

d. <u>LUP Type 3 Receiving Water Monitoring Requirements</u>

i In the event that an LUP Type 3 discharger violates an applicable NEL contained in this General Permit and has a direct discharge to receiving waters, the LUP discharger shall subsequently sample Receiving Waters (RWs) for turbidity, pH (if applicable) and SSC.

ii LUP Type 3 dischargers that meet the project criteria in Appendix 3 of this General Permit and have more than 30 acres of soil disturbance in the project area or project section area designated as Type 3, shall comply with the Bioassessment requirements prior to commencement of construction activity.

iii LUP Type 3 dischargers shall obtain RW samples in accordance with the requirements of the Receiving Water Sampling Locations section (Section M.4.d of this Attachment).

e. LUP Type 3 Receiving Water Sampling Locations

i **Upstream/up-gradient RW samples**: LUP Type 3 dischargers shall obtain any required upstream/up-gradient receiving water samples from a representative and accessible location as close as possible to and upstream from the effluent discharge point.

ii **Downstream/down-gradient RW samples**: LUP Type 3 dischargers shall obtain any required downstream/down-gradient receiving water samples from a representative and accessible location as close as possible to and downstream from the effluent discharge point.

iii If two or more discharge locations discharge to the same receiving water, LUP Type 3 dischargers may sample the receiving water at a single upstream and downstream location.

f. LUP Type 2 & 3 Monitoring Requirements for Non-Visible Pollutants

LUP Type 2 & 3 dischargers shall implement sampling and analysis requirements to monitor non-visible pollutants associated with (1) construction sites; (2) activities producing pollutants that are not visually detectable in storm water discharges; and (3) activities which could cause or contribute to an exceedance of water quality objectives in the receiving waters.

i Sampling and analysis for non-visible pollutants is only required where LUP Type 2 & 3 dischargers believe pollutants associated with construction activities have the potential to be discharged with storm water runoff due to a spill or in the event there was a breach, malfunction, failure and/or leak of any BMP. Also, failure to implement BMPs may require sample collection.

(1) Visual observations made during the monitoring program described above will help LUP Type 2 & 3 dischargers determine when to collect samples.

(2) LUP Type 2 & 3 dischargers are not required to sample if one of the conditions described above (e.g., breach or spill) occurs and the site is cleaned of material and pollutants and/or BMPs are implemented prior to the next storm event.

ii LUP Type 2 & 3 dischargers shall collect samples down-gradient from the discharge locations where the visual observations were made triggering the monitoring and which can be safely accessed. For sites where sampling and analysis is required, personnel trained in water quality sampling procedures shall collect storm water samples.

iii If sampling for non-visible pollutant parameters is required, LUP Type 2 & 3 dischargers shall ensure that samples be analyzed for parameters indicating the presence of pollutants identified in the pollutant source assessment required in Section J.2.a.i.

iv LUP Type 2 & 3 dischargers shall collect samples during the first two hours of discharge from rain events that occur during business hours and which generate runoff.

v LUP Type 2 & 3 dischargers shall ensure that a sufficiently large sample of storm water that has not come into contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample[14]) will be collected for comparison with the discharge sample. Samples shall be collected during the first two hours of discharge from rain events that occur during daylight hours and which generate runoff.

vi LUP Type 2 & 3 dischargers shall compare the uncontaminated sample to the samples of discharge using field analysis or through laboratory analysis. Analyses may include, but are not limited to, indicator parameters such as: pH, specific conductance, dissolved oxygen, conductivity, salinity, and Total Dissolved Solids (TDS).

vii For laboratory analyses, all sampling, sample preservation, and other analyses must be conducted according to test procedures pursuant to 40 C.F.R. Part 136. LUP Type 2 & 3 dischargers shall ensure that field samples are collected and analyzed according to manufacturer specifications of the sampling devices employed. Portable meters shall be calibrated according to manufacturer's specification.

viii LUP Type 2 & 3 dischargers shall ensure that all field and/or analytical data are kept in the SWPPP document.

[14] Sample collected at a location unaffected by construction activities

g. LUP Type 2 & 3 Visual Observation and Sample Collection Exceptions

i LUP Type 2 & 3 dischargers shall be prepared to collect samples and conduct visual observation (inspections) to meet the minimum visual observation requirements of this Attachment. Type 2 & 3 LUP dischargers are not required to physically collect samples or conduct visual observation (inspections) under the following conditions:

(1) During dangerous weather conditions such as flooding and electrical storms;

(2) Outside of scheduled site business hours.

(3) When access to the site is unsafe due to storm events.

ii If the LUP Type 2 or 3 discharger does not collect the required samples or visual observation (inspections) due to these exceptions, an explanation why the sampling or visual observation (inspections) were not conducted shall be included in both the SWPPP and the Annual Report.

h. LUP Type 2 & 3 Storm Water Sample Collection and Handling Instructions

LUP Type 2 & 3 dischargers shall refer to Table 5 below for test Methods, detection Limits, and reporting Units. During storm water sample collection and handling, the LUP Type 2 & 3 discharger shall:

i Identify the parameters required for testing and the number of storm water discharge points that will be sampled. Request the laboratory to provide the appropriate number of sample containers, types of containers, sample container labels, blank chain of custody forms, and sample preservation instructions.

ii Determine how to ship the samples to the laboratory. The testing laboratory should receive samples within 48 hours of the physical sampling (unless otherwise required by the laboratory). The options are to either deliver the samples to the laboratory, arrange to have the laboratory pick them up, or ship them overnight to the laboratory.

iii Use only the sample containers provided by the laboratory to collect and store samples. Use of any other type of containers could contaminate your samples.

iv Prevent sample contamination, by not touching, or putting anything into the sample containers before collecting storm water samples.

v Not overfilling sample containers. Overfilling can change the analytical results.

vi Tightly screw the cap of each sample container without stripping the threads of the cap.

vii Complete and attach a label to each sample container. The label shall identify the date and time of sample collection, the person taking the sample, and the sample collection location or discharge point. The label should also identify any sample containers that have been preserved.

viii Carefully pack sample containers into an ice chest or refrigerator to prevent breakage and maintain temperature during shipment. Remember to place frozen ice packs into the shipping container. Samples should be kept as close to 4° C (39° F) as possible until arriving at the laboratory. Do not freeze samples.

ix Complete a Chain of Custody form for each set of samples. The Chain of Custody form shall include the discharger's name, address, and phone number, identification of each sample container and sample collection point, person collecting the samples, the date and time each sample container was filled, and the analysis that is required for each sample container.

x Upon shipping/delivering the sample containers, obtain both the signatures of the persons relinquishing and receiving the sample containers.

xi Designate and train personnel to collect, maintain, and ship samples in accordance with the above sample protocols and good laboratory practices.

xii Refer to the Surface Water Ambient Monitoring Program's (SWAMP) Quality Assurance Management Plan (QAMP) for more information on sampling collection and analysis. See http://www.waterboards.ca.gov/water_issues/programs/swamp/[15] QAMP Link: http://www.waterboards.ca.gov/water_issues/programs/swamp/qamp.shtml

[15] Additional information regarding QAMP can be found at http://mpsl.mlml.calstate.edu/swqacompare.htm.

Table 5. Test Methods, Detection Limits, Reporting Units and Applicable NALs/NELs

Parameter	Test Method	Discharge Type	Min. Detection Limit	Reporting Units	Numeric Action Levels	Numeric Effluent Limitation (LUP Type 3)
pH	Field test with calibrated portable instrument	Type 2 & 3	0.2	pH units	Lower = 6.5 upper = 8.5	Lower = 6.0 upper = 9.0
Turbidity	EPA 0180.1 and/or field test with calibrated portable instrument	Type 2 & 3	1	NTU	250 NTU	500 NTU
SSC	ASTM Method D 3977-97[16]	Type 3 if NEL is exceeded	5 Mg/L		N/A	N/A
Bioassessment	(STE) Level I of (SAFIT),[17] fixed-count of 600 org/sample	Type 3 LUPs > 30 acres	N/A N/A		N/A	N/A

i. <u>LUP Type 2 & 3 Monitoring Methods</u>

i The LUP Type 2 or 3 discharger's project M&RP shall include a description of the following items:

(1) Visual observation locations, visual observation procedures, and visual observation follow-up and tracking procedures.

(2) Sampling locations, and sample collection and handling procedures. This shall include detailed procedures for sample collection, storage, preservation, and shipping to the testing lab to assure that consistent quality control and quality assurance is maintained. Dischargers shall attach to the monitoring program a copy of the Chain of Custody form used when handling and shipping samples.

[16] ASTM, 1999, Standard Test Method for Determining Sediment Concentration in Water Samples: American Society of Testing and Materials, D 3977-97, Vol. 11.02, pp. 389-394

[17] The current SAFIT STEs (28 November 2006) list requirements for both the Level I and Level II taxonomic effort, and are located at: http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf. When new editions are published by SAFIT, they will supersede all previous editions. All editions will be posted at the State Water Board's SWAMP website.

(3) Identification of the analytical methods and related method detection limits (if applicable) for each parameter required in Section M.4.f above.

ii LUP Type 2 & 3 dischargers shall ensure that all sampling and sample preservation be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment (including a discharger's own field instruments for measuring pH and turbidity) shall be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements. All laboratory analyses shall be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this General Permit or by the Regional Water Board. With the exception of field analysis conducted by the discharger for turbidity and pH, all analyses shall be sent to and conducted at a laboratory certified for such analyses by the State Department of Health Services (SSC exception). The LUP discharger shall conduct its own field analysis of pH and may conduct its own field analysis of turbidity if the discharger has sufficient capability (qualified and trained employees, properly calibrated and maintained field instruments, etc.) to adequately perform the field analysis.

j. <u>LUP Type 2 & 3 Analytical Methods</u>

LUP Type 2 & 3 dischargers shall refer to Table 5 above for test Methods, detection Limits, and reporting Units.

i **pH**: LUP Type 2 & 3 dischargers shall perform pH analysis on-site with a calibrated pH meter or pH test kit. The LUP discharger shall record pH monitoring results on paper and retain these records in accordance with Section M.4.o, below.

ii **Turbidity**: LUP Type 2 & 3 dischargers shall perform turbidity analysis using a calibrated turbidity meter (turbidimeter), either on-site or at an accredited lab. Acceptable test methods include Standard Method 2130 or USEPA Method 180.1. The results shall be recorded in the site log book in Nephelometric Turbidity Units (NTU).

iii **Suspended sediment concentration (SSC)**: LUP Type 3 dischargers exceeding their NEL, shall perform SSC analysis using ASTM Method D3977-97.

iv **Bioassessment**: LUP Type 3 dischargers shall perform bioassessment sampling and analysis according to Appendix 3 of this General Permit.

k. Watershed Monitoring Option

If an LUP Type 2 or 3 discharger is part of a qualified regional watershed-based monitoring program the LUP Type 2 or 3 discharger may be eligible for relief from the monitoring requirements in this Attachment. The Regional Water Board may approve proposals to substitute an acceptable watershed-based monitoring program if it determines that the watershed-based monitoring program will provide information to determine each discharger's compliance with the requirements of this General Permit.

l. Particle Size Analysis for Risk Justification

LUP Type 2 & 3 dischargers justifying an alternative project risk shall report a soil particle size analysis used to determine the RUSLE K-Factor. ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, shall be used to determine the percentages of sand, very fine sand, silt, and clay on the site.

m. NAL Exceedance Report

i In the event that any effluent sample exceeds an applicable NAL, the Regional Water Boards may require LUP Type 2 & 3 dischargers to submit NAL Exceedance Reports.

ii LUP Type 2 & 3 dischargers shall certify each NAL Exceedance Report in accordance with the Special Provisions for Construction Activity.

iii LUP Type 2 & 3 dischargers shall retain an electronic or paper copy of each NAL Exceedance Report for a minimum of three years after the date the exceedance report is filed.

iv LUP Type 2 & 3 dischargers shall include in the NAL Exceedance Report:

(1) the analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit"); and
(2) the date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation.

(3) Description of the current BMPs associated with the effluent sample that exceeded the NAL and the proposed corrective actions taken.

n. NEL Violation Report

i All LUP Type 3 dischargers shall electronically submit all storm event sampling results to the State Water Board no later than 5 days after the conclusion of the storm event.

ii In the event that a LUP Type 3 discharger has violated an applicable NEL, the discharger shall submit an NEL Violation Report to the State Water Board no later than 24 hours after the NEL exceedance has been identified.

iii The LUP Type 3 discharger shall certify each NEL Violation Report in accordance with the Special Provisions for Construction Activity.

iv The LUP Type 3 discharger shall retain an electronic or paper copy of each NEL Violation Report for a minimum of three years after the date the violation report is filed.

v The LUP Type 3 discharger shall include in the NEL Violation Report:

(1) the analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit"); and
(2) the date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation.
(3) Description of the current on-site BMPs, and the proposed corrective actions taken to manage the NEL exceedance.

vi Compliance Storm Exemption:
In the event that an applicable NEL has been exceeded during a storm event equal to or larger than the Compliance Storm Event (see Section F.2.c of this Attachment), the LUP Type 3 discharger shall report the on-site rain gauge and nearby governmental rain gauge readings for verification.

o. Monitoring Records

LUP Type 2 & 3 dischargers shall ensure that records of all storm water monitoring information and copies of all reports (including Annual Reports) required by this General Permit be retained for a period of at least three years. LUP Type 2 & 3 dischargers may retain records off-

site and make them available upon request. These records shall include:

i The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation (rain gauge);

ii The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and or measurements;

iii The date and approximate time of analyses;

iv The individual(s) who performed the analyses;

v A summary of all analytical results from the last three years, the method detection limits and reporting units, the analytical techniques or methods used, and all chain of custody forms;

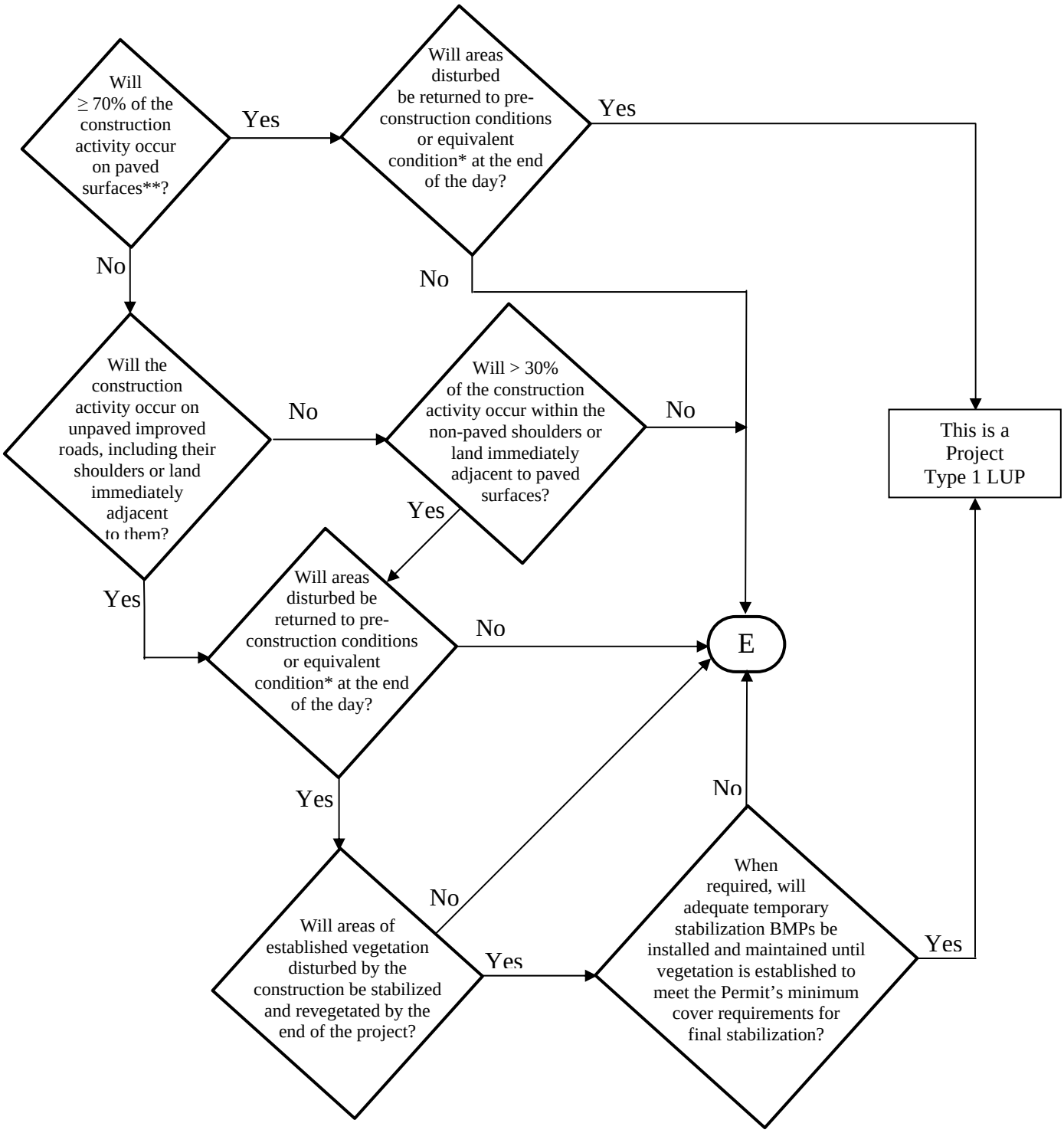
vi Quality assurance/quality control records and results;

vii Non-storm water discharge inspections and visual observation (inspections) and storm water discharge visual observation records (see Section M.4.a above);

viii Visual observation and sample collection exception records (see Section M.4.g above); and

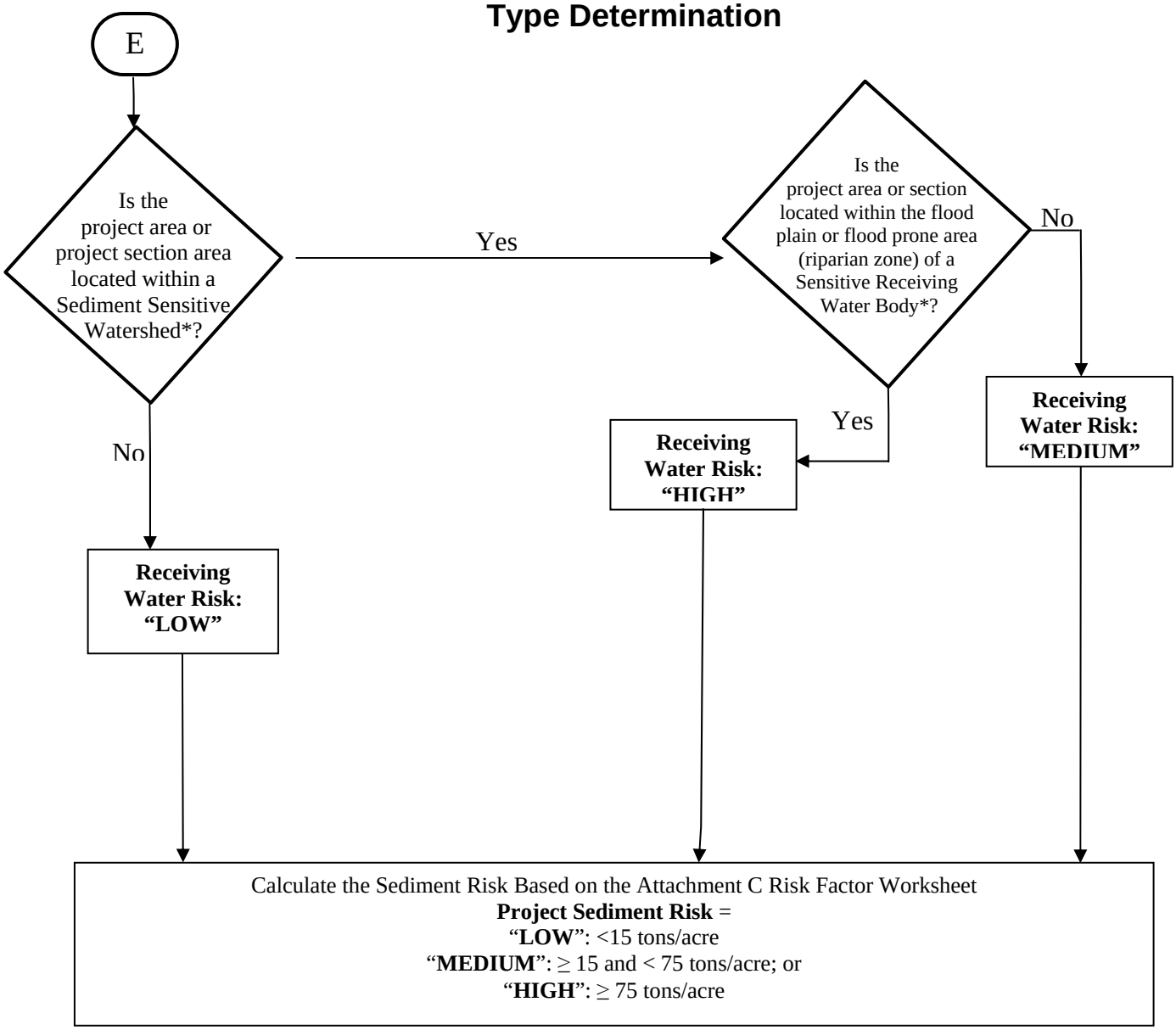
ix The records of any corrective actions and follow-up activities that resulted from analytical results, visual observation (inspections), or inspections.

ATTACHMENT A.1
LUP Project Area or Project Section Area Type Determination



*See Definition of Terms
** Or: "Will < 30% of the soil disturbance occur on unpaved surfaces?

ATTACHMENT A.1
LUP Project Area or Project Section Area Type Determination



* See Definition of Terms

PROJECT SEDIMENT RISK

RECEIVING WATER RISK	**LOW**	**MEDIUM**	**HIGH**
LOW	Type 1	Type 1	Type 2
MEDIUM	Type 1	Type 2	Type 3
HIGH	Type 2	Type 3	Type 3

ATTACHMENT A.1
Definition of Terms

1. **Equivalent Condition** – Means disturbed soils such as those from trench excavation are required to be hauled away, backfilled into the trench, and/or covered (e.g., metal plates, pavement, plastic covers over spoil piles) at the end of the construction day.
2. **Linear Construction Activity** – Linear construction activity consists of underground/ overhead facilities that typically include, but are not limited to, any conveyance, pipe or pipeline for the transportation of any gaseous, liquid (including water, wastewater for domestic municipal services), liquescent, or slurry substance; any cable line or wire for the transmission of electrical energy; any cable line or wire for communications (e.g., telephone, telegraph, radio or television messages); and associated ancillary facilities. Construction activities associated with LUPs include, but are not limited to those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities) and include, but are not limited to, underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/ tower pad and cable/ wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installations, welding, concrete and/or pavement repair or replacement, and stockpile/ borrow locations.
3. **Sediment Sensitive Receiving Water Body –** Defined as a water body segment that is listed on EPA's approved CWA 303(d) list for sedimentation/siltation, turbidity, or is designated with beneficial uses of SPAWN, MIGRATORY, and COLD.
4. **Sediment Sensitive Watershed –** Defined as a watershed draining into a receiving water body listed on EPA's approved CWA 303(d) list for sedimentation/siltation, turbidity, or a water body designated with beneficial uses of SPAWN, MIGRATORY, and COLD.

ATTACHMENT A.2
PERMIT REGISTRATION DOCUMENTS (PRDs)
GENERAL INSTRUCTIONS FOR LINEAR UNDERGROUND/OVERHEAD PROJECTS TO COMPLY WITH THE CONSTRUCTION GENERAL PERMIT

GENERAL INSTRUCTIONS

Who Must Submit

This permit is effective on July 1, 2010.

The Legally Responsible Person (LRP) for construction activities associated with linear underground/overhead project (LUP) must electronically apply for coverage under this General Permit on or after July 1, 2010. If it is determined that the LUP construction activities require an NPDES permit, the Legally Responsible Person[1] (LRP) shall submit PRDs for this General Permit in accordance with the following:

LUPs associated with Private or Municipal Development Projects

1. For LUPs associated with pre-development and pre-redevelopment construction activities:

   The LRP must obtain coverage[2] under this General Permit for its pre-development and pre-redevelopment construction activities where the total disturbed land area of these construction activities is greater than 1 acre.

2. For LUPs associated with new development and redevelopment construction projects:

   The LRP must obtain coverage under this General Permit for LUP construction activities associated with new development and redevelopment projects where the total disturbed land area of the LUP is greater than 1 acre. Coverage under this permit is not required where the same LUP construction activities are covered by another NPDES permit.

LUPs not associated with private or municipal new development or redevelopment projects:

The LRP must obtain coverage under this General Permit on or after July 1, 2010 for its LUP construction activities where the total disturbed land area is greater than 1 acre.

PRD Submittal Requirements

Prior to the start of construction activities a LRP must submit PRDs and fees to the State Water Board for each LUP.

New and Ongoing LUPs

Dischargers of new LUPs that commence construction activities after the adoption date of this General Permit shall file PRDs prior to the commencement of construction and implement the SWPPP upon the start of construction.

[1] person possessing the title of the land on which the construction activities will occur for the regulated site
[2] obtain coverage means filing PRDs for the project.

PERMIT REGISTRATION DOCUMENTS (PRDs)
GENERAL INSTRUCTIONS (CONTINUED)

Dischargers of ongoing LUPs that are currently covered under State Water Board Order No. 2003-0007 (Small LUP General Permit) shall electronically file Permit Registration Documents no later than July 1, 2010. After July 1, 2010, all NOIs subject to State Water Board Order No. 2003-0007-DWQ will be terminated. All existing dischargers shall be exempt from the risk determination requirements in Attachment A. All existing dischargers are therefore subject to LUP Type 1 requirements regardless of their project's sediment and receiving water risks. However, a Regional Board retains the authority to require an existing discharger to comply with the risk determination requirements in Attachment A.

Where to Apply

The Permit Registration Documents (PRDs) can be found at www.waterboards.ca.gov/water_issues/programs/stormwater/

Fees

The annual fee for storm water permits are established through the State of California Code of Regulations.

When Permit Coverage Commences

To obtain coverage under the General Permit, the LRP must include the complete PRDs and the annual fee. All PRDs deemed incomplete will be rejected with an explanation as to what is required to complete submittal. Upon receipt of complete PRDs and associated fee, each discharger will be sent a waste discharger's identification (WDID) number.

Projects and Activities Not Defined As Construction Activity

1. LUP construction activity does not include routine maintenance projects to maintain original line and grade, hydraulic capacity, or original purpose of the facility. Routine maintenance projects are projects associated with operations and maintenance activities that are conducted on existing lines and facilities and within existing right-of-way, easements, franchise agreements or other legally binding agreements of the discharger. Routine maintenance projects include, but are not limited to projects that are conducted to:

- Maintain the original purpose of the facility, or hydraulic capacity.
- Update existing lines[3] and facilities to comply with applicable codes, standards and regulations regardless if such projects result in increased capacity.
- Repairing leaks.

Routine maintenance does not include construction of new[4] lines or facilities resulting from compliance with applicable codes, standards and regulations.

[3] Update existing lines includes replacing existing lines with new materials or pipes.
[4] New lines are those that are not associated with existing facilities and are not part of a project to update or replace existing lines.

Routine maintenance projects do not include those areas of maintenance projects that are outside of an existing right-of-way, franchise, easements, or agreements. When a project must acquire new areas, those areas may be subject to this General Permit based on the area of disturbed land outside the original right-of-way, easement or agreement.

2. LUP construction activity does not include field activities associated with the planning and design of a project (e.g., activities associated with route selection).

3. Tie-ins conducted immediately adjacent to "energized" or "pressurized" facilities by the discharger are not considered small construction activities where all other LUP construction activities associated with the tie-in are covered by a NOI and SWPPP of a third party or municipal agency.

Calculating Land Disturbance Areas of LUPs

The total land area disturbed for LUPs is the sum of the:

- Surface areas of trenches, laterals and ancillary facilities, plus
- Area of the base of stockpiles on unpaved surfaces, plus
- Surface area of the borrow area, plus
- Areas of paved surfaces constructed for the project, plus
- Areas of new roads constructed or areas of major reconstruction to existing roads (e.g. improvements to two-track surfaces or road widening) for the sole purpose of accessing construction activities or as part of the final project, plus
- Equipment and material storage, staging, and preparation areas (laydown areas) not on paved surfaces, plus
- Soil areas outside the surface area of trenches, laterals and ancillary facilities that will be graded, and/or disturbed by the use of construction equipment, vehicles and machinery during construction activities.

Stockpiling Areas

Stockpiling areas, borrow areas and the removal of soils from a construction site may or may not be included when calculating the area of disturbed soil for a site depending on the following conditions:

- For stockpiling of soils onsite or immediately adjacent to a LUP site and the stockpile is not on a paved surface, the area of the base of the stockpile is to be included in the disturbed area calculation.

- The surface area of borrow areas that are onsite or immediately adjacent to a project site are to be included in the disturbed area calculation.

- For soil that is hauled offsite to a location owned or operated by the discharger that is not a paved surface, the area of the base of the stockpile is to be included in the disturbed area calculation except when the offsite location is already subject to a separate storm water permit.

PERMIT REGISTRATION DOCUMENTS (PRDs)
GENERAL INSTRUCTIONS (CONTINUED)

- For soil that is brought to the project from an off-site location owned or operated by the discharger the surface area of the borrow pit is to be included in the disturbed area calculation except when the offsite location is already subject to a separate storm water permit.

- Trench spoils on a paved surface that are either returned to the trench or excavation or hauled away from the project daily for disposal or reuse will not be included in the disturbed area calculation.

If you have any questions concerning submittal of PRDs, please call the State Water Board at (866) 563-3107.

ATTACHMENT B
PERMIT REGISTRATION DOCUMENTS (PRDs) TO COMPLY WITH THE TERMS OF THE GENERAL PERMIT TO DISCHARGE STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY

GENERAL INSTRUCTIONS

A. All Linear Construction Projects shall comply with the PRD requirements in Attachment A.2 of this Order.

B. Who Must Submit

Discharges of storm water associated with construction that results in the disturbance of one acre or more of land must apply for coverage under the General Construction Storm Water Permit (General Permit). Any construction activity that is a part of a larger common plan of development or sale must also be permitted, regardless of size. (For example, if 0.5 acre of a 20-acre subdivision is disturbed by the construction activities of discharger A and the remaining 19.5 acres is to be developed by discharger B, discharger A must obtain a General Storm Water Permit for the 0.5 acre project).

Other discharges from construction activities that are covered under this General Permit can be found in the General Permit Section II.B.

It is the LRP's responsibility to obtain coverage under this General Permit by electronically submitting complete PRDs (Permit Registration Documents).

In all cases, the proper procedures for submitting the PRDs must be completed before construction can commence.

C. Construction Activity Not Covered By This General Permit

Discharges from construction that are not covered under this General Permit can be found in the General Permit Sections II.A &B..

D. Annual Fees and Fee Calculation

Annual fees are calculated based upon the total area of land to be disturbed not the total size of the acreage owned. However, the calculation includes all acres to be disturbed during the duration of the project. For example, if 10 acres are scheduled to be disturbed the first year and 10 in each subsequent year for 5 years, the annual fees would be based upon 50 acres of disturbance. The State Water Board will evaluate adding acreage to an existing Permit Waste Discharge Identification (WDID) number on a case-by-case basis. In general, any acreage to be considered must be contiguous to the permitted land area and the existing

SWPPP must be appropriate for the construction activity and topography of the acreage under consideration. As acreage is built out and stabilized or sold, the Change of Information (COI) form enables the applicant to remove those acres from inclusion in the annual fee calculation. Checks should be made payable to: State Water Board.

The Annual fees are established through regulations adopted by the State Water Board. The total annual fee is the current base fee plus applicable surcharges for all construction sites submitting an NOI, based on the total acreage to be disturbed during the life of the project. Annual fees are subject to change by regulation.

Dischargers that apply for and satisfy the Small Construction Erosivity Wavier requirements shall pay a fee of $200.00 plus an applicable surcharge, see the General Permit Section II.B.7.

E. When to Apply

LRP's proposing to conduct construction activities subject to this General Permit must submit their PRDs prior to the commencement of construction activity.

F. Requirements for Completing Permit Registration Documents (PRDs)

All dischargers required to comply with this General Permit shall electronically submit the required PRDs for their type of construction as defined below.

G. Standard PRD Requirements (All Dischargers)

1. Notice of Intent
2. Risk Assessment (Standard or Site-Specific)
3. Site Map
4. SWPPP
5. Annual Fee
6. Certification

H. Additional PRD Requirements Related to Construction Type

1. Discharger in unincorporated areas of the State (not covered under an adopted Phase I or II SUSMP requirements) and that are not a linear project shall also submit a completed:
   a. Post-Construction Water Balance Calculator (Appendix 2).

2. Dischargers who are proposing to implement ATS shall submit:
   a. Complete ATS Plan in accordance with Attachment F at least 14 days prior to the planned operation of the ATS and a paper copy shall be available onsite during ATS operation.

b. Certification proof that design done by a professional in accordance with Attachment F.

3. Dischargers who are proposing an alternate Risk Justification:
   a. Particle Size Analysis.

I. Exceptions to Standard PRD Requirements

Construction sites with an R value less than 5 as determined in the Risk Assessment are not required to submit a SWPPP.

J. Description of PRDs

1. Notice of Intent (NOI)

2. Site Map(s) Includes:
   a. The project's surrounding area (vicinity)
   b. Site layout
   c. Construction site boundaries
   d. Drainage areas
   e. Discharge locations
   f. Sampling locations
   g. Areas of soil disturbance (temporary or permanent)
   h. Active areas of soil disturbance (cut or fill)
   i. Locations of all runoff BMPs
   j. Locations of all erosion control BMPs
   k. Locations of all sediment control BMPs
   l. ATS location (if applicable)
   m. Locations of sensitive habitats, watercourses, or other features which are not to be disturbed
   n. Locations of all post-construction BMPs
   o. Locations of storage areas for waste, vehicles, service, loading/unloading of materials, access (entrance/exits) points to construction site, fueling, and water storage, water transfer for dust control and compaction practices

3. **SWPPPs**
   A site-specific SWPPP shall be developed by each discharger and shall be submitted with the PRDs.

4. **Risk Assessment**
   All dischargers shall use the Risk Assessment procedure as describe in the General Permit Appendix 1.

   a. The Standard Risk Assessment includes utilization of the following:
      i. Receiving water Risk Assessment interactive map

ii. EPA Rainfall Erosivity Factor Calculator Website
iii. Sediment Risk interactive map
iv. Sediment sensitive water bodies list

b. The Site-Specific Risk Assessment includes the completion of the hand calculated R value Risk Calculator

5. **Post-Construction Water Balance Calculator**
All dischargers subject to this requirement shall complete the Water Balance Calculator (in Appendix 2) in accordance with the instructions.

6. **ATS Design Document and Certification**
All dischargers using ATS must submit electronically their system design (as well as any supporting documentation) and proof that the system was designed by a qualified ATS design professional (See Attachment F).

To obtain coverage under the General Permit PRDs must be included and completed. If any of the required items are missing, the PRD submittal is considered incomplete and will be rejected. Upon receipt of a complete PRD submittal, the State Water Board will process the application package in the order received and assign a (WDID) number.

Questions?

If you have any questions on completing the PRDs please email stormwater@waterboards.ca.gov or call (866) 563-3107.

ATTACHMENT C
RISK LEVEL 1 REQUIREMENTS

A. Effluent Standards

[These requirements are the same as those in the General Permit order.]

1. Narrative – Risk Level 1 dischargers shall comply with the narrative effluent standards listed below:

   a. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

   b. Dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

2. Numeric – Risk Level 1 dischargers are not subject to a numeric effluent standard.

B. Good Site Management "Housekeeping"

1. Risk Level 1 dischargers shall implement good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged. At a minimum, Risk Level 1 dischargers shall implement the following good housekeeping measures:

   a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

   b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

e. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.

2. Risk Level 1 dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.

c. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

d. Cover waste disposal containers at the end of every business day and during a rain event.

e. Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

f. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.

g. Implement procedures that effectively address hazardous and non-hazardous spills.

h. Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities. The SWPPP shall require that:

i. Equipment and materials for cleanup of spills shall be available on site and that spills and leaks shall be cleaned up immediately and disposed of properly; and

ii. Appropriate spill response personnel are assigned and trained.

i. Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

3. Risk Level 1 dischargers shall implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:

   a. Prevent oil, grease, or fuel to leak in to the ground, storm drains or surface waters.

   b. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate BMPs.

   c. Clean leaks immediately and disposing of leaked materials properly.

4. Risk Level 1 dischargers shall implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:

   a. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.

   b. Contain fertilizers and other landscape materials when they are not actively being used.

   c. Discontinue the application of any erodible landscape material within 2 days before a forecasted rain event or during periods of precipitation.

   d. Apply erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.

   e. Stack erodible landscape material on pallets and covering or storing such materials when not being used or applied.

5. Risk Level 1 dischargers shall conduct an assessment and create a list of potential pollutant sources and identify any areas of the site where additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. This potential pollutant list shall be kept with the SWPPP and shall identify

all non-visible pollutants which are known, or should be known, to occur on the construction site. At a minimum, when developing BMPs, Risk Level 1 dischargers shall do the following:

a. Consider the quantity, physical characteristics (e.g., liquid, powder, solid), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.

b. Consider the degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.

c. Consider the direct and indirect pathways that pollutants may be exposed to storm water or authorized non-storm water discharges. This shall include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.

d. Ensure retention of sampling, visual observation, and inspection records.

e. Ensure effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

6. Risk Level 1 dischargers shall implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations. Such particulates can include, but are not limited to, sediment, nutrients, trash, metals, bacteria, oil and grease and organics.

C. Non-Storm Water Management

1. Risk Level 1 dischargers shall implement measures to control all non-storm water discharges during construction.

2. Risk Level 1 dischargers shall wash vehicles in such a manner as to prevent non-storm water discharges to surface waters or MS4 drainage systems.

3. Risk Level 1 dischargers shall clean streets in such a manner as to prevent unauthorized non-storm water discharges from reaching surface water or MS4 drainage systems.

D. Erosion Control

1. Risk Level 1 dischargers shall implement effective wind erosion control.

2. Risk Level 1 dischargers shall provide effective soil cover for inactive[1] areas and all finished slopes, open space, utility backfill, and completed lots.

3. Risk Level 1 dischargers shall limit the use of plastic materials when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

E. Sediment Controls

1. Risk Level 1 dischargers shall establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.

2. On sites where sediment basins are to be used, Risk Level 1 dischargers shall, at minimum, design sediment basins according to the method provided in CASQA's Construction BMP Guidance Handbook.

F. Run-on and Runoff Controls

Risk Level 1 dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off site shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this General Permit.

G. Inspection, Maintenance and Repair

1. Risk Level 1 dischargers shall ensure that all inspection, maintenance repair and sampling activities at the project location shall be performed or supervised by a Qualified SWPPP Practitioner (QSP) representing the discharger. The QSP may delegate any or all of these activities to an employee trained to do the task(s) appropriately, but shall ensure adequate deployment.

2. Risk Level 1 dischargers shall perform weekly inspections and observations, and at least once each 24-hour period during extended

[1] Inactive areas of construction are areas of construction activity that have been disturbed and are not scheduled to be re-disturbed for at least 14 days.

storm events, to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. Inspectors shall be the QSP or be trained by the QSP.

3. Upon identifying failures or other shortcomings, as directed by the QSP, Risk Level 1 dischargers shall begin implementing repairs or design changes to BMPs within 72 hours of identification and complete the changes as soon as possible.

4. For each inspection required, Risk Level 1 dischargers shall complete an inspection checklist, using a form provided by the State Water Board or Regional Water Board or in an alternative format.

5. Risk Level 1 dischargers shall ensure that checklists shall remain onsite with the SWPPP and at a minimum, shall include:

    a. Inspection date and date the inspection report was written.

    b. Weather information, including presence or absence of precipitation, estimate of beginning of qualifying storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall in inches.

    c. Site information, including stage of construction, activities completed, and approximate area of the site exposed.

    d. A description of any BMPs evaluated and any deficiencies noted.

    e. If the construction site is safely accessible during inclement weather, list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list the results of visual inspections at all relevant outfalls, discharge points, downstream locations and any projected maintenance activities.

    f. Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.

    g. Any corrective actions required, including any necessary changes to the SWPPP and the associated implementation dates.

    h. Photographs taken during the inspection, if any.

    i. Inspector's name, title, and signature.

H. Rain Event Action Plan

Not required for Risk Level 1 dischargers.

I. Risk Level 1 Monitoring and Reporting Requirements

Table 1- Summary of Monitoring Requirements

Risk Level	Visual Inspections					Sample Collection	
	Quarterly Non-storm Water Discharge	Pre-storm Event		Daily Storm BMP	Post Storm	Storm Water Discharge	Receiving Water
		Baseline	REAP				
1	X	X		X	X		

1. **Construction Site Monitoring Program Requirements**

   a. Pursuant to Water Code Sections 13383 and 13267, all dischargers subject to this General Permit shall develop and implement a written site-specific Construction Site Monitoring Program (CSMP) in accordance with the requirements of this Section. The CSMP shall include all monitoring procedures and instructions, location maps, forms, and checklists as required in this section. The CSMP shall be developed prior to the commencement of construction activities, and revised as necessary to reflect project revisions. The CSMP shall be a part of the Storm Water Pollution Prevention Plan (SWPPP), included as an appendix or separate SWPPP chapter.

   b. Existing dischargers registered under the State Water Board Order No. 99-08-DWQ shall make and implement necessary revisions to their Monitoring Programs to reflect the changes in this General Permit in a timely manner, but no later than July 1, 2010. Existing dischargers shall continue to implement their existing Monitoring Programs in compliance with State Water Board Order No. 99-08-DWQ until the necessary revisions are completed according to the schedule above.

   c. When a change of ownership occurs for all or any portion of the construction site prior to completion or final stabilization, the new discharger shall comply with these requirements as of the date the ownership change occurs.

2. **Objectives**

   The CSMP shall be developed and implemented to address the following objectives:

   a. To demonstrate that the site is in compliance with the Discharge Prohibitions;

b. To determine whether non-visible pollutants are present at the construction site and are causing or contributing to exceedances of water quality objectives;

c. To determine whether immediate corrective actions, additional Best Management Practice (BMP) implementation, or SWPPP revisions are necessary to reduce pollutants in storm water discharges and authorized non-storm water discharges; and

d. To determine whether BMPs included in the SWPPP are effective in preventing or reducing pollutants in storm water discharges and authorized non-storm water discharges.

3. **Risk Level 1 - Visual Monitoring (Inspection) Requirements for Qualifying Rain Events**

a. Risk Level 1 dischargers shall visually observe (inspect) storm water discharges at all discharge locations within two business days (48 hours) after each qualifying rain event.

b. Risk Level 1 dischargers shall visually observe (inspect) the discharge of stored or contained storm water that is derived from and discharged subsequent to a qualifying rain event producing precipitation of ½ inch or more at the time of discharge. Stored or contained storm water that will likely discharge after operating hours due to anticipated precipitation shall be observed prior to the discharge during operating hours.

c. Risk Level 1 dischargers shall conduct visual observations (inspections) during business hours only.

d. Risk Level 1 dischargers shall record the time, date and rain gauge reading of all qualifying rain events.

e. Within 2 business days (48 hours) prior to each qualifying rain event, Risk Level 1 dischargers shall visually observe (inspect):

i. All storm water drainage areas to identify any spills, leaks, or uncontrolled pollutant sources. If needed, the discharger shall implement appropriate corrective actions.

ii. All BMPs to identify whether they have been properly implemented in accordance with the SWPPP. If needed, the discharger shall implement appropriate corrective actions.

iii. Any storm water storage and containment areas to detect leaks and ensure maintenance of adequate freeboard.

f. For the visual observations (inspections) described in e.i and e.iii above, Risk Level 1 dischargers shall observe the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

g. Within two business days (48 hours) after each qualifying rain event, Risk Level 1 dischargers shall conduct post rain event visual observations (inspections) to (1) identify whether BMPs were adequately designed, implemented, and effective, and (2) identify additional BMPs and revise the SWPPP accordingly.

h. Risk Level 1 dischargers shall maintain on-site records of all visual observations (inspections), personnel performing the observations, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations.

4. **Risk Level 1 – Visual Observation Exemptions**

a. Risk Level 1 dischargers shall be prepared to conduct visual observation (inspections) until the minimum requirements of Section I.3 above are completed. Risk Level 1 dischargers are not required to conduct visual observation (inspections) under the following conditions:

i. During dangerous weather conditions such as flooding and electrical storms.

ii. Outside of scheduled site business hours.

b. If no required visual observations (inspections) are collected due to these exceptions, Risk Level 1 dischargers shall include an explanation in their SWPPP and in the Annual Report documenting why the visual observations (inspections) were not conducted.

5. **Risk Level 1 – Monitoring Methods**

Risk Level 1 dischargers shall include a description of the visual observation locations, visual observation procedures, and visual observation follow-up and tracking procedures in the CSMP.

6. **Risk Level 1 – Non-Storm Water Discharge Monitoring Requirements**

a. Visual Monitoring Requirements:

   i. Risk Level 1 dischargers shall visually observe (inspect) each drainage area for the presence of (or indications of prior) unauthorized and authorized non-storm water discharges and their sources.

   ii. Risk Level 1 dischargers shall conduct one visual observation (inspection) quarterly in each of the following periods: January-March, April-June, July-September, and October-December. Visual observation (inspections) are only required during daylight hours (sunrise to sunset).

   iii. Risk Level 1 dischargers shall ensure that visual observations (inspections) document the presence or evidence of any non-storm water discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source. Risk Level 1 dischargers shall maintain on-site records indicating the personnel performing the visual observation (inspections), the dates and approximate time each drainage area and non-storm water discharge was observed, and the response taken to eliminate unauthorized non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water discharges.

7. **Risk Level 1 – Non-Visible Pollutant Monitoring Requirements**

   a. Risk Level 1 dischargers shall collect one or more samples during any breach, malfunction, leakage, or spill observed during a visual inspection which could result in the discharge of pollutants to surface waters that would not be visually detectable in storm water.

   b. Risk Level 1 dischargers shall ensure that water samples are large enough to characterize the site conditions.

   c. Risk Level 1 dischargers shall collect samples at all discharge locations that can be safely accessed.

   d. Risk Level 1 dischargers shall collect samples during the first two hours of discharge from rain events that occur during business hours and which generate runoff.

   e. Risk Level 1 dischargers shall analyze samples for all non-visible pollutant parameters (if applicable) - parameters indicating the

presence of pollutants identified in the pollutant source assessment required (Risk Level 1 dischargers shall modify their CSMPs to address these additional parameters in accordance with any updated SWPPP pollutant source assessment).

f. Risk Level 1 dischargers shall collect a sample of storm water that has not come in contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample) for comparison with the discharge sample.

g. Risk Level 1 dischargers shall compare the uncontaminated sample to the samples of discharge using field analysis or through laboratory analysis.[2]

h. Risk Level 1 dischargers shall keep all field /or analytical data in the SWPPP document.

8. **Risk Level 1 – Particle Size Analysis for Project Risk Justification**

Risk Level 1 dischargers justifying an alternative project risk shall report a soil particle size analysis used to determine the RUSLE K-Factor. ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, shall be used to determine the percentages of sand, very fine sand, silt, and clay on the site.

9. **Risk Level 1 – Records**

Risk Level 1 dischargers shall retain records of all storm water monitoring information and copies of all reports (including Annual Reports) for a period of at least three years. Risk Level 1 dischargers shall retain all records on-site while construction is ongoing. These records include:

a. The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation.

b. The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and or measurements.

c. The date and approximate time of analyses.

d. The individual(s) who performed the analyses.

[2] For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136. Field discharge samples shall be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed.

e. A summary of all analytical results from the last three years, the method detection limits and reporting units, and the analytical techniques or methods used.

f. Rain gauge readings from site inspections.

g. Quality assurance/quality control records and results.

h. Non-storm water discharge inspections and visual observation (inspections) and storm water discharge visual observation records (see Sections I.3 and I.6 above).

i. Visual observation and sample collection exception records (see Section I.4 above).

j. The records of any corrective actions and follow-up activities that resulted from analytical results, visual observation (inspections), or inspections.

ATTACHMENT D
RISK LEVEL 2 REQUIREMENTS

A. Effluent Standards

[These requirements are the same as those in the General Permit order.]

1. Narrative – Risk Level 2 dischargers shall comply with the narrative effluent standards listed below:

   a. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

   b. Dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

2. Numeric – Risk level 2 dischargers are subject to a pH NAL of 6.5-8.5, and a turbidity NAL of 250 NTU.

B. Good Site Management "Housekeeping"

1. Risk Level 2 dischargers shall implement good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged. At a minimum, Risk Level 2 dischargers shall implement the following good housekeeping measures:

   a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

   b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

e. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.

2. Risk Level 2 dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.

c. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

d. Cover waste disposal containers at the end of every business day and during a rain event.

e. Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

f. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.

g. Implement procedures that effectively address hazardous and non-hazardous spills.

h. Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities. The SWPPP shall require:

i. Equipment and materials for cleanup of spills shall be available on site and that spills and leaks shall be cleaned up immediately and disposed of properly.

ii. Appropriate spill response personnel are assigned and trained.

i. Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

3. Risk Level 2 dischargers shall implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:

   a. Prevent oil, grease, or fuel to leak in to the ground, storm drains or surface waters.

   b. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate BMPs.

   c. Clean leaks immediately and disposing of leaked materials properly.

4. Risk Level 2 dischargers shall implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:

   a. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.

   b. Contain all fertilizers and other landscape materials when they are not actively being used.

   c. Discontinue the application of any erodible landscape material within 2 days before a forecasted rain event or during periods of precipitation.

   d. Apply erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.

   e. Stack erodible landscape material on pallets and covering or storing such materials when not being used or applied.

5. Risk Level 2 dischargers shall conduct an assessment and create a list of potential pollutant sources and identify any areas of the site where additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. This potential pollutant list shall be kept with the SWPPP and shall identify

all non-visible pollutants which are known, or should be known, to occur on the construction site. At a minimum, when developing BMPs, Risk Level 2 dischargers shall do the following:

a. Consider the quantity, physical characteristics (e.g., liquid, powder, solid), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.

b. Consider the degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.

c. Consider the direct and indirect pathways that pollutants may be exposed to storm water or authorized non-storm water discharges. This shall include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.

d. Ensure retention of sampling, visual observation, and inspection records.

e. Ensure effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

6. Risk Level 2 dischargers shall implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations. Such particulates can include, but are not limited to, sediment, nutrients, trash, metals, bacteria, oil and grease and organics.

7. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall document all housekeeping BMPs in the SWPPP and REAP(s) in accordance with the nature and phase of the construction project. Construction phases at traditional land development projects include Grading and Land Development Phase, Streets and Utilities, or Vertical Construction for traditional land development projects.

C. Non-Storm Water Management

1. Risk Level 2 dischargers shall implement measures to control all non-storm water discharges during construction.

2. Risk Level 2 dischargers shall wash vehicles in such a manner as to prevent non-storm water discharges to surface waters or MS4 drainage systems.

3. Risk Level 2 dischargers shall clean streets in such a manner as to prevent unauthorized non-storm water discharges from reaching surface water or MS4 drainage systems.

D. Erosion Control

1. Risk Level 2 dischargers shall implement effective wind erosion control.

2. Risk Level 2 dischargers shall provide effective soil cover for inactive[1] areas and all finished slopes, open space, utility backfill, and completed lots.

3. Risk Level 2 dischargers shall limit the use of plastic materials when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

E. Sediment Controls

1. Risk Level 2 dischargers shall establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.

2. On sites where sediment basins are to be used, Risk Level 2 dischargers shall, at minimum, design sediment basins according to the method provided in CASQA's Construction BMP Guidance Handbook.

3. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall implement appropriate erosion control BMPs (runoff control and soil stabilization) in conjunction with sediment control BMPs for areas under active[2] construction.

4. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall apply linear sediment controls along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes to comply with sheet flow lengths[3] in accordance with Table 1.

Table 1 - Critical Slope/Sheet Flow Length Combinations

Slope Percentage	Sheet flow length not

[1] Inactive areas of construction are areas of construction activity that have been disturbed and are not scheduled to be re-disturbed for at least 14 days.
[2] Active areas of construction are areas undergoing land surface disturbance. This includes construction activity during the preliminary stage, mass grading stage, streets and utilities stage and the vertical construction stage.
[3] Sheet flow length is the length that shallow, low velocity flow travels across a site.

	to exceed
0-25% 20	feet
25-50% 15	feet
Over 50%	10 feet

5. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall ensure that construction activity traffic to and from the project is limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment.

6. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall ensure that all storm drain inlets and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits (e.g. tire washoff locations) are maintained and protected from activities that reduce their effectiveness.

7. **Additional Risk Level 2 Requirement:** Risk Level 2 dischargers shall inspect on a daily basis all immediate access roads daily. At a minimum daily (when necessary) and prior to any rain event, the discharger shall remove any sediment or other construction activity-related materials that are deposited on the roads (by vacuuming or sweeping).

F. Run-on and Run-off Controls

Risk Level 2 dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off site shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this General Permit.

G. Inspection, Maintenance and Repair

1. Risk Level 2 dischargers shall ensure that all inspection, maintenance repair and sampling activities at the project location shall be performed or supervised by a Qualified SWPPP Practitioner (QSP) representing the discharger. The QSP may delegate any or all of these activities to an employee appropriately trained to do the task(s).

2. Risk Level 2 dischargers shall perform weekly inspections and observations, and at least once each 24-hour period during extended storm events, to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. Inspectors shall be the QSP or be trained by the QSP.

3. Upon identifying failures or other shortcomings, as directed by the QSP, Risk Level 2 dischargers shall begin implementing repairs or

design changes to BMPs within 72 hours of identification and complete the changes as soon as possible.

4. For each inspection required, Risk Level 2 dischargers shall complete an inspection checklist, using a form provided by the State Water Board or Regional Water Board or in an alternative format.

5. Risk Level 2 dischargers shall ensure that checklists shall remain onsite with the SWPPP and at a minimum, shall include:

   a. Inspection date and date the inspection report was written.

   b. Weather information, including presence or absence of precipitation, estimate of beginning of qualifying storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall in inches.

   c. Site information, including stage of construction, activities completed, and approximate area of the site exposed.

   d. A description of any BMPs evaluated and any deficiencies noted.

   e. If the construction site is safely accessible during inclement weather, list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list the results of visual inspections at all relevant outfalls, discharge points, downstream locations and any projected maintenance activities.

   f. Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.

   g. Any corrective actions required, including any necessary changes to the SWPPP and the associated implementation dates.

   h. Photographs taken during the inspection, if any.

   i. Inspector's name, title, and signature.

H. Rain Event Action Plan

1. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP develop a Rain Event Action Plan (REAP) 48 hours prior to any likely precipitation event. A likely precipitation event is any weather pattern that is forecast to have a 50% or greater probability of producing precipitation in the project area. The discharger shall

ensure a QSP obtain a printed copy of precipitation forecast information from the National Weather Service Forecast Office (e.g., by entering the zip code of the project's location at http://www.srh.noaa.gov/forecast).

2. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP develop the REAPs for all phases of construction (i.e., Grading and Land Development, Streets and Utilities, Vertical Construction, Final Landscaping and Site Stabilization).

3. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP ensure that the REAP include, at a minimum, the following site information:

   a. Site Address
   b. Calculated Risk Level (2 or 3)
   c. Site Storm Water Manager Information including the name, company, and 24-hour emergency telephone number
   d. Erosion and Sediment Control Provider information including the name, company, and 24-hour emergency telephone number
   e. Storm Water Sampling Agent information including the name, company, and 24-hour emergency telephone number

4. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP include in the REAP, at a minimum, the following project phase information:

   a. Activities associated with each construction phase
   b. Trades active on the construction site during each construction phase
   c. Trade contractor information
   d. Suggested actions for each project phase

5. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP develop additional REAPs for project sites where construction activities are indefinitely halted or postponed (Inactive Construction). At a minimum, Inactive Construction REAPs must include:

   a. Site Address
   b. Calculated Risk Level (2 or 3)
   c. Site Storm Water Manager Information including the name, company, and 24-hour emergency telephone number
   d. Erosion and Sediment Control Provider information including the name, company, and 24-hour emergency telephone number
   e. Storm Water Sampling Agent information including the name, company, and 24-hour emergency telephone number

f. Trades active on site during Inactive Construction
g. Trade contractor information
h. Suggested actions for inactive construction sites

6. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP begin implementation and make the REAP available onsite no later than 24 hours prior to the likely precipitation event.

7. **Additional Risk Level 2 Requirement:** The discharger shall ensure a QSP maintain onsite a paper copy of each REAP onsite in compliance with the record retention requirements of the Special Provisions in this General Permit.

I. Risk Level 2 Monitoring and Reporting Requirements

Table 2- Summary of Monitoring Requirements

Risk Level	Visual Inspections					Sample Collection	
	Quarterly Non-storm Water Discharge	Pre-storm Event		Daily Storm BMP	Post Storm	Storm Water Discharge	Receiving Water
		Baseline	REAP				
2	X	X	X	X	X	X	

1. Construction Site Monitoring Program Requirements

   a. Pursuant to Water Code Sections 13383 and 13267, all dischargers subject to this General Permit shall develop and implement a written site-specific Construction Site Monitoring Program (CSMP) in accordance with the requirements of this Section. The CSMP shall include all monitoring procedures and instructions, location maps, forms, and checklists as required in this section. The CSMP shall be developed prior to the commencement of construction activities, and revised as necessary to reflect project revisions. The CSMP shall be a part of the Storm Water Pollution Prevention Plan (SWPPP), included as an appendix or separate SWPPP chapter.

   b. Existing dischargers registered under the State Water Board Order No. 99-08-DWQ shall make and implement necessary revisions to their Monitoring Program to reflect the changes in this General Permit in a timely manner, but no later than July 1, 2010. Existing dischargers shall continue to implement their existing Monitoring Programs in compliance with State Water Board Order No. 99-08-DWQ until the necessary revisions are completed according to the schedule above.

   c. When a change of ownership occurs for all or any portion of the construction site prior to completion or final stabilization, the new discharger shall comply with these requirements as of the date the ownership change occurs.

2. **Objectives**

   The CSMP shall be developed and implemented to address the following objectives:

a. To demonstrate that the site is in compliance with the Discharge Prohibitions and applicable Numeric Action Levels (NALs)/Numeric Effluent Limitations (NELs) of this General Permit.

b. To determine whether non-visible pollutants are present at the construction site and are causing or contributing to exceedances of water quality objectives.

c. To determine whether immediate corrective actions, additional Best Management Practice (BMP) implementation, or SWPPP revisions are necessary to reduce pollutants in storm water discharges and authorized non-storm water discharges.

d. To determine whether BMPs included in the SWPPP/Rain Event Action Plan (REAP) are effective in preventing or reducing pollutants in storm water discharges and authorized non-storm water discharges.

3. **Risk Level 2 – Visual Monitoring (Inspection) Requirements for Qualifying Rain Events**

a. Risk Level 2 dischargers shall visually observe (inspect) storm water discharges at all discharge locations within two business days (48 hours) after each qualifying rain event.

b. Risk Level 2 dischargers shall visually observe (inspect) the discharge of stored or contained storm water that is derived from and discharged subsequent to a qualifying rain event producing precipitation of ½ inch or more at the time of discharge. Stored or contained storm water that will likely discharge after operating hours due to anticipated precipitation shall be observed prior to the discharge during operating hours.

c. Risk Level 2 dischargers shall conduct visual observations (inspections) during business hours only.

d. Risk Level 2 dischargers shall record the time, date and rain gauge reading of all qualifying rain events.

e. Within 2 business days (48 hours) prior to each qualifying rain event, Risk Level 2 dischargers shall visually observe (inspect):

i. all storm water drainage areas to identify any spills, leaks, or uncontrolled pollutant sources. If needed, the discharger shall implement appropriate corrective actions.

ii. all BMPs to identify whether they have been properly implemented in accordance with the SWPPP/REAP. If needed, the discharger shall implement appropriate corrective actions.

iii. any storm water storage and containment areas to detect leaks and ensure maintenance of adequate freeboard.

f. For the visual observations (inspections) described in c.i and c.iii above, Risk Level 2 dischargers shall observe the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

g. Within two business days (48 hours) after each qualifying rain event, Risk Level 2 dischargers shall conduct post rain event visual observations (inspections) to (1) identify whether BMPs were adequately designed, implemented, and effective, and (2) identify additional BMPs and revise the SWPPP accordingly.

h. Risk Level 2 dischargers shall maintain on-site records of all visual observations (inspections), personnel performing the observations, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations.

4. **Risk Level 2 – Water Quality Sampling and Analysis**

a. Risk Level 2 dischargers shall collect storm water grab samples from sampling locations, as defined in Section I.5. The storm water grab sample(s) obtained shall be representative of the flow and characteristics of the discharge.

b. At minimum, Risk Level 2 dischargers shall collect 3 samples per day of the qualifying event.

c. Risk Level 2 dischargers shall ensure that the grab samples collected of stored or contained storm water are from discharges subsequent to a qualifying rain event (producing precipitation of ½ inch or more at the time of discharge).

<u>Storm Water Effluent Monitoring Requirements</u>

d. Risk Level 2 dischargers shall analyze their effluent samples for:

i. pH and turbidity.

ii. Any additional parameters for which monitoring is required by the Regional Water Board.

5. **Risk Level 2 – Storm Water Discharge Water Quality Sampling Locations**

Effluent Sampling Locations

a. Risk Level 2 dischargers shall perform sampling and analysis of storm water discharges to characterize discharges associated with construction activity from the entire project disturbed area.

b. Risk Level 2 dischargers shall collect effluent samples at all discharge points where storm water is discharged off-site.

c. Risk Level 2 dischargers shall ensure that storm water discharge collected and observed represent[4] the effluent in each drainage area based on visual observation of the water and upstream conditions.

d. Risk Level 2 dischargers shall monitor and report site run-on from surrounding areas if there is reason to believe run-on may contribute to an exceedance of NALs or NELs.

e. Risk Level 2 dischargers who deploy an ATS on their site, or a portion on their site, shall collect ATS effluent samples and measurements from the discharge pipe or another location representative of the nature of the discharge.

f. Risk Level 2 dischargers shall select analytical test methods from the list provided in Table 3 below.

g. All storm water sample collection preservation and handling shall be conducted in accordance with Section I.7 “Storm Water Sample Collection and Handling Instructions” below.

6. **Risk Level 2 – Visual Observation and Sample Collection Exemptions**

a. Risk Level 2 dischargers shall be prepared to collect samples and conduct visual observation (inspections) until the minimum requirements of Sections I.3 and I.4 above are completed. Risk

[4] For example, if there has been concrete work recently in an area, or drywall scrap is exposed to the rain, a pH sample shall be taken of drainage from the relevant work area. Similarly, if sediment laden water is flowing through some parts of a silt fence, samples shall be taken of the sediment-laden water even if most water flowing through the fence is clear.

Level 2 dischargers are not required to physically collect samples or conduct visual observation (inspections) under the following conditions:

i. During dangerous weather conditions such as flooding and electrical storms.

ii. Outside of scheduled site business hours.

b. If no required samples or visual observation (inspections) are collected due to these exceptions, Risk Level 2 dischargers shall include an explanation in their SWPPP and in the Annual Report documenting why the sampling or visual observation (inspections) were not conducted.

7. **Risk Level 2 – Storm Water Sample Collection and Handling Instructions**

a. Risk Level 2 dischargers shall refer to Table 3 below for test methods, detection limits, and reporting units.

b. Risk Level 2 dischargers shall ensure that testing laboratories will receive samples within 48 hours of the physical sampling (unless otherwise required by the laboratory), and shall use only the sample containers provided by the laboratory to collect and store samples.

c. Risk Level 2 dischargers shall designate and train personnel to collect, maintain, and ship samples in accordance with the Surface Water Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).[5]

8. **Risk Level 2 – Monitoring Methods**

a. Risk Level 2 dischargers shall include a description of the following items in the CSMP:

i. Visual observation locations, visual observation procedures, and visual observation follow-up and tracking procedures.

ii. Sampling locations, and sample collection and handling procedures. This shall include detailed procedures for sample

[5] Additional information regarding SWAMP's QAPrP and QAMP can be found at http://www.waterboards.ca.gov/water_issues/programs/swamp/.
QAPrP:http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf.
QAMP: http://www.waterboards.ca.gov/water_issues/programs/swamp/qamp.shtml.

collection, storage, preservation, and shipping to the testing lab to assure that consistent quality control and quality assurance is maintained. Dischargers shall attach to the monitoring program an example Chain of Custody form used when handling and shipping samples.

iii. Identification of the analytical methods and related method detection limits (if applicable) for each parameter required in Section I.4 above.

b. Risk Level 2 dischargers shall ensure that all sampling and sample preservation are in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment (including a discharger's own field instruments for measuring pH and turbidity) should be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements. Risk Level 2 dischargers shall ensure that all laboratory analyses are conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this General Permit or by the Regional Water Board. With the exception of field analysis conducted by the discharger for turbidity and pH, all analyses should be sent to and conducted at a laboratory certified for such analyses by the State Department of Health Services. Risk Level 2 dischargers shall conduct their own field analysis of pH and may conduct their own field analysis of turbidity if the discharger has sufficient capability (qualified and trained employees, properly calibrated and maintained field instruments, etc.) to adequately perform the field analysis.

9. **Risk Level 2 – Analytical Methods**

a. Risk Level 2 dischargers shall refer to Table 3 below for test methods, detection limits, and reporting units.

b. **pH**: Risk Level 2 dischargers shall perform pH analysis on-site with a calibrated pH meter or a pH test kit. Risk Level 2 dischargers shall record pH monitoring results on paper and retain these records in accordance with Section I.14, below.

c. **Turbidity**: Risk Level 2 dischargers shall perform turbidity analysis using a calibrated turbidity meter (turbidimeter), either on-site or at an accredited lab. Acceptable test methods include Standard Method 2130 or USEPA Method 180.1. The results will be recorded in the site log book in Nephelometric Turbidity Units (NTU).

10. **Risk Level 2 - Non-Storm Water Discharge Monitoring Requirements**

    a. Visual Monitoring Requirements:

        i. Risk Level 2 dischargers shall visually observe (inspect) each drainage area for the presence of (or indications of prior) unauthorized and authorized non-storm water discharges and their sources.

        ii. Risk Level 2 dischargers shall conduct one visual observation (inspection) quarterly in each of the following periods: January-March, April-June, July-September, and October-December. Visual observation (inspections) are only required during daylight hours (sunrise to sunset).

        iii. Risk Level 2 dischargers shall ensure that visual observations (inspections) document the presence or evidence of any non-storm water discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source. Risk Level 2 dischargers shall maintain on-site records indicating the personnel performing the visual observation (inspections), the dates and approximate time each drainage area and non-storm water discharge was observed, and the response taken to eliminate unauthorized non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water discharges.

    b. Effluent Sampling Locations:

        i. Risk Level 2 dischargers shall sample effluent at all discharge points where non-storm water and/or authorized non-storm water is discharged off-site.

        ii. Risk Level 2 dischargers shall send all non-storm water sample analyses to a laboratory certified for such analyses by the State Department of Health Services.

        iii. Risk Level 2 dischargers shall monitor and report run-on from surrounding areas if there is reason to believe run-on may contribute to an exceedance of NALs.

11. **Risk Level 2 – Non-Visible Pollutant Monitoring Requirements**

a. Risk Level 2 dischargers shall collect one or more samples during any breach, malfunction, leakage, or spill observed during a visual inspection which could result in the discharge of pollutants to surface waters that would not be visually detectable in storm water.

b. Risk Level 2 dischargers shall ensure that water samples are large enough to characterize the site conditions.

c. Risk Level 2 dischargers shall collect samples at all discharge locations that can be safely accessed.

d. Risk Level 2 dischargers shall collect samples during the first two hours of discharge from rain events that occur during business hours and which generate runoff.

e. Risk Level 2 dischargers shall analyze samples for all non-visible pollutant parameters (if applicable) - parameters indicating the presence of pollutants identified in the pollutant source assessment required (Risk Level 2 dischargers shall modify their CSMPs to address these additional parameters in accordance with any updated SWPPP pollutant source assessment).

f. Risk Level 2 dischargers shall collect a sample of storm water that has not come in contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample) for comparison with the discharge sample.

g. Risk Level 2 dischargers shall compare the uncontaminated sample to the samples of discharge using field analysis or through laboratory analysis.[6]

h. Risk Level 2 dischargers shall keep all field /or analytical data in the SWPPP document.

12. **Risk Level 2 – Watershed Monitoring Option**

Risk Level 2 dischargers who are part of a qualified regional watershed-based monitoring program may be eligible for relief from the requirements in Sections I.5. The Regional Water Board may approve proposals to substitute an acceptable watershed-based monitoring program by determining if the watershed-based monitoring program

[6] For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136. Field discharge samples shall be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed.

will provide substantially similar monitoring information in evaluating discharger compliance with the requirements of this General Permit.

13. **Risk Level 2 – Particle Size Analysis for Project Risk Justification**

    Risk Level 2 dischargers justifying an alternative project risk shall report a soil particle size analysis used to determine the RUSLE K-Factor. ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, shall be used to determine the percentages of sand, very fine sand, silt, and clay on the site.

14. **Risk Level 2 – Records**

    Risk Level 2 dischargers shall retain records of all storm water monitoring information and copies of all reports (including Annual Reports) for a period of at least three years. Risk Level 2 dischargers shall retain all records on-site while construction is ongoing. These records include:

    a. The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation.

    b. The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and or measurements.

    c. The date and approximate time of analyses.

    d. The individual(s) who performed the analyses.

    e. A summary of all analytical results from the last three years, the method detection limits and reporting units, the analytical techniques or methods used, and the chain of custody forms.

    f. Rain gauge readings from site inspections;

    g. Quality assurance/quality control records and results.

    h. Non-storm water discharge inspections and visual observation (inspections) and storm water discharge visual observation records (see Sections I.3 and I.10 above).

    i. Visual observation and sample collection exception records (see Section I.6 above).

j. The records of any corrective actions and follow-up activities that resulted from analytical results, visual observation (inspections), or inspections.

15. **Risk Level 2 – NAL Exceedance Report**

a. In the event that any effluent sample exceeds an applicable NAL, Risk Level 2 dischargers shall electronically submit all storm event sampling results to the State Water Board no later than 10 days after the conclusion of the storm event. The Regional Boards have the authority to require the submittal of an NAL Exceedance Report.

b. Risk Level 2 dischargers shall certify each NAL Exceedance Report in accordance with the Special Provisions for Construction Activity.

c. Risk Level 2 dischargers shall retain an electronic or paper copy of each NAL Exceedance Report for a minimum of three years after the date the annual report is filed.

d. Risk Level 2 dischargers shall include in the NAL Exceedance Report:

i. The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as “less than the method detection limit”).

ii. The date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation.

iii. A description of the current BMPs associated with the effluent sample that exceeded the NAL and the proposed corrective actions taken.

Table 3 – Risk Level 2 Test Methods, Detection Limits, Reporting Units and Applicable NALs/NELs

Parameter	Test Method / Protocol	Discharge Type	Min. Detection Limit	Reporting Units	Numeric Action Level
pH	Field test with calibrated portable instrument	Risk Level 2 Discharges	0.2 pH	units	lower NAL = 6.5 upper NAL = 8.5
Turbidity EPA	0180.1 and/or field test with calibrated portable instrument	Risk Level 2 Discharges other than ATS	1 NTU		250 NTU
		For ATS discharges	1 NTU		N/A

ATTACHMENT E
RISK LEVEL 3 REQUIREMENTS

A. Effluent Standards

[These requirements are the same as those in the General Permit order.]

1. Narrative – Risk Level 3 dischargers shall comply with the narrative effluent standards listed below:

   a. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

   b. Dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

2. Numeric –Risk Level 3 dischargers are subject to a pH NAL of 6.5-8.5, and a turbidity NAL of 250 NTU. In addition, Risk Level 3 dischargers are subject to a pH NEL of 6.0-9.0 and a turbidity NEL of 500 NTU.

B. Good Site Management "Housekeeping"

1. Risk Level 3 dischargers shall implement good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged. At a minimum, Risk Level 3 dischargers shall implement the following good housekeeping measures:

   a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

   b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

e. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.

2. Risk Level 3 dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.

c. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

d. Cover waste disposal containers at the end of every business day and during a rain event.

e. Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

f. Contain and securely protecting stockpiled waste material from wind and rain at all times unless actively being used.

g. Implement procedures that effectively address hazardous and non-hazardous spills.

h. Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities. The SWPPP shall require that:

i. Equipment and materials for cleanup of spills shall be available on site and that spills and leaks shall be cleaned up immediately and disposed of properly; and

ii. Appropriate spill response personnel are assigned and trained.

i. Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

3. Risk Level 3 dischargers shall implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:

   a. Prevent oil, grease, or fuel to leak in to the ground, storm drains or surface waters.

   b. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate BMPs.

   c. Clean leaks immediately and disposing of leaked materials properly.

4. Risk Level 3 dischargers shall implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:

   a. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.

   b. Contain fertilizers and other landscape materials when they are not actively being used.

   c. Discontinuing the application of any erodible landscape material within 2 days before a forecasted rain event or during periods of precipitation.

   d. Applying erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.

   e. Stacking erodible landscape material on pallets and covering or storing such materials when not being used or applied.

5. Risk Level 3 dischargers shall conduct an assessment and create a list of potential pollutant sources and identify any areas of the site where additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. This potential pollutant list shall be kept with the SWPPP and shall identify

all non-visible pollutants which are known, or should be known, to occur on the construction site. At a minimum, when developing BMPs, Risk Level 3 dischargers shall do the following:

a. Consider the quantity, physical characteristics (e.g., liquid, powder, solid), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.

b. Consider the degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.

c. Consider the direct and indirect pathways that pollutants may be exposed to storm water or authorized non-storm water discharges. This shall include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.

d. Ensure retention of sampling, visual observation, and inspection records.

e. Ensure effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

6. Risk Level 3 dischargers shall implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations. Such particulates can include, but are not limited to, sediment, nutrients, trash, metals, bacteria, oil and grease and organics.

7. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall document all housekeeping BMPs in the SWPPP and REAP(s) in accordance with the nature and phase of the construction project. Construction phases at traditional land development projects include Grading and Land Development Phase, Streets and Utilities, or Vertical Construction for traditional land development projects.

C. Non-Storm Water Management

1. Risk Level 3 dischargers shall implement measures to control all non-storm water discharges during construction.

2. Risk Level 3 dischargers shall wash vehicles in such a manner as to prevent non-storm water discharges to surface waters or MS4 drainage systems.

3. Risk Level 3 dischargers shall clean streets in such a manner as to prevent unauthorized non-storm water discharges from reaching surface water or MS4 drainage systems.

D. Erosion Control

1. Risk Level 3 dischargers shall implement effective wind erosion control.

2. Risk Level 3 dischargers shall provide effective soil cover for inactive[1] areas and all finished slopes, open space, utility backfill, and completed lots.

3. Dischargers shall limit the use of plastic materials when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

E. Sediment Controls

1. Risk Level 3 dischargers shall establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.

2. On sites where sediment basins are to be used, Risk Level 3 dischargers shall, at minimum, design sediment basins according to the method provided in CASQA's Construction BMP Guidance Handbook.

3. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall implement appropriate erosion control BMPs (runoff control and soil stabilization) in conjunction with sediment control BMPs for areas under active[2] construction.

4. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall apply linear sediment controls along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes to comply with sheet flow lengths[3] in accordance with Table 1.

---

[1] Inactive areas of construction are areas of construction activity that have been disturbed and are not scheduled to be re-disturbed for at least 14 days.
[2] Active areas of construction are areas undergoing land surface disturbance. This includes construction activity during the preliminary stage, mass grading stage, streets and utilities stage and the vertical construction stage
[3] Sheet flow length is the length that shallow, low velocity flow travels across a site.

Table 1 - Critical Slope/Sheet Flow Length Combinations

Slope Percentage	Sheet flow length not to exceed
0-25% 20	feet
25-50% 15	feet
Over 50%	10 feet

5. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall ensure that construction activity traffic to and from the project is limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment.

6. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall ensure that all storm drain inlets and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits (e.g. tire washoff locations) are maintained and protected from activities that reduce their effectiveness.

7. **Additional Risk Level 3 Requirement:** Risk Level 3 dischargers shall inspect on a daily basis all immediate access roads daily. At a minimum daily (when necessary) and prior to any rain event, the discharger shall remove any sediment or other construction activity-related materials that are deposited on the roads (by vacuuming or sweeping).

8. **Additional Risk Level 3 Requirement:** The Regional Water Board may require Risk Level 3 dischargers to implement additional site-specific sediment control requirements if the implementation of the other requirements in this section are not adequately protecting the receiving waters.

F. Run-on and Run-off Controls

Risk Level 3 dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off site shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this General Permit.

G. Inspection, Maintenance and Repair

1. Risk Level 3 dischargers shall ensure that all inspection, maintenance repair and sampling activities at the project location shall be performed or supervised by a Qualified SWPPP Practitioner (QSP) representing the discharger. The QSP may delegate any or all of these activities to an employee appropriately trained to do the task(s).

2. Risk Level 3 dischargers shall perform weekly inspections and observations, and at least once each 24-hour period during extended storm events, to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. Inspectors shall be the QSP or be trained by the QSP.

3. Upon identifying failures or other shortcomings, as directed by the QSP, Risk Level 3 dischargers shall begin implementing repairs or design changes to BMPs within 72 hours of identification and complete the changes as soon as possible.

4. For each inspection required, Risk Level 3 dischargers shall complete an inspection checklist, using a form provided by the State Water Board or Regional Water Board or in an alternative format.

5. Risk Level 3 dischargers shall ensure that checklists shall remain onsite with the SWPPP and at a minimum, shall include:

    a. Inspection date and date the inspection report was written.

    b. Weather information, including presence or absence of precipitation, estimate of beginning of qualifying storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall in inches.

    c. Site information, including stage of construction, activities completed, and approximate area of the site exposed.

    d. A description of any BMPs evaluated and any deficiencies noted.

    e. If the construction site is safely accessible during inclement weather, list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list the results of visual inspections at all relevant outfalls, discharge points, downstream locations and any projected maintenance activities.

    f. Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.

    g. Any corrective actions required, including any necessary changes to the SWPPP and the associated implementation dates.

    h. Photographs taken during the inspection, if any.

i. Inspector's name, title, and signature.

H. Rain Event Action Plan

1. **Additional Risk Level 3 Requirement:** The discharger shall ensure a QSP develop a Rain Event Action Plan (REAP) 48 hours prior to any likely precipitation event. A likely precipitation event is any weather pattern that is forecast to have a 50% or greater probability of producing precipitation in the project area. The QSP shall obtain a printed copy of precipitation forecast information from the National Weather Service Forecast Office (e.g., by entering the zip code of the project's location at http://www.srh.noaa.gov/forecast).

2. **Additional Risk Level 3 Requirement:** The discharger shall ensure a QSP develop the REAPs for all phases of construction (i.e., Grading and Land Development, Streets and Utilities, Vertical Construction, Final Landscaping and Site Stabilization).

3. **Additional Risk Level 3 Requirement:** The discharger shall ensure a QSP ensure that the REAP include, at a minimum, the following site information:

   a. Site Address.
   b. Calculated Risk Level (2 or 3).
   c. Site Storm Water Manager Information including the name, company, and 24-hour emergency telephone number.
   d. Erosion and Sediment Control Provider information including the name, company, and 24-hour emergency telephone number.
   e. Storm Water Sampling Agent information including the name, company, and 24-hour emergency telephone number.

4. **Additional Risk Level 3 Requirement:** The QSP shall include in the REAP, at a minimum, the following project phase information:

   a. Activities associated with each construction phase.
   b. Trades active on the construction site during each construction phase.
   c. Trade contractor information.
   d. Suggested actions for each project phase.

5. **Additional Risk Level 3 Requirement:** The QSP shall develop additional REAPs for project sites where construction activities are indefinitely halted or postponed (Inactive Construction). At a minimum, Inactive Construction REAPs must include:

a. Site Address.
b. Calculated Risk Level (2 or 3).
c. Site Storm Water Manager Information including the name, company, and 24-hour emergency telephone number.
d. Erosion and Sediment Control Provider information including the name, company, and 24-hour emergency telephone number.
e. Storm Water Sampling Agent information including the name, company, and 24-hour emergency telephone number.
f. Trades active on site during Inactive Construction.
g. Trade contractor information.
h. Suggested actions for inactive construction sites.

6. **Additional Risk Level 3 Requirement:** The discharger shall ensure a QSP begin implementation and make the REAP available onsite no later than 24 hours prior to the likely precipitation event.

7. **Additional Risk Level 3 Requirement:** The discharger shall ensure a QSP maintain onsite a paper copy of each REAP onsite in compliance with the record retention requirements of the Special Provisions in this General Permit.

I. Risk Level 3 Monitoring and Reporting Requirements

Table 2- Summary of Monitoring Requirements

Risk Level	Visual Inspections					Sample Collection	
	Quarterly Non-storm Water Discharge	Pre-storm Event		Daily Storm BMP	Post Storm	Storm Water Discharge	Receiving Water
		Baseline	REAP				
3	X	X	X	X	X	X	X[4]

1. Construction Site Monitoring Program Requirements

   a. Pursuant to Water Code Sections 13383 and 13267, all dischargers subject to this General Permit shall develop and implement a written site-specific Construction Site Monitoring Program (CSMP) in accordance with the requirements of this Section. The CSMP shall include all monitoring procedures and instructions, location maps, forms, and checklists as required in this section. The CSMP shall be developed prior to the commencement of construction activities, and revised as necessary to reflect project revisions. The CSMP shall be a part of the Storm Water Pollution Prevention Plan (SWPPP), included as an appendix or separate SWPPP chapter.

   b. Existing dischargers registered under the State Water Board Order No. 99-08-DWQ shall make and implement necessary revisions to their Monitoring Program to reflect the changes in this General Permit in a timely manner, but no later than July 1, 2010. Existing dischargers shall continue to implement their existing Monitoring Program in compliance with State Water Board Order No. 99-08-DWQ until the necessary revisions are completed according to the schedule above.

   c. When a change of ownership occurs for all or any portion of the construction site prior to completion or final stabilization, the new discharger shall comply with these requirements as of the date the ownership change occurs.

2. **Objectives**

   The CSMP shall be developed and implemented to address the following objectives:

[4] When NEL exceeded

a. To demonstrate that the site is in compliance with the Discharge Prohibitions and applicable Numeric Action Levels (NALs)/Numeric Effluent Limitations (NELs) of this General Permit.

b. To determine whether non-visible pollutants are present at the construction site and are causing or contributing to exceedances of water quality objectives.

c. To determine whether immediate corrective actions, additional Best Management Practice (BMP) implementation, or SWPPP revisions are necessary to reduce pollutants in storm water discharges and authorized non-storm water discharges.

d. To determine whether BMPs included in the SWPPP/Rain Event Action Plan (REAP) are effective in preventing or reducing pollutants in storm water discharges and authorized non-storm water discharges.

3. **Risk Level 3 – Visual Monitoring (Inspection) Requirements for Qualifying Rain Events**

a. Risk Level 3 dischargers shall visually observe (inspect) storm water discharges at all discharge locations within two business days (48 hours) after each qualifying rain event.

b. Risk Level 3 dischargers shall visually observe (inspect) the discharge of stored or contained storm water that is derived from and discharged subsequent to a qualifying rain event producing precipitation of ½ inch or more at the time of discharge. Stored or contained storm water that will likely discharge after operating hours due to anticipated precipitation shall be observed prior to the discharge during operating hours.

c. Risk Level 3 dischargers shall conduct visual observations (inspections) during business hours only.

d. Risk Level 3 dischargers shall record the time, date and rain gauge reading of all qualifying rain events.

e. Within 2 business days (48 hours) prior to each qualifying rain event, Risk Level 3 dischargers shall visually observe (inspect):

i. all storm water drainage areas to identify any spills, leaks, or uncontrolled pollutant sources. If needed, the discharger shall implement appropriate corrective actions.

ii. all BMPs to identify whether they have been properly implemented in accordance with the SWPPP/REAP. If needed, the discharger shall implement appropriate corrective actions.

iii. any storm water storage and containment areas to detect leaks and ensure maintenance of adequate freeboard.

f. For the visual observations (inspections) described in c.i. and c.iii above, Risk Level 3 dischargers shall observe the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

g. Within two business days (48 hours) after each qualifying rain event, Risk Level 3 dischargers shall conduct post rain event visual observations (inspections) to (1) identify whether BMPs were adequately designed, implemented, and effective, and (2) identify additional BMPs and revise the SWPPP accordingly.

h. Risk Level 3 dischargers shall maintain on-site records of all visual observations (inspections), personnel performing the observations, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations.

4. **Risk Level 3 – Water Quality Sampling and Analysis**

a. Risk Level 3 dischargers shall collect storm water grab samples from sampling locations, as defined in Section I.5. The storm water grab sample(s) obtained shall be representative of the flow and characteristics of the discharge.

b. At minimum, Risk Level 3 dischargers shall collect 3 samples per day of the qualifying event.

c. Risk Level 3 dischargers shall ensure that the grab samples collected of stored or contained storm water are from discharges subsequent to a qualifying rain event (producing precipitation of ½ inch or more at the time of discharge).

<u>Storm Water Effluent Monitoring Requirements</u>

d. Risk Level 3 dischargers shall analyze their effluent samples for:

i. pH and turbidity.

ii. Any additional parameters for which monitoring is required by the Regional Water Board.

e. Risk 3 dischargers shall electronically submit all storm event sampling results to the State Water Board no later than 5 days after the conclusion of the storm event.

f. Risk Level 3 discharger sites that have violated the turbidity daily average NEL shall analyze subsequent effluent samples for all the parameters specified in Section I.4.e, above, and Suspended Sediment Concentration (SSC).

Receiving Water Monitoring Requirements

g. In the event that a Risk Level 3 discharger violates an NEL contained in this General Permit and has a direct discharge into receiving waters, the Risk Level 3 discharger shall subsequently sample receiving waters (RWs) for all parameter(s) required in Section I.4.e above for the duration of coverage under this General Permit.

h. Risk Level 3 dischargers disturbing 30 acres or more of the landscape and with direct discharges into receiving waters shall conduct or participate in benthic macroinvertebrate bioassessment of RWs prior to commencement of construction activity (See Appendix 3).

i. Risk Level 3 dischargers shall obtain RW samples in accordance with the Receiving Water sampling location section (Section I.5), below.

5. **Risk Level 3 – Storm Water Discharge Water Quality Sampling Locations**

Effluent Sampling Locations

a. Risk Level 3 dischargers shall perform sampling and analysis of storm water discharges to characterize discharges associated with construction activity from the entire project disturbed area.

b. Risk Level 3 dischargers shall collect effluent samples at all discharge points where storm water is discharged off-site.

c. Risk Level 3 dischargers shall ensure that storm water discharge collected and observed represent[5] the effluent in each drainage area based on visual observation of the water and upstream conditions.

d. Risk Level 3 dischargers shall monitor and report site run-on from surrounding areas if there is reason to believe run-on may contribute to an exceedance of NALs or NELs.

e. Risk Level 3 dischargers who deploy an ATS on their site, or a portion on their site, shall collect ATS effluent samples and measurements from the discharge pipe or another location representative of the nature of the discharge.

f. Risk Level 3 dischargers shall select analytical test methods from the list provided in Table 3 below.

g. All storm water sample collection preservation and handling shall be conducted in accordance with Section I.7 "Storm Water Sample Collection and Handling Instructions" below.

Receiving Water Sampling Locations

h. **Upstream/up-gradient RW samples**: Risk Level 3 dischargers shall obtain any required upstream/up-gradient receiving water samples from a representative and accessible location as close as possible and upstream from the effluent discharge point.

i. **Downstream/down-gradient RW samples**: Risk Level 3 dischargers shall obtain any required downstream/down-gradient receiving water samples from a representative and accessible location as close as possible and downstream from the effluent discharge point.

j. If two or more discharge locations discharge to the same receiving water, Risk Level 3 dischargers may sample the receiving water at a single upstream and downstream location.

[5] For example, if there has been concrete work recently in an area, or drywall scrap is exposed to the rain, a pH sample shall be taken of drainage from the relevant work area. Similarly, if sediment-laden water is flowing through some parts of a silt fence, samples shall be taken of the sediment laden water even if most water flowing through the fence is clear.

6. **Risk Level 3 – Visual Observation and Sample Collection Exemptions**

   a. Risk Level 3 dischargers shall be prepared to collect samples and conduct visual observation (inspections) until the minimum requirements of Sections I.3 and I.4 above are completed. Risk Level 3 dischargers are not required to physically collect samples or conduct visual observation (inspections) under the following conditions:

      i. During dangerous weather conditions such as flooding and electrical storms.

      ii. Outside of scheduled site business hours.

   b. If no required samples or visual observation (inspections) are collected due to these exceptions, Risk Level 3 dischargers shall include an explanation in their SWPPP and in the Annual Report documenting why the sampling or visual observation (inspections) were not conducted.

7. **Risk Level 3 – Storm Water Sample Collection and Handling Instructions**

   a. Risk Level 3 dischargers shall refer to Table 3 below for test methods, detection limits, and reporting units.

   b. Risk Level 3 dischargers shall ensure that testing laboratories will receive samples within 48 hours of the physical sampling (unless otherwise required by the laboratory), and shall use only the sample containers provided by the laboratory to collect and store samples.

   c. Risk Level 3 dischargers shall designate and train personnel to collect, maintain, and ship samples in accordance with the Surface Water Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).[6]

[6] Additional information regarding SWAMP's QAPrP and QAMP can be found at http://www.waterboards.ca.gov/water_issues/programs/swamp/.
QAPrP:http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf
QAMP: http://www.waterboards.ca.gov/water_issues/programs/swamp/qamp.shtml

8. **Risk Level 3 – Monitoring Methods**

   a. Risk Level 3 dischargers shall include a description of the following items in the CSMP:

      i. Visual observation locations, visual observation procedures, and visual observation follow-up and tracking procedures.

      ii. Sampling locations, and sample collection and handling procedures. This shall include detailed procedures for sample collection, storage, preservation, and shipping to the testing lab to assure that consistent quality control and quality assurance is maintained. Dischargers shall attach to the monitoring program an example Chain of Custody form used when handling and shipping samples.

      iii. Identification of the analytical methods and related method detection limits (if applicable) for each parameter required in Section I.4 above.

   b. Risk Level 3 dischargers shall ensure that all sampling and sample preservation are in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment (including a discharger's own field instruments for measuring pH and turbidity) should be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements. Risk Level 3 dischargers shall ensure that all laboratory analyses are conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this General Permit or by the Regional Water Board. With the exception of field analysis conducted by the discharger for turbidity and pH, all analyses should be sent to and conducted at a laboratory certified for such analyses by the State Department of Health Services (SSC exception). Risk Level 3 dischargers shall conduct their own field analysis of pH and may conduct their own field analysis of turbidity if the discharger has sufficient capability (qualified and trained employees, properly calibrated and maintained field instruments, etc.) to adequately perform the field analysis.

9. **Risk Level 3 – Analytical Methods**

   a. Risk Level 3 dischargers shall refer to Table 3 below for test methods, detection limits, and reporting units.

b. **pH**: Risk Level 3 dischargers shall perform pH analysis on-site with a calibrated pH meter or a pH test kit. Risk Level 3 dischargers shall record pH monitoring results on paper and retain these records in accordance with Section I.14, below.

c. **Turbidity**: Risk Level 3 dischargers shall perform turbidity analysis using a calibrated turbidity meter (turbidimeter), either on-site or at an accredited lab. Acceptable test methods include Standard Method 2130 or USEPA Method 180.1. The results will be recorded in the site log book in Nephelometric Turbidity Units (NTU).

d. **Suspended sediment concentration (SSC)**: Risk Level 3 dischargers shall perform SSC analysis using ASTM Method D3977-97.

e. **Bioassessment**: Risk Level 3 dischargers shall perform bioassessment sampling and analysis according to Appendix 3 of this General Permit.

10. **Risk Level 3 - Non-Storm Water Discharge Monitoring Requirements**

a. Visual Monitoring Requirements:

i. Risk Level 3 dischargers shall visually observe (inspect) each drainage area for the presence of (or indications of prior) unauthorized and authorized non-storm water discharges and their sources.

ii. Risk Level 3 dischargers shall conduct one visual observation (inspection) quarterly in each of the following periods: January-March, April-June, July-September, and October-December. Visual observation (inspections) are only required during daylight hours (sunrise to sunset).

iii. Risk Level 3 dischargers shall ensure that visual observations (inspections) document the presence or evidence of any non-storm water discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source. Risk Level 3 dischargers shall maintain on-site records indicating the personnel performing the visual observation (inspections), the dates and approximate time each drainage area and non-storm water discharge was observed, and the response taken to eliminate unauthorized non-storm water discharges and to

reduce or prevent pollutants from contacting non-storm water discharges.

b. Effluent Sampling Locations:

i. Risk Level 3 dischargers shall sample effluent at all discharge points where non-storm water and/or authorized non-storm water is discharged off-site.

ii. Risk Level 3 dischargers shall send all non-storm water sample analyses to a laboratory certified for such analyses by the State Department of Health Services.

iii. Risk Level 3 dischargers shall monitor and report run-on from surrounding areas if there is reason to believe run-on may contribute to an exceedance of NALs or NELs.

11. **Risk Level 3 – Non-Visible Pollutant Monitoring Requirements**

a. Risk Level 3 dischargers shall collect one or more samples during any breach, malfunction, leakage, or spill observed during a visual inspection which could result in the discharge of pollutants to surface waters that would not be visually detectable in storm water.

b. Risk Level 3 dischargers shall ensure that water samples are large enough to characterize the site conditions.

c. Risk Level 3 dischargers shall collect samples at all discharge locations that can be safely accessed.

d. Risk Level 3 dischargers shall collect samples during the first two hours of discharge from rain events that occur during business hours and which generate runoff.

e. Risk Level 3 dischargers shall analyze samples for all non-visible pollutant parameters (if applicable) - parameters indicating the presence of pollutants identified in the pollutant source assessment required (Risk Level 3 dischargers shall modify their CSMPs to address these additional parameters in accordance with any updated SWPPP pollutant source assessment).

f. Risk Level 3 dischargers shall collect a sample of storm water that has not come in contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample) for comparison with the discharge sample.

g. Risk Level 3 dischargers shall compare the uncontaminated sample to the samples of discharge using field analysis or through laboratory analysis.[7]

h. Risk Level 3 dischargers shall keep all field /or analytical data in the SWPPP document.

12. **Risk Level 3 – Watershed Monitoring Option**

Risk Level 3 dischargers who are part of a qualified regional watershed-based monitoring program may be eligible for relief from the requirements in Sections I.5. The Regional Water Board may approve proposals to substitute an acceptable watershed-based monitoring program by determining if the watershed-based monitoring program will provide substantially similar monitoring information in evaluating discharger compliance with the requirements of this General Permit.

13. **Risk Level 3 – Particle Size Analysis for Project Risk Justification**

Risk Level 3 dischargers justifying an alternative project risk shall report a soil particle size analysis used to determine the RUSLE K-Factor. ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, shall be used to determine the percentages of sand, very fine sand, silt, and clay on the site.

14. **Risk Level 3 – Records**

Risk Level 3 dischargers shall retain records of all storm water monitoring information and copies of all reports (including Annual Reports) for a period of at least three years. Risk Level 3 dischargers shall retain all records on-site while construction is ongoing. These records include:

a. The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation.

b. The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and or measurements.

c. The date and approximate time of analyses.

[7] For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136. Field discharge samples shall be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed.

d. The individual(s) who performed the analyses.

e. A summary of all analytical results from the last three years, the method detection limits and reporting units, the analytical techniques or methods used, and the chain of custody forms.

f. Rain gauge readings from site inspections.

g. Quality assurance/quality control records and results.

h. Non-storm water discharge inspections and visual observation (inspections) and storm water discharge visual observation records (see Sections I.3 and I.10 above).

i. Visual observation and sample collection exception records (see Section I.6 above).

j. The records of any corrective actions and follow-up activities that resulted from analytical results, visual observation (inspections), or inspections.

15. **Risk Level 3 – NAL Exceedance Report**

a. In the event that any effluent sample exceeds an applicable NAL, Risk Level 3 dischargers shall electronically submit all storm event sampling results to the State Water Board no later than 10 days after the conclusion of the storm event. The Regional Boards have the authority to require the submittal of an NAL Exceedance Report.

b. Risk Level 3 dischargers shall certify each NAL Exceedance Report in accordance with the Special Provisions for Construction Activity In this General Permit.

c. Risk Level 3 dischargers shall retain an electronic or paper copy of each NAL Exceedance Report for a minimum of three years after the date the annual report is filed.

d. Risk Level 3 dischargers shall include in the NAL Exceedance Report:

i. The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as “less than the method detection limit”).

ii. The date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation.

iii. A description of the current BMPs associated with the effluent sample that exceeded the NAL and the proposed corrective actions taken.

16. **Risk Level 3 – NEL Violation Report**

a. Risk Level 3 dischargers shall electronically submit all storm event sampling results to the State Water Board no later than 5 days after the conclusion of the storm event.

b. In the event that a discharger has violated an applicable NEL, Risk Level 3 dischargers shall submit an NEL Violation Report to the State Water Board within 24 hours after the NEL exceedance has been identified.

c. Risk Level 3 dischargers shall certify each NEL Violation Report in accordance with the Special Provisions for Construction Activity in this General Permit.

d. Risk Level 3 dischargers shall retain an electronic or paper copy of each NEL Violation Report for a minimum of three years after the date the annual report is filed.

e. Risk Level 3 dischargers shall include in the NEL Violation Report:

i. The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as “less than the method detection limit”);

ii. The date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation; and

iii. A Description of the current onsite BMPs, and the proposed corrective actions taken to manage the NEL exceedance.

f. Compliance Storm Exemption - In the event that an applicable NEL has been exceeded during a storm event equal to or larger than the Compliance Storm Event, Risk level 3 discharger shall report the on-site rain gauge reading and nearby governmental rain gauge readings for verification.

17. **Risk Level 3 – Bioassessment**

a. Risk Level 3 dischargers with a total project-related ground disturbance exceeding 30 acres shall:

i. Conduct bioassessment monitoring, as described in Appendix 3.

ii. Include the collection and reporting of specified in stream biological data and physical habitat.

iii. Use the bioassessment sample collection and Quality Assurance & Quality Control (QA/QC) protocols developed by the State of California's Surface Water Ambient Monitoring Program (SWAMP).[8]

b. Risk Level 3 dischargers qualifying for bioassessment, where construction commences out of an index period for the site location shall:

i. Receive Regional Board approval for the sampling exception.

ii. Conduct bioassessment monitoring, as described in Appendix 3.

iii. Include the collection and reporting of specified instream biological data and physical habitat.

iv. Use the bioassessment sample collection and Quality Assurance & Quality Control (QA/QC) protocols developed by the State of California's Surface Water Ambient Monitoring Program (SWAMP).

OR

v. Make a check payable to: Cal State Chico Foundation (SWAMP Bank Account) or San Jose State Foundation (SWAMP Bank Account) and include the WDID# on the check for the amount calculated for the exempted project.

vi. Send a copy of the check to the Regional Water Board office for the site's region.

vii. Invest $**7,500.00 X The number of samples required** into the SWAMP program as compensation (upon regional board approval).

[8] http://www.waterboards.ca.gov/water_issues/programs/swamp/.

Table 3 – Risk Level 3 Test Methods, Detection Limits, Reporting Units and Applicable NALs/NELs

Parameter	Test Method / Protocol	Discharge Type	Min. Detection Limit	Reporting Units	Numeric Action Level	Numeric Effluent Limitation
pH	Field test with calibrated portable instrument	Risk Level 3 Discharges	0.2 pH	units	lower NAL = 6.5 upper NAL = 8.5	lower NEL = 6.0 upper NEL = 9.0
Turbidity EPA	0180.1 and/or field test with calibrated portable instrument	Risk Level 3 Discharges other than ATS	1	NTU	250 NTU	500 NTU
		For ATS discharges	1 NTU		N/A	10 NTU for Daily Weighted Average & 20 NTU for Any Single Sample
SSC ASTM	Method D 3977-97[9]	Risk Level 3 (if NEL exceeded)	5 mg/L		N/A	N/A
Bioassessment	(STE) Level I of (SAFIT),[10] fixed-count of 600 org/sample	Risk Level 3 projects> 30 acres	N/A N/A		N/A	N/A

[9] ASTM, 1999, Standard Test Method for Determining Sediment Concentration in Water Samples: American Society of Testing and Materials, D 3977-97, Vol. 11.02, pp. 389-394.

[10] The current SAFIT STEs (28 November 2006) list requirements for both the Level I and Level II taxonomic effort, and are located at: http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf. When new editions are published by SAFIT, they will supersede all previous editions. All editions will be posted at the State Water Board's SWAMP website.

ATTACHMENT F:
Active Treatment System (ATS) Requirements

Table 1 – Numeric Effluent Limitations, Numeric Action Levels, Test Methods, Detection Limits, and Reporting Units

Parameter	Test Method	Discharge Type	Min. Detection Limit	Units	Numeric Action Level	Numeric Effluent Limitation
Turbidity	EPA 0180.1 and/or field test with a calibrated portable instrument	For ATS discharges	1 NTU		N/A	10 NTU for Daily Flow-Weighted Average & 20 NTU for Any Single Sample

A. Dischargers choosing to implement an Active Treatment System (ATS) on their site shall comply with all of the requirements in this Attachment.

B. The discharger shall maintain a paper copy of each ATS specification onsite in compliance with the record retention requirements in the Special Provisions of this General Permit.

C. ATS Design, Operation and Submittals

1. The ATS shall be designed and approved by a Certified Professional in Erosion and Sediment Control (CPESC), a Certified Professional in Storm Water Quality (CPSWQ); a California registered civil engineer; or any other California registered engineer.

2. The discharger shall ensure that the ATS is designed in a manner to preclude the accidental discharge of settled floc[1] during floc pumping or related operations.

3. The discharger shall design outlets to dissipate energy from concentrated flows.

4. The discharger shall install and operate an ATS by assigning a lead person (or project manager) who has either a minimum of five years construction storm

[1] Floc is defined as a clump of solids formed by the chemical action in ATS systems.

water experience or who is a licensed contractors specifically holding a California Class A Contractors license.[2]

5. The discharger shall prepare an ATS Plan that combines the site-specific data and treatment system information required to safely and efficiently operate an ATS. The ATS Plan shall be electronically submitted to the State Water Board at least 14 days prior to the planned operation of the ATS and a paper copy shall be available onsite during ATS operation. At a minimum, the ATS Plan shall include:

   a. ATS Operation and Maintenance Manual for All Equipment.

   b. ATS Monitoring, Sampling & Reporting Plan, including Quality Assurance/Quality Control (QA/QC).

   c. ATS Health and Safety Plan.

   d. ATS Spill Prevention Plan.

6. The ATS shall be designed to capture and treat (within a 72-hour period) a volume equivalent to the runoff from a 10-year, 24-hour storm event using a watershed runoff coefficient of 1.0.

D. Treatment – Chemical Coagulation/Flocculation

1. Jar tests shall be conducted using water samples selected to represent typical site conditions and in accordance with ASTM D2035-08 (2003).

2. The discharger shall conduct, at minimum, six site-specific jar tests (per polymer with one test serving as a control) for each project to determine the proper polymer and dosage levels for their ATS.

3. Single field jar tests may also be conducted during a project if conditions warrant, for example if construction activities disturb changing types of soils, which consequently cause change in storm water and runoff characteristics.

E. Residual Chemical and Toxicity Requirements

1. The discharger shall utilize a residual chemical test method that has a method detection limit (MDL) of 10% or less than the maximum allowable threshold

[2] Business and Professions Code Division 3, Chapter 9, Article 4, Class A Contractor: A general engineering contractor is a contractor whose principal contracting business is in connection with fixed works requiring specialized engineering knowledge and skill. [http://www.cslb.ca.gov/General-Information/library/licensing-classifications.asp].

concentration[3] (MATC) for the specific coagulant in use and for the most sensitive species of the chemical used.

2. The discharger shall utilize a residual chemical test method that produces a result within one hour of sampling.

3. The discharger shall have a California State certified laboratory validate the selected residual chemical test. Specifically the lab will review the test protocol, test parameters, and the detection limit of the coagulant. The discharger shall electronically submit this documentation as part of the ATS Plan.

4. If the discharger cannot utilize a residual chemical test method that meets the requirements above, the discharger shall operate the ATS in Batch Treatment[4] mode.

5. A discharger planning to operate in Batch Treatment mode shall perform toxicity testing in accordance with the following:

   a. The discharger shall initiate acute toxicity testing on effluent samples representing effluent from each batch prior to discharge[5]. All bioassays shall be sent to a laboratory certified by the Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). The required field of testing number for Whole Effluent Toxicity (WET) testing is E113.[6]

   b. Acute toxicity tests shall be conducted with the following species and protocols. The methods to be used in the acute toxicity testing shall be those outlined for a 96-hour acute test in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, USEPA-841-R-02-012" for Fathead minnow, *Pimephales promelas* (fathead minnow). Acute toxicity for *Oncorhynchus mykiss* (Rainbow Trout) may be used as a substitute for testing fathead minnows.

   c. All toxicity tests shall meet quality assurance criteria and test acceptability criteria in the most recent versions of the EPA test method for WET testing.

   d. The discharger shall electronically report all acute toxicity testing.

---

[3] The Maximum Allowable Threshold Concentration (MATC) is the allowable concentration of residual, or dissolved, coagulant/flocculant in effluent. The MATC shall be coagulant/flocculant-specific, and based on toxicity testing conducted by an independent, third-party laboratory. A typical MATC would be:
The MATC is equal to the geometric mean of the NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) Acute and Chronic toxicity results for most sensitive species determined for the specific coagulant. The most sensitive species test shall be used to determine the MATC.
[4] Batch Treatment mode is defined as holding or recirculating the treated water in a holding basin or tank(s) until treatment is complete or the basin or storage tank(s) is full.
[5] This requirement only requires that the test be initiated prior to discharge.
[6] http://www.dhs.ca.gov/ps/ls/elap/pdf/FOT_Desc.pdf.

F. Filtration

1. The ATS shall include a filtration step between the coagulant treatment train and the effluent discharge. This is commonly provided by sand, bag, or cartridge filters, which are sized to capture suspended material that might pass through the clarifier tanks.

2. Differential pressure measurements shall be taken to monitor filter loading and confirm that the final filter stage is functioning properly.

G. Residuals Management

1. Sediment shall be removed from the storage or treatment cells as necessary to ensure that the cells maintain their required water storage (i.e., volume) capability.

2. Handling and disposal of all solids generated during ATS operations shall be done in accordance with all local, state, and federal laws and regulations.

H. ATS Instrumentation

1. The ATS shall be equipped with instrumentation that automatically measures and records effluent water quality data and flow rate.

2. The minimum data recorded shall be consistent with the Monitoring and Reporting requirements below, and shall include:

   a. Influent Turbidity

   b. Effluent Turbidity

   c. Influent pH

   d. Effluent pH

   e. Residual Chemical

   f. Effluent Flow rate

   g. Effluent Flow volume

3. Systems shall be equipped with a data recording system, such as data loggers or webserver-based systems, which records each measurement on a frequency no longer than once every 15 minutes.

4. Cumulative flow volume shall be recorded daily. The data recording system shall have the capacity to record a minimum of seven days continuous data.

5. Instrumentation systems shall be interfaced with system control to provide auto shutoff or recirculation in the event that effluent measurements exceed turbidity or pH.

6. The system shall also assure that upon system upset, power failure, or other catastrophic event, the ATS will default to a recirculation mode or safe shut down.

7. Instrumentation (flow meters, probes, valves, streaming current detectors, controlling computers, etc.) shall be installed and maintained per manufacturer's recommendations, which shall be included in the QA/QC plan.

8. The QA/QC plan shall also specify calibration procedures and frequencies, instrument method detection limit or sensitivity verification, laboratory duplicate procedures, and other pertinent procedures.

9. The instrumentation system shall include a method for controlling coagulant dose, to prevent potential overdosing. Available technologies include flow/turbidity proportional metering, periodic jar testing and metering pump adjustment, and ionic charge measurement controlling the metering pump.

I. ATS Effluent Discharge

1. ATS effluent shall comply with all provisions and prohibitions in this General Permit, specifically the NELs.

2. NELs for discharges from an ATS:

   a. Turbidity of all ATS discharges shall be less than 10 NTU for daily flow-weighted average of all samples and 20 NTU for any single sample.

   b. Residual Chemical shall be < 10% of MATC[7] for the most sensitive species of the chemical used.

3. If an analytical effluent sampling result is outside the range of pH NELs (i.e., is below the lower NEL for pH or exceeds the upper NEL for pH) or exceeds the turbidity NEL (as listed in Table 1), the discharger is in violation of this General

[7] The Maximum Allowable Threshold Concentration (MATC) is the allowable concentration of residual, or dissolved, coagulant/flocculant in effluent. The MATC shall be coagulant/flocculant-specific, and based on toxicity testing conducted by an independent, third-party laboratory. The MATC is equal to the geometric mean of the NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) Acute and Chronic toxicity results for most sensitive species determined for the specific coagulant. The most sensitive species test shall be used to determine the MATC.

Permit and shall electronically file the results in violation within 24-hours of obtaining the results.

4. If ATS effluent is authorized to discharge into a sanitary sewer system, the discharger shall comply with any pre-treatment requirements applicable for that system. The discharger shall include any specific criteria required by the municipality in the ATS Plan.

5. Compliance Storm Event:

   Discharges of storm water from ATS shall comply with applicable NELs (above) unless the storm event causing the discharges is determined after the fact to be equal to or larger than the Compliance Storm Event (expressed in inches of rainfall). The Compliance Storm Event for ATS discharges is the 10 year, 24 hour storm, as determined using these maps:

   http://www.wrcc.dri.edu/pcpnfreq/nca10y24.gif
   http://www.wrcc.dri.edu/pcpnfreq/sca10y24.gif

   This exemption is dependent on the submission of rain gauge data verifying the storm event is equal to or larger than the Compliance Storm.

J. Operation and Maintenance Plan

1. Each Project shall have a site-specific Operation and Maintenance (O&M) Manual covering the procedures required to install, operate and maintain the ATS.[8]

2. The O&M Manual shall only be used in conjunction with appropriate project-specific design specifications that describe the system configuration and operating parameters.

3. The O&M Manual shall have operating manuals for specific pumps, generators, control systems,and other equipment.

K. Sampling and Reporting Quality Assurance/ Quality Check (QA/QC) Plan

4. A project-specific QA/QC Plan shall be developed for each project. The QA/QC Plan shall include at a minimum:

   a. Calibration – Calibration methods and frequencies for all system and field instruments shall be specified.

   b. Method Detection Limits (MDLs) – The methods for determining MDLs shall be specified for each residual coagulant measurement method. Acceptable

[8] The manual is typically in a modular format covering generalized procedures for each component that is utilized in a particular system.

minimum MDLs for each method, specific to individual coagulants, shall be specified.

c. Laboratory Duplicates – Requirements for monthly laboratory duplicates for residual coagulant analysis shall be specified.

L. Personnel Training

1. Operators shall have training specific to using an ATS and liquid coagulants for storm water discharges in California.

2. The training shall be in the form of a formal class with a certificate and requirements for testing and certificate renewal.

3. Training shall include a minimum of eight hours classroom and 32 hours field training. The course shall cover the following topics:

   a. Coagulation Basics –Chemistry and physical processes

   b. ATS System Design and Operating Principles

   c. ATS Control Systems

   d. Coagulant Selection – Jar testing, dose determination, etc.

   e. Aquatic Safety/Toxicity of Coagulants, proper handling and safety

   f. Monitoring, Sampling, and Analysis

   g. Reporting and Recordkeeping

   h. Emergency Response

M. Active Treatment System (ATS) Monitoring Requirements

Any discharger who deploys an ATS on their site shall conduct the following:

1. Visual Monitoring

   a. A designated responsible person shall be on site daily at all times during treatment operations.

   b. Daily on-site visual monitoring of the system for proper performance shall be conducted and recorded in the project data log.

i. The log shall include the name and phone number of the person responsible for system operation and monitoring.

ii. The log shall include documentation of the responsible person's training.

2. Operational and Compliance Monitoring

a. Flow shall be continuously monitored and recorded at not greater than 15-minute intervals for total volume treated and discharged.

b. Influent and effluent pH must be continuously monitored and recorded at not greater than 15-minute intervals.

c. Influent and effluent turbidity (expressed in NTU) must be continuously monitored and recorded at not greater than 15-minute intervals.

d. The type and amount of chemical used for pH adjustment, if any, shall be monitored and recorded.

e. Dose rate of chemical used in the ATS system (expressed in mg/L) shall be monitored and reported 15-minutes after startup and every 8 hours of operation.

f. Laboratory duplicates – monthly laboratory duplicates for residual coagulant analysis must be performed and records shall be maintained onsite.

g. Effluent shall be monitored and recorded for residual chemical/additive levels.

h. If a residual chemical/additive test does not exist and the ATS is operating in a batch treatment mode of operation refer to the toxicity monitoring requirements below.

3. Toxicity Monitoring

A discharger operating in batch treatment mode shall perform toxicity testing in accordance with the following:

a. The discharger shall initiate acute toxicity testing on effluent samples representing effluent from each batch prior to discharge.[9] All bioassays shall be sent to a laboratory certified by the Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). The required field of testing number for Whole Effluent Toxicity (WET) testing is E113.[10]

[9] This requirement only requires that the test be initiated prior to discharge.
[10] http://www.dhs.ca.gov/ps/ls/elap/pdf/FOT_Desc.pdf.

b. Acute toxicity tests shall be conducted with the following species and protocols. The methods to be used in the acute toxicity testing shall be those outlined for a 96-hour acute test in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, USEPA-841-R-02-012" for Fathead minnow, *Pimephales promelas or* Rainbow trout *Oncorhynchus mykiss* may be used as a substitute for fathead minnow.

c. All toxicity tests shall meet quality assurance criteria and test acceptability criteria in the most recent versions of the EPA test method for WET testing.[11]

4. Reporting and Recordkeeping

At a minimum, every 30 days a LRP representing the discharger shall access the State Water Boards Storm Water Mulit-Application and Report Tracking system (SMARTS) and electronically upload field data from the ATS. Records must be kept for three years after the project is completed .

5. Non-compliance Reporting

a. Any indications of toxicity or other violations of water quality objectives shall be reported to the appropriate regulatory agency as required by this General Permit.

b. Upon any measurements that exceed water quality standards, the system operator shall immediately notify his supervisor or other responsible parties, who shall notify the Regional Water Board.

c. If any monitoring data exceeds any applicable NEL in this General Permit, the discharger shall electronically submit a NEL Violation Report to the State Water Board within 24 hours after the NEL exceedance has been identified.

i. ATS dischargers shall certify each NEL Violation Report in accordance with the Special Provisions for Construction Activity in this General Permit.

ii. ATS dischargers shall retain an electronic or paper copy of each NEL Violation Report for a minimum of three years after the date the annual report is filed.

iii. ATS dischargers shall include in the NEL Violation Report:

(1) The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit");

[11] http://www.epa.gov/waterscience/methods/wet/.

(2) The date, place, time of sampling, visual observation (inspections), and/or measurements, including precipitation; and

(3) A description of the current onsite BMPs, and the proposed corrective actions taken to manage the NEL exceedance.

iv. Compliance Storm Exemption - In the event that an applicable NEL has been exceeded during a storm event equal to or larger than the Compliance Storm Event, ATS dischargers shall report the on-site rain gauge reading and nearby governmental rain gauge readings for verification.

Risk Determination Worksheet

Step 1 Determine Sediment Risk via one of the options listed:

1. GIS Map Method - EPA Rainfall Erosivity Calculator & GIS map
2. Individual Method - EPA Rainfall Erosivity Calculator & Individual Data

Step 2 Determine Receiving Water Risk via one of the options listed:

1. GIS map of Sediment Sensitive Watersheds provided (in development)
2. List of Sediment Sensitive Watersheds provided

Step 3 Determine Combined Risk Level

Sediment Risk Factor Worksheet	Entry

A) R Factor

Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.

http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm

R Factor Value	0

B) K Factor (weighted average, by area, for all site soils)

The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.

Site-specific K factor guidance

K Factor Value	0

C) LS Factor (weighted average, by area, for all slopes)

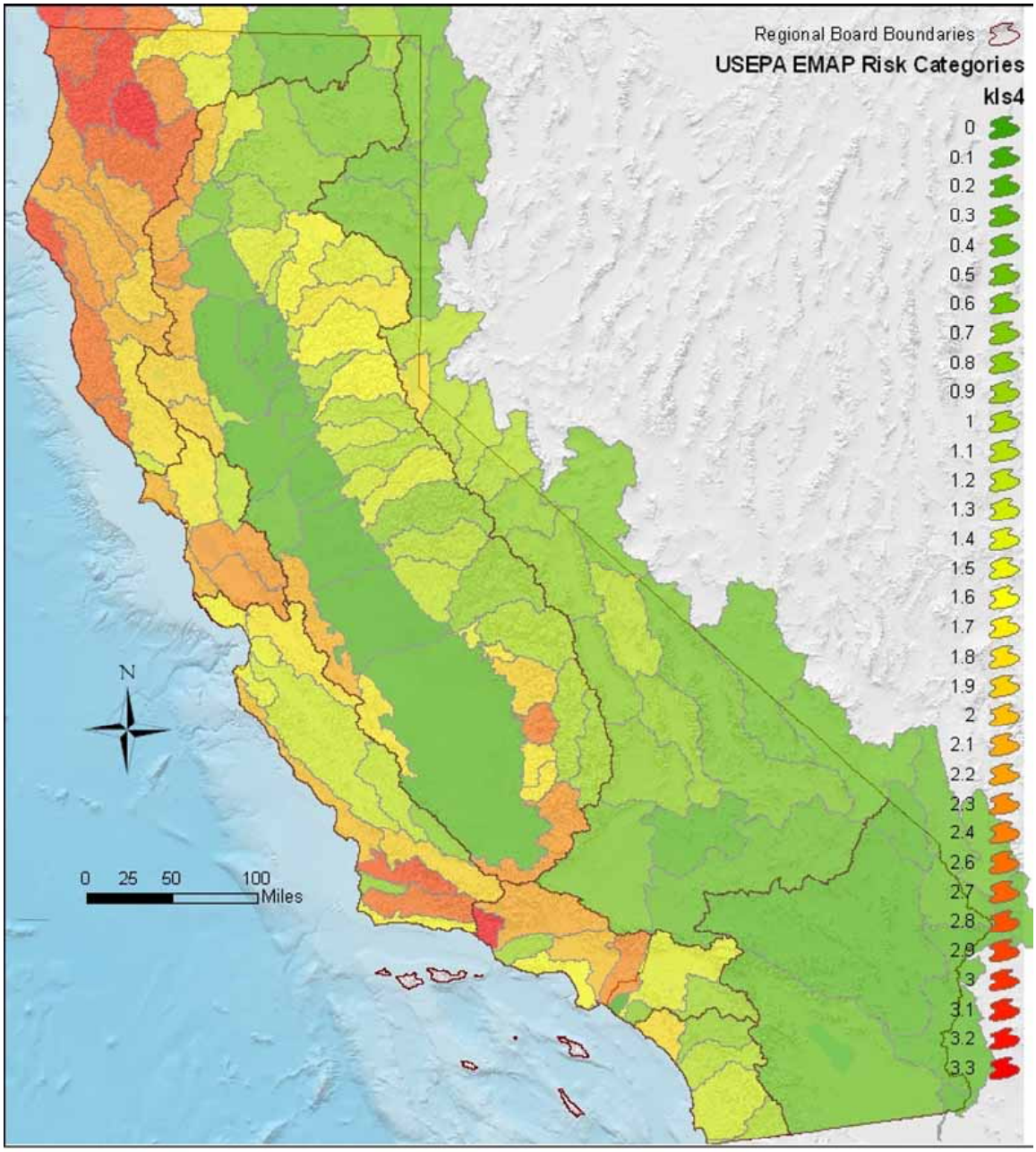
The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.

LS Table

LS Factor Value	0

Watershed Erosion Estimate (=RxKxLS) in tons/acre	0
Site Sediment Risk Factor Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 tons/acre High Sediment Risk: >= 75 tons/acre	**Low**

For the GIS Map Method, the R factor for the project is calculated using the online calculator at (see cell to right). The product of K and LS are shown on the figure below. To determine soil loss in tons per acre, multiply the R factor times the value for K times LS from the map.
http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm



Water Boards

State Water Resources Control Board, January 15, 2008

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment**? (For help with impaired waterbodies please check the attached worksheet or visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?: 2006 Approved Sediment-impared WBs Worksheet http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml **OR**	**Yes**	**High**
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? http://www.ice.ucdavis.edu/geowbs/asp/wbquse.asp		

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	
High	Level 2		Level 3

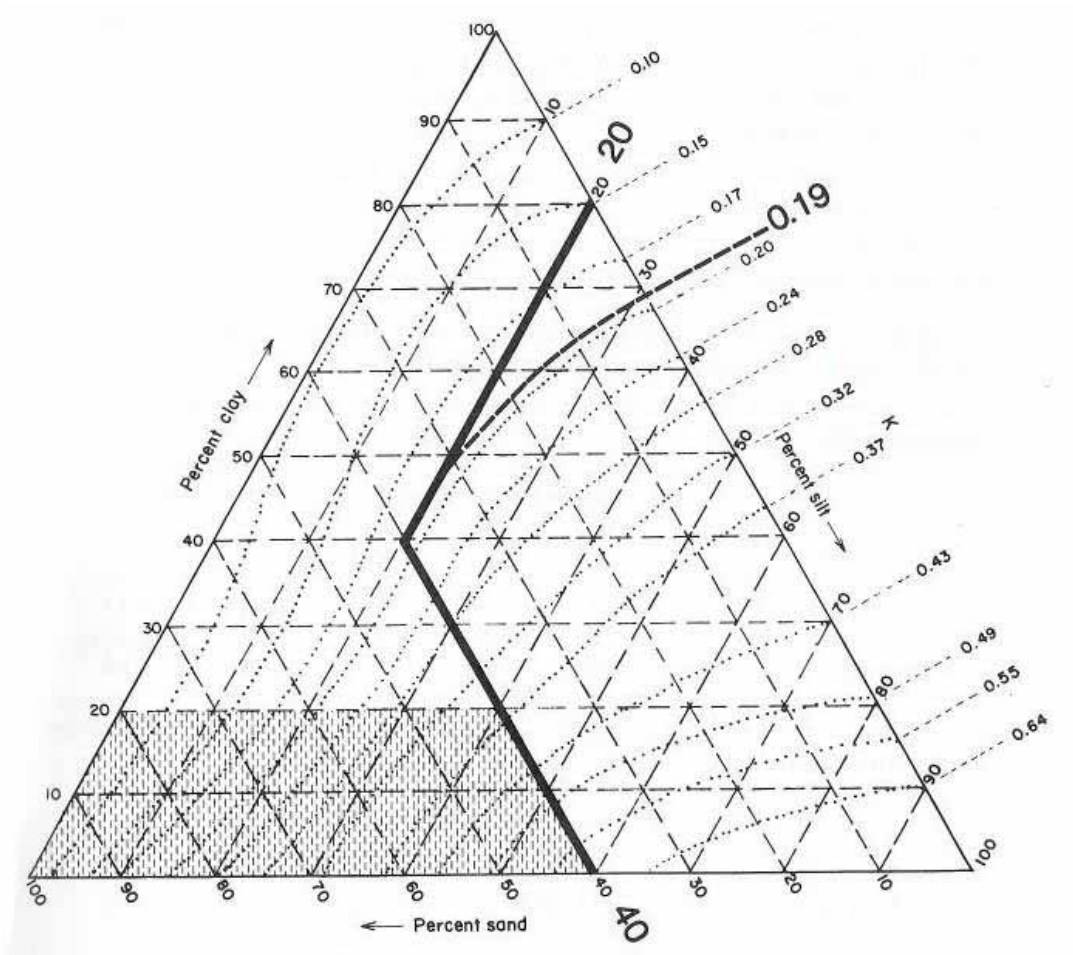
Project Sediment Risk: **Low**

Project RW Risk: **High**

Project Combined Risk: **Level 2**

Soil Erodibility Factor (K)

The K factor can be determined by using the nomograph method, which requires that a particle size analysis (ASTM D-422) be done to determine the percentages of sand, very fine sand, silt and clay. Use the figure below to determine appropriate K value.



Erickson triangular nomograph used to estimate soil erodibility (K) factor.
The figure above is the USDA nomograph used to determine the K factor for a soil, based on its texture (% silt plus very fine sand, % sand, % organic matter, soil structure, and permeability).
Nomograph from Erickson 1977 as referenced in Goldman et. al., 1986.

Sheet Flow Length (ft)	Average Watershed Slope (%) 0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0	16.0	20.0	
<3	0.05	0.07	0.09	0.13	0.17	0.20	0.23	0.26	0.32	0.35	0.36	0.38	0.39	0.41	
6	0.05	0.07	0.09	0.13	0.17	0.20	0.23	0.26	0.32	0.37	0.41	0.45	0.49	0.56	
9	0.05	0.07	0.09	0.13	0.17	0.20	0.23	0.26	0.32	0.38	0.45	0.51	0.56	0.67	
12	0.05	0.07	0.09	0.13	0.17	0.20	0.23	0.26	0.32	0.39	0.47	0.55	0.62	0.76	
15	0.05	0.07	0.09	0.13	0.17	0.20	0.23	0.26	0.32	0.40	0.49	0.58	0.67	0.84	
25	0.05	0.07	0.10	0.16	0.21	0.26	0.31	0.36	0.45	0.57	0.71	0.85	0.98	1.24	
50	0.05	0.08	0.13	0.21	0.30	0.38	0.46	0.54	0.70	0.91	1.15	1.40	1.64	2.10	
75	0.05	0.08	0.14	0.25	0.36	0.47	0.58	0.69	0.91	1.20	1.54	1.87	2.21	2.86	
100	0.05	0.09	0.15	0.28	0.41	0.55	0.68	0.82	1.10	1.46	1.88	2.31	2.73	3.57	
150	0.05	0.09	0.17	0.33	0.50	0.68	0.86	1.05	1.43	1.92	2.51	3.09	3.68	4.85	
200	0.06	0.10	0.18	0.37	0.57	0.79	1.02	1.25	1.72	2.34	3.07	3.81	4.56	6.04	
250	0.06	0.10	0.19	0.40	0.64	0.89	1.16	1.43	1.99	2.72	3.60	4.48	5.37	7.16	
300	0.06	0.10	0.20	0.43	0.69	0.98	1.28	1.60	2.24	3.09	4.09	5.11	6.15	8.23	1
400	0.06	0.11	0.22	0.48	0.80	1.14	1.51	1.90	2.70	3.75	5.01	6.30	7.60	10.24	1
600	0.06	0.12	0.24	0.56	0.96	1.42	1.91	2.43	3.52	4.95	6.67	8.45	10.26	13.94	1
800	0.06	0.12	0.26	0.63	1.10	1.65	2.25	2.89	4.24	6.03	8.17	10.40	12.69	17.35	2
1000	0.06	0.13	0.27	0.69	1.23	1.86	2.55	3.30	4.91	7.02	9.57	12.23	14.96	20.57	2

LS Factors for Construction Sites. *Table from Renard et. al., 1997.*

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	1510	Range Grazing-Riparian	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAE115301	1	North Coast	E	Estuaries	Bodega HU, Estero Americano HA, estuary	11530012	199	A	Acres	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Water Quality Attainment strategy is attempting to increase voluntary measures for attainment of standards & objectives, as was done in the Estero de San Antonio/Stemple Creek T Water Quality Attainment Strategy, adopted by NCRWQCB in Dec, 97.
CAR111111	1	North Coast	R	Rivers/Streams	Eel River HU, Lower Eel River HA, Eel River Delta	11110000	426	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2019	
CAR111111	1	North Coast	R	Rivers/Streams	Eel River HU, Lower Eel River HA, Eel River Delta	11110000	426	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR111111	1	North Coast	R	Rivers/Streams	Eel River HU, Lower Eel River HA, Eel River Delta	11110000	426	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	1510	Range Grazing-Riparian	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	1520	Range Grazing-Upland	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	2100	Harvesting, Restoration, Residue Management	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	2300	Logging Road Construction/Maintenance	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2004	
CAR111411	1	North Coast	R	Rivers/Streams	Eel River HU, Middle Main HA	11140000	674	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2004	
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	1935	Agriculture-grazing	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	2100	Harvesting, Restoration, Residue Management	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	2300	Logging Road Construction/Maintenance	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	2400	Silvicultural Point Sources	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR111621	1	North Coast	R	Rivers/Streams	Eel River HU, Upper Main HA (Includes Tomki Creek)	11160000	1141	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	USEPA will develop a TMDL for Eel River, Upper Main Fork.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	2100	Harvesting, Restoration, Residue Management	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	2300	Logging Road Construction/Maintenance	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Elk River	11000000	88	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	The Eureka Plain HU, Elk River, includes the following Calwater Planning Watersheds (PWS): 110.00021, 110.00030, 110.00032, and 110.00042. Sedimentation, threat sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	2100	Harvesting, Restoration, Residue Management	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR110001	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	2300	Logging Road Construction/Maintenance	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR11000	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR11000	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR11000	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR11000	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR11000	1	North Coast	R	Rivers/Streams	Eureka Plain HU, Freshwater Creek	11000000	84	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	The Eureka Plain HU, Freshwater Creek, includes the following Calwater Planning Watersheds (PWS): 110.00011, 110.00012, 110.00014, 110.00040, and 110.00050. Sedimentation, threat of sedimentation, impaired irrigation water quality, impaired domestic supply water quality, impaired spawning habitat, increased rate and depth of flooding due to sediment, property damage. NCRWQCB and California Department of forestry staff are involved in ongoing efforts to attain adherance to Forest Practice Rules.
CAR10511	1	North Coast	R	Rivers/Streams	Klamath River HU, Lower HA, Klamath Glen HSA	10511000	609	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	If this listing is determined to be on tribal lands, USEPA should place this water body and pollutant on the section 303d list for the tribal lands. It is not the State Water Board's inten this listing affect other actions related to decommissioning and removal of dams on the Klamath River
CAR10910	1	North Coast	R	Rivers/Streams	Mad River HU, Mad River	10900000	654	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	USEPA will develop TMDL for the Mad River. Sediment TMDLS will be developed for the area tributary to and including: (1) the Mad River (North Fork), (2) the mad River (Upper), (3) the Mad River (Middle).
CAR10910	1	North Coast	R	Rivers/Streams	Mad River HU, Mad River	10900000	654	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	USEPA will develop TMDL for the Mad River. Sediment TMDLS will be developed for the area tributary to and including: (1) the Mad River (North Fork), (2) the mad River (Upper), (3) the Mad River (Middle).
CAR10910	1	North Coast	R	Rivers/Streams	Mad River HU, Mad River	10900000	654	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	USEPA will develop TMDL for the Mad River. Sediment TMDLS will be developed for the area tributary to and including: (1) the Mad River (North Fork), (2) the mad River (Upper), (3) the Mad River (Middle).
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	7300	Dam Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	7400	Flow Regulation/Modification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11412	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Austin Creek HSA	11412000	81	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment.
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	1300	Specialty Crop Production	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	1935	Agriculture-grazing	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7300	Dam Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7350	Upstream Impoundment	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7400	Flow Regulation/Modification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11411	1	North Coast	R	Rivers/Streams	Russian River HU, Lower Russian River HA, Guerneville HSA	11411000	195	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11426	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Big Sulphur Creek HSA	11426000	85	M	Miles	1100	Sedimentation/Siltation	3210	Geothermal Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11426	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Big Sulphur Creek HSA	11426000	85	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11426	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Big Sulphur Creek HSA	11426000	85	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1100	Nonirrigated Crop Production	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1300	Specialty Crop Production	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1510	Range Grazing-Riparian	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1520	Range Grazing-Upland	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	1935	Agriculture-grazing	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	3210	Geothermal Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	4501	Surface Runoff	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7500	Bridge Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11425	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Geyserville HSA	11425000	242	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment TMDL.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1300	Specialty Crop Production	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1510	Range Grazing-Riparian	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1600	Intensive Animal Feeding Operations	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	1935	Agriculture-grazing	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	2100	Harvesting, Restoration, Residue Management	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	4300	Other Urban Runoff	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	4501	Surface Runoff	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	4300	Other Urban Runoff	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	4500	Highway/Road/Bridge Runoff	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	8050	Erosion From Derelict Land	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	8300	Highway Maintenance and Runoff	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR11421	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Laguna de Santa Rosa	11421000	96	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Entire Russian River watershed (including Laguna de Santa Rosa) is listed for sedimentation.
CAR30411	3	Central Coast	R	Rivers/Streams	San Vicente Creek	30411023	9.11953	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (below city of Lompoc to Ocean)	31410040	3.8	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (below city of Lompoc to Ocean)	31410040	3.8	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (below city of Lompoc to Ocean)	31410040	3.8	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (Cachuma Lake to below city o Lompoc)	31440050	43	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (Cachuma Lake to below city o Lompoc)	31440050	43	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2019	
CAR31410	3	Central Coast	R	Rivers/Streams	Santa Ynez River (Cachuma Lake to below city o Lompoc)	31440050	43	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	
CAR31300	3	Central Coast	R	Rivers/Streams	Shuman Canyon Creek	31300041	8.5496	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR30413	3	Central Coast	R	Rivers/Streams	Valencia Creek	30413023	6.19	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2008	
CAR30413	3	Central Coast	R	Rivers/Streams	Valencia Creek	30413023	6.19	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2008	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Zayante Creek	30412040	9.20875	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR11423	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Mark West Creek HSA	11423000	99	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1100	Nonirrigated Crop Production	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1300	Specialty Crop Production	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1400	Pasture Grazing-Riparian and/or Upland	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1510	Range Grazing-Riparian	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1520	Range Grazing-Upland	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	1940	Dairies	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	4100	Urban Runoff--Non-industrial Permitted	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	4300	Other Urban Runoff	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	4501	Surface Runoff	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7500	Bridge Construction	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11422	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Santa Rosa Creek	11422000	87	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Entire Russian River watershed (including Santa Rosa Creek) is listed for sedimentation.
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	2300	Logging Road Construction/Maintenance	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7300	Dam Construction	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7350	Upstream Impoundment	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7400	Flow Regulation/Modification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11424	1	North Coast	R	Rivers/Streams	Russian River HU, Middle Russian River HA, Warm Springs HSA	11424000	255	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Sediment impacts in Russian River tributaries prompted listing entire Russian River watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7100	Channelization	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7300	Dam Construction	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7400	Flow Regulation/Modification	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7500	Bridge Construction	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR11432	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Coyote Valley HSA	11432000	171	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11433	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Forsythe Creek HSA	11433000	122	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11433	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Forsythe Creek HSA	11433000	122	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	8300	Highway Maintenance and Runoff	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAR11431	1	North Coast	R	Rivers/Streams	Russian River HU, Upper Russian River HA, Ukiah HSA	11431000	460	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2019	Russian River Watershed tributary sediment impairments led to listing of entire watershed for sediment .
CAB20114	2	San Francisco Bay	B	Bays and Harbors	Tomales Bay	20114033	8545.46	A	Acres	1100	Sedimentation/Siltation	1000	Agriculture	2008	TMDL will be developed as part of ongoing watershed management effort. Tributary streams, Lagunitas Creek and Walker Creek, must be managed first. Additional monitoring assessment needed.
CAB20114	2	San Francisco Bay	B	Bays and Harbors	Tomales Bay	20114033	8545.46	A	Acres	1100	Sedimentation/Siltation	7350	Upstream Impoundment	2008	TMDL will be developed as part of ongoing watershed management effort. Tributary streams, Lagunitas Creek and Walker Creek, must be managed first. Additional monitoring assessment needed.
CAR20240	2	San Francisco Bay	R	Rivers/Streams	Butano Creek	20240031	3.62774	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Impairment to steelhead habita
CAR20113	2	San Francisco Bay	R	Rivers/Streams	Lagunitas Creek	20113020	16.75	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2009	Tributary to Tomales Bay. TMDLs will be developed as part of evolving watershed management effort. Additional monitoring and assessment nee
CAR20113	2	San Francisco Bay	R	Rivers/Streams	Lagunitas Creek	20113020	16.75	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2009	Tributary to Tomales Bay. TMDLs will be developed as part of evolving watershed management effort. Additional monitoring and assessment nee
CAR20650	2	San Francisco Bay	R	Rivers/Streams	Napa River	20650010	65.33	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2006	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20650	2	San Francisco Bay	R	Rivers/Streams	Napa River	20650010	65.33	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2006	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20650	2	San Francisco Bay	R	Rivers/Streams	Napa River	20650010	65.33	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2006	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20650	2	San Francisco Bay	R	Rivers/Streams	Napa River	20650010	65.33	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2006	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20240	2	San Francisco Bay	R	Rivers/Streams	Pescadero Creek	20240013	26.03	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	If California Department of Fish and Game and the National Marine Fisheries Service find that for this water body fish populations are not impacted, the State Water Board supp removing this water body and pollutant from the list.
CAR20630	2	San Francisco Bay	R	Rivers/Streams	Petaluma River	20630020	21.566	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR20630	2	San Francisco Bay	R	Rivers/Streams	Petaluma River	20630020	21.566	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	
CAR20630	2	San Francisco Bay	R	Rivers/Streams	Petaluma River	20630020	21.566	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2019	
CAR20550	2	San Francisco Bay	R	Rivers/Streams	San Francisquito Creek	20550040	12.05	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2008	Impairment to steelhead habita
CAR20230	2	San Francisco Bay	R	Rivers/Streams	San Gregorio Creek	20230014	11.14	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	Impairment to steelhead habita
CAR20640	2	San Francisco Bay	R	Rivers/Streams	Sonoma Creek	20640050	30.23	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2008	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20640	2	San Francisco Bay	R	Rivers/Streams	Sonoma Creek	20640050	30.23	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2008	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20640	2	San Francisco Bay	R	Rivers/Streams	Sonoma Creek	20640050	30.23	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2008	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20640	2	San Francisco Bay	R	Rivers/Streams	Sonoma Creek	20640050	30.23	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2008	TMDL will be developed as part of ongoing watershed management effort. Additional monitoring and assessment nee
CAR20112	2	San Francisco Bay	R	Rivers/Streams	Walker Creek	20112013	15.8352	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2009	Tributary to Tomales Bay. TMDLs will be developed as part of evolving watershed management effort. Additional monitoring and assessment nee
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	7000	Hydromodification	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	7200	Dredging	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAB30600	3	Central Coast	B	Bays and Harbors	Moss Landing Harbor	30600014	79.2726	A	Acres	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAE30600	3	Central Coast	E	Estuaries	Elkhorn Slough	30600014	2033.73	A	Acres	1100	Sedimentation/Siltation	1000	Agriculture	2015	
CAE30600	3	Central Coast	E	Estuaries	Elkhorn Slough	30600014	2033.73	A	Acres	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2015	
CAE30600	3	Central Coast	E	Estuaries	Elkhorn Slough	30600014	2033.73	A	Acres	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2015	
CAE30600	3	Central Coast	E	Estuaries	Elkhorn Slough	30600014	2033.73	A	Acres	1100	Sedimentation/Siltation	7810	Channel Erosion	2015	
CAE30600	3	Central Coast	E	Estuaries	Elkhorn Slough	30600014	2033.73	A	Acres	1100	Sedimentation/Siltation	9100	Nonpoint Source	2015	
CAE30600	3	Central Coast	E	Estuaries	Moro Cojo Slough	30913011	62.4949	A	Acres	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAE30600	3	Central Coast	E	Estuaries	Moro Cojo Slough	30913011	62.4949	A	Acres	1100	Sedimentation/Siltation	1200	Irrigated Crop Production	2019	
CAE30600	3	Central Coast	E	Estuaries	Moro Cojo Slough	30913011	62.4949	A	Acres	1100	Sedimentation/Siltation	1915	Agriculture-storm runoff	2019	
CAE30600	3	Central Coast	E	Estuaries	Moro Cojo Slough	30913011	62.4949	A	Acres	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	
CAE30600	3	Central Coast	E	Estuaries	Moro Cojo Slough	30913011	62.4949	A	Acres	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAE30413	3	Central Coast	E	Estuaries	Soquel Lagoon	30413014	1.15873	A	Acres	1100	Sedimentation/Siltation	3000	Construction/Land Development	2011	
CAR30413	3	Central Coast	R	Rivers/Streams	Aptos Creek	30413023	8.40589	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2008	
CAR30413	3	Central Coast	R	Rivers/Streams	Aptos Creek	30413023	8.40589	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2008	
CAR30412	3	Central Coast	R	Rivers/Streams	Bean Creek	30412041	8.90707	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bean Creek	30412041	8.90707	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bean Creek	30412041	8.90707	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bean Creek	30412041	8.90707	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bean Creek	30412041	8.90707	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bear Creek(Santa Cruz County	30412030	6.31531	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bear Creek(Santa Cruz County	30412030	6.31531	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bear Creek(Santa Cruz County	30412030	6.31531	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bear Creek(Santa Cruz County	30412030	6.31531	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Bear Creek(Santa Cruz County	30412030	6.31531	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	1300	Specialty Crop Production	2019	
CAR30412	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR304123	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Boulder Creek	30412020	7.55958	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Branciforte Creek	30412051	5.78	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Branciforte Creek	30412051	5.78	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Branciforte Creek	30412051	5.78	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR313003	3	Central Coast	R	Rivers/Streams	Casmalia Canyon Creek	31300040	4.96262	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Fall Creek	30412022	5.07242	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Fall Creek	30412022	5.07242	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Fall Creek	30412022	5.07242	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Fall Creek	30412022	5.07242	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Kings Creek	30412011	4.36837	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Kings Creek	30412011	4.36837	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Kings Creek	30412011	4.36837	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Kings Creek	30412011	4.36837	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Kings Creek	30412011	4.36837	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Love Creek	30412021	3.78816	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Mountain Charlie Gulch	30412040	3.92844	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Mountain Charlie Gulch	30412040	3.92844	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Mountain Charlie Gulch	30412040	3.92844	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Mountain Charlie Gulch	30412040	3.92844	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	3110	Road Construction	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	3215	Disturbed Sites (Land Develop.)	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR304123	3	Central Coast	R	Rivers/Streams	Newell Creek (Upper	30412031	3.50199	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR404224	4	Los Angeles	R	Rivers/Streams	Las Virgenes Creek	40422010	11.62	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR404214	4	Los Angeles	R	Rivers/Streams	Malibu Creek	40421000	10.85	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR404244	4	Los Angeles	R	Rivers/Streams	Medea Creek Reach 1 (Lake to Confl. with Lindero)	40424000	2.57	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR403124	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 2 (estuary to Potrero Rd was Calleguas Creek Reaches 1 and 2 on 1998 303d list)	40312000	4.31213	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403124	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 2 (estuary to Potrero Rd was Calleguas Creek Reaches 1 and 2 on 1998 303d list)	40312000	4.31213	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403124	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 3 (Potrero Road upstream to confluence with Conejo Creek on 1998 303d list)	40312000	3.46697	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403124	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 3 (Potrero Road upstream to confluence with Conejo Creek on 1998 303d list)	40312000	3.46697	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403114	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 4 (was Revolon Slough Main Branch: Mugu Lagoon to Central Avenue on 1998 303d list)	40311000	7.18751	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403114	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 4 (was Revolon Slough Main Branch: Mugu Lagoon to Central Avenue on 1998 303d list)	40311000	7.18751	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403614	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 5 (was Beardsley Channe on 1998 303d list)	40311000	4.34088	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403614	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 5 (was Beardsley Channe on 1998 303d list)	40311000	4.34088	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403624	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 6 (was Arroyo Las Posas Reaches 1 and 2 on 1998 303d list)	40362000	15.2966	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403624	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 6 (was Arroyo Las Posas Reaches 1 and 2 on 1998 303d list)	40362000	15.2966	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403624	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 7 (was Arroyo Simi Reaches 1 and 2 on 1998 303d list)	40367000	13.9129	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403624	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 7 (was Arroyo Simi Reaches 1 and 2 on 1998 303d list)	40367000	13.9129	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403674	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 8 (was Tapo Canyon Reach 1)	40366000	7.18869	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403644	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 11 (Arroyo Santa Rosa was part of Conejo Creek Reach 3 on 1998 303d list)	40365000	8.68888	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR403644	4	Los Angeles	R	Rivers/Streams	Calleguas Creek Reach 11 (Arroyo Santa Rosa was part of Conejo Creek Reach 3 on 1998 303d list)	40365000	8.68888	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2005	For 2006, sedimentation/siltation was moved by USEPA from the being addressed list back to the 303(d) list pending completion and USEPA approval of a TMDL.
CAR404234	4	Los Angeles	R	Rivers/Streams	Medea Creek Reach 2 (Abv Confl. with Linderc	40423000	5.41	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR404244	4	Los Angeles	R	Rivers/Streams	Triunfo Canyon Creek Reach 1	40424000	2.51	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR404244	4	Los Angeles	R	Rivers/Streams	Triunfo Canyon Creek Reach 2	40424000	3.32	M	Miles	1100	Sedimentation/Siltation	9000	Source Unknown	2019	
CAR526415	5	Central Valley	R	Rivers/Streams	Fall River (Pit)	52641031	8.61219	M	Miles	1100	Sedimentation/Siltation	2105	Historical Land Management Activities	2016	The sedimentation is accumulated sand size sediment in the upper Fall River. The historic land management activities include logging, grazing, channelization, roads, and railroads.
CAR517325	5	Central Valley	R	Rivers/Streams	Humbug Creek	51732030	2.20272	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2012	All resource extraction sources are abandoned mine
CAR559115	5	Central Valley	R	Rivers/Streams	Panoche Creek (Silver Creek to Belmont Avenue)	55112000	17.6357	M	Miles	1100	Sedimentation/Siltation	1000	Agriculture	2007	
CAR559115	5	Central Valley	R	Rivers/Streams	Panoche Creek (Silver Creek to Belmont Avenue)	55112000	17.6357	M	Miles	1100	Sedimentation/Siltation	1935	Agriculture-grazing	2007	

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR55911 5		Central Valley	R	Rivers/Streams	Panoche Creek (Silver Creek to Belmont Avenue)	55112000	17.6357	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2007	
CAL63030(6		Lahontan	L	Lakes/Reservoirs	Bridgeport Reservoi	63030050	2614.34	A	Acres	1100	Sedimentation/Siltation	1350	Grazing-Related Sources	2006	
CAL63030(6		Lahontan	L	Lakes/Reservoirs	Bridgeport Reservoi	63030050	2614.34	A	Acres	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2006	
CAL63030(6		Lahontan	L	Lakes/Reservoirs	Bridgeport Reservoi	63030050	2614.34	A	Acres	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2006	
CAL63030(6		Lahontan	L	Lakes/Reservoirs	Bridgeport Reservoi	63030050	2614.34	A	Acres	1100	Sedimentation/Siltation	8540	Sediment Resuspension	2006	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	1350	Grazing-Related Sources	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	2000	Silviculture	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	3200	Land Development	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	4300	Other Urban Runoff	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	4500	Highway/Road/Bridge Runoff	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	4600	Urban Runoff--Erosion and Sedimentation	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7000	Hydromodification	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7100	Channelization	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7600	Removal of Riparian Vegetation	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7810	Channel Erosion	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	8100	Atmospheric Deposition	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	8540	Sediment Resuspension	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	8600	Natural Sources	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	8700	Recreational and Tourism Activities (non-boating)	2007	
CAL63430(6		Lahontan	L	Lakes/Reservoirs	Tahoe, Lake	63430010	85364.1	A	Acres	1100	Sedimentation/Siltation	9100	Nonpoint Source	2007	
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	4501	Surface Runoff	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	5000	Resource Extraction	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	8100	Atmospheric Deposition	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	8700	Recreational and Tourism Activities (non-boating)	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63420 6		Lahontan	R	Rivers/Streams	Blackwood Creek	63420021	5.87001	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2008	Creek affected by past gravel quarry operations and other watershed disturbance including grazing and timber harv
CAR63520 6		Lahontan	R	Rivers/Streams	Bronco Creek	63520053	1.34403	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2006	Watershed disturbance in naturally highly erosive watershe
CAR63520 6		Lahontan	R	Rivers/Streams	Bronco Creek	63520053	1.34403	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2006	Watershed disturbance in naturally highly erosive watershe
CAR63520 6		Lahontan	R	Rivers/Streams	Bronco Creek	63520053	1.34403	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2006	Watershed disturbance in naturally highly erosive watershe
CAR63040 6		Lahontan	R	Rivers/Streams	Clearwater Creek	63040051	12.4874	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2006	Listed on basis of limited information; additional monitoring may support delisti
CAR63040 6		Lahontan	R	Rivers/Streams	Clearwater Creek	63040051	12.4874	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2006	Listed on basis of limited information; additional monitoring may support delisti
CAR63040 6		Lahontan	R	Rivers/Streams	Clearwater Creek	63040051	12.4874	M	Miles	1100	Sedimentation/Siltation	8300	Highway Maintenance and Runoff	2006	Listed on basis of limited information; additional monitoring may support delisti
CAR63010 6		Lahontan	R	Rivers/Streams	East Walker River, below Bridgeport Reservo	63030050	8.00973	M	Miles	1100	Sedimentation/Siltation	1350	Grazing-Related Sources	2019	
CAR63010 6		Lahontan	R	Rivers/Streams	East Walker River, below Bridgeport Reservo	63030050	8.00973	M	Miles	1100	Sedimentation/Siltation	4500	Highway/Road/Bridge Runoff	2019	
CAR63010 6		Lahontan	R	Rivers/Streams	East Walker River, below Bridgeport Reservo	63030050	8.00973	M	Miles	1100	Sedimentation/Siltation	4600	Urban Runoff--Erosion and Sedimentation	2019	
CAR63010 6		Lahontan	R	Rivers/Streams	East Walker River, below Bridgeport Reservo	63030050	8.00973	M	Miles	1100	Sedimentation/Siltation	7350	Upstream Impoundment	2019	
CAR63010 6		Lahontan	R	Rivers/Streams	East Walker River, below Bridgeport Reservo	63030050	8.00973	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2019	
CAR63520 6		Lahontan	R	Rivers/Streams	Gray Creek (Nevada County	63520052	2.8033	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2006	Sediment from disturbance of naturally highly erosive watershe
CAR63520 6		Lahontan	R	Rivers/Streams	Gray Creek (Nevada County	63520052	2.8033	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2006	Sediment from disturbance of naturally highly erosive watershe
CAR63520 6		Lahontan	R	Rivers/Streams	Gray Creek (Nevada County	63520052	2.8033	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2006	Sediment from disturbance of naturally highly erosive watershe
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2019	
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2019	
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2019	
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	7550	Habitat Modification	2019	
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	8700	Recreational and Tourism Activities (non-boating)	2019	
CAR63410 6		Lahontan	R	Rivers/Streams	Heavenly Valley Creek (USFS boundary to Trout Creek)	63410031	1.44732	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAR63030 6		Lahontan	R	Rivers/Streams	Hot Springs Canyon Creek	63030042	2.8612	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2008	Listed on basis of limited data; further monitoring may support delistir
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	4300	Other Urban Runoff	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	7000	Hydromodification	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	7800	Drainage/Filling Of Wetlands	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	8300	Highway Maintenance and Runoff	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	8700	Recreational and Tourism Activities (non-boating)	2006	
CAR63520 6		Lahontan	R	Rivers/Streams	Squaw Creek	63520011	5.8	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2006	
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	3000	Construction/Land Development	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	3100	Highway/Road/Bridge Construction	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	7700	Streambank Modification/Destabilization	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	7820	Erosion/Siltation	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	8600	Natural Sources	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	8700	Recreational and Tourism Activities (non-boating)	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	8710	Snow skiing activities	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63510 6		Lahontan	R	Rivers/Streams	Truckee River	63510010	39.1307	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2006	Watershed disturbance including ski resorts, silvicultural activities, urban development, reservoir construction and management; highly erosive subwatersh
CAR63420 6		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2008	
CAR63420 6		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	3200	Land Development	2008	
CAR63420 6		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	4000	Urban Runoff/Storm Sewers	2008	

WBID	REGION NUMBER	REGION NAME	WATER BODY TYPE ABBR	WATER BODY TYPE	WATER BODY NAME	CALWATER WATERSHED	ESTIMATED SIZE AFFECTED	UNIT ABBR	UNIT	POLLUTANT CODE	POLLUTANT	SOURCE CODE	POTENTIAL SOURCES	PROPOSED TMDL COMPLETION	COMMENTS
CAR634206		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	4500	Highway/Road/Bridge Runoff	2008	
CAR634206		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	7810	Channel Erosion	2008	
CAR634206		Lahontan	R	Rivers/Streams	Ward Creek	63420020	5.675	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2008	
CAR632106		Lahontan	R	Rivers/Streams	Wolf Creek (Alpine County)	63210031	11.8207	M	Miles	1100	Sedimentation/Siltation	1500	Range Grazing-Riparian and/or Upland	2019	
CAR632106		Lahontan	R	Rivers/Streams	Wolf Creek (Alpine County)	63210031	11.8207	M	Miles	1100	Sedimentation/Siltation	2000	Silviculture	2019	
CAR632106		Lahontan	R	Rivers/Streams	Wolf Creek (Alpine County)	63210031	11.8207	M	Miles	1100	Sedimentation/Siltation	9100	Nonpoint Source	2019	
CAL801718		Santa Ana	L	Lakes/Reservoirs	Big Bear Lake	80171000	2865.01	A	Acres	1100	Sedimentation/Siltation	3000	Construction/Land Development	2006	
CAL801718		Santa Ana	L	Lakes/Reservoirs	Big Bear Lake	80171000	2865.01	A	Acres	1100	Sedimentation/Siltation	8710	Snow skiing activities	2006	
CAL801718		Santa Ana	L	Lakes/Reservoirs	Big Bear Lake	80171000	2865.01	A	Acres	1100	Sedimentation/Siltation	9105	Unknown Nonpoint Source	2006	
CAR801718		Santa Ana	R	Rivers/Streams	Rathbone (Rathbun) Creek	80171000	4.68	M	Miles	1100	Sedimentation/Siltation	8710	Snow skiing activities	2006	
CAR801718		Santa Ana	R	Rivers/Streams	Rathbone (Rathbun) Creek	80171000	4.68	M	Miles	1100	Sedimentation/Siltation	9105	Unknown Nonpoint Source	2006	
CAE904319		San Diego	E	Estuaries	Agua Hedionda Lagoon	90431000	6.83187	A	Acres	1100	Sedimentation/Siltation	9201	Nonpoint/Point Source	2019	
CAE904219		San Diego	E	Estuaries	Buena Vista Lagoon	90421000	202.298	A	Acres	1100	Sedimentation/Siltation	9201	Nonpoint/Point Source	2019	
CAE906109		San Diego	E	Estuaries	Los Penasquitos Lagoon	90610000	468.918	A	Acres	1100	Sedimentation/Siltation	9201	Nonpoint/Point Source	2019	
CAE904619		San Diego	E	Estuaries	San Elijo Lagoon	90461000	565.804	A	Acres	1100	Sedimentation/Siltation	9201	Nonpoint/Point Source	2019	Estimated size of impairment is 150 acres

Post-Construction Water Balance Calculator

3	User may make changes from any cell that is orange or brown in color (similar to the cells to the immediate right). Cells in green are calculated for you.		(Step 1a) If you know the 85th percentile storm event for your location enter it in the box below	(Step 1b) If you can not answer 1a then select the county where the project is located (click on the cell to the right for drop-down): This will determine the average 85th percentile 24 hr. storm event for your site, which will appear under precipitation to left.	***SACRAMENTO***
4				(Step 1c) If you would like a more percise value select the location closest to your site. If you do not recgonize any of these locations, leave this drop-down menu at location. The average value for the County will be used.	**SACRAMENTO FAA ARPT**
5	***Project Information***			***Runoff Calculations***	
6	***Project Name:***	***Optional***		(Step 2) Indicate the Soil Type (dropdown menu to right):	***Group C Soils*** / **Low infiltration. Sandy clay loam. Infiltration rate 0.05 to 0.15 inch/hr when wet.**
7	***Waste Discharge Identification (WDID):***	***Optional***		(Step 3) Indicate the existing **dominant** non-built land Use Type (dropdown menu to right):	***Wood & Grass: <50% ground cover***
8	***Date:***	***Optional***		(Step 4) Indicate the proposed **dominant** non-built land Use Type (dropdown menu to right):	***Lawn, Grass, or Pasture covering more than 75% of the open space***
9	***Sub Drainage Area Name (from map):***	***Optional***			**Complete Either**
10	***Runoff Curve Numbers***				**Sq Ft** / **Acres** / **Acres**
11	**Existing Pervious Runoff Curve Number**		**82**	*(Step 5) Total Project Site Area:*	**5.00** / **5.00**
12	**Proposed Development Pervious Runoff Curve Number**		**74**	*(Step 6) Sub-watershed Area:*	**5.00** / **5.00**
13	***Design Storm***			*Percent of total project :*	**100%**
14	Based on the County you indicated above, we have included the 85 percentile average 24 hr event - P85 (in)^ for your area.	**0.62**	**in**		
15	The Amount of rainfall needed for runoff to occur (Existing runoff curve number -P from existing RCN (in)^)	**0.44**	**In**	***(Step 7) Sub-watershed Conditions***	**Complete Either** / **Calculated Acres**
16	P used for calculations (in) (the greater of the above two criteria)	**0.62**	**In**	Sub-watershed Area (acres)	**Sq Ft** / **Acres** / **5.00**
17	^Available at www.cabmphandbooks.com			Existing Rooftop Impervious Coverage	**0** / **0.00**
18				Existing Non-Rooftop Impervious Coverage	**0** / **0.00**
19				Proposed Rooftop Impervious Coverage	**0** / **0.00**
20				Proposed Non-Rooftop Impervious Coverage	**0** / **0.00**
21					
22				***Credits***	**Acres** / **Square Feet**
23				Porous Pavement	**0.00** / **0**
24				Tree Planting	**0.00** / **0**
25	**Pre-Project Runoff Volume (cu ft)**	**247**	**Cu.Ft.**	Downspout Disconnection	**0.00** / **0**
26	**Project-Related Runoff Volume Increase w/o credits (cu ft)**	**0**	**Cu.Ft.**	Impervious Area Disconnection	**0.00** / **0**
27				Green Roof	**0.00** / **0**
28				Stream Buffer	**0.00** / **0**
29				Vegetated Swales	**0.00** / **0**
30	**Project-Related Volume Increase with Credits (cu ft)**	**0**	**Cu.Ft.**	**Subtotal**	**0.00** / **0**
31				**Subtotal Runoff Volume Reduction Credit**	**0 Cu. Ft.**
32					
33	You have achieved your minimum requirements			***(Step 9) Impervious Volume Reduction Credits***	**Volume (cubic feet)**
34				Rain Barrels/Cisterns	**0 Cu. Ft.**
35				Soil Quality	**0 Cu. Ft.**
36				**Subtotal Runoff Volume Reduction**	**0 Cu. Ft.**
37				**Total Runoff Volume Reduction Credit**	**0 Cu. Ft.**
38					
39					

Porous Pavement Credit Worksheet

Please fill out a porous pavement credit worksheet for each project sub-watershed.

For the PROPOSED Development:

Proposed Porous Pavement	Runoff Reduction*	Fill in either Acres or SqFt		Equivalent Acres
		In SqFt.	In Acres	
Area of **Brick without Grout** on less than 12 inches of base with at least 20% void space over soil	0.45			0.00
Area of **Brick without Grout** on more than 12 inches of base with at least 20% void space over soil	0.90			0.00
Area of **Cobbles** less than 12 inches deep and over soil	0.30			0.00
Area of **Cobbles** less than 12 inches deep and over soil	0.60			0.00
Area of **Reinforced Grass Pavement** on less than 12 inches of base with at least 20% void space over soil	0.45			0.00
Area of **Reinforced Grass Pavement** on at least 12 inches of base with at least 20% void space over soil	0.90			0.00
Area of **Porous Gravel Pavement** on less than 12 inches of base with at least 20% void space over soil	0.38			0.00
Area of **Porous Gravel Pavement** on at least 12 inches of base with at least 20% void space over soil	0.75			0.00
Area of **Poured Porous Concrete or Asphalt Pavement** with less than 4 inches of gravel base (washed stone)	0.40			0.00
Area of **Poured Porous Concrete or Asphalt Pavement** with 4 to 8 inches of gravel base (washed stone)	0.60			0.00
Area of **Poured Porous Concrete or Asphalt Pavement** with 8 to 12 inches of gravel base (washed stone)	0.80			0.00
Area of **Poured Porous Concrete or Asphalt Pavement** with 12 or more inches of gravel base (washed stone)	1.00			0.00

*=1-Rv**

Return to Calculator

**Using Site Design Techniques to meet Development Standards for Stormwater Quality (BASMAA 2003)

**NCDENR Stormwater BMP Manual (2007)

Tree Planting Credit Worksheet

Please fill out a tree canopy credit worksheet for each project sub-watershed.

Tree Canopy Credit Criteria	Number of Trees Planted	Credit (acres)
Number of proposed evergreen trees to be planted (credit = number of trees x 0.005)*	0	0.00
Number of proposed deciduous trees to be planted (credit = number of trees x 0.0025)*		0.00
	Square feet Under Canopy	
Square feet under an existing tree canopy, that will remain on the property, with an average diameter at 4.5 ft above grade (i.e., diameter at breast height or DBH) is LESS than 12 in diameter.		0.00
Square feet under an existing tree canopy that will remain on the property, with an average diameter at 4.5 ft above grade (i.e., diameter at breast height or DBH) is 12 in diameter or GREATER.		0.00
Please describe below how the project will ensure that these trees will be maintained.		

0

Return to Calculator

* credit amount based on credits from Stormwater Quality Design Manual for the Sacramento and South Placer Regions

Downspout Disconnection Credit Worksheet

Please fill out a downspout disconnection credit worksheet for each project subwatershed. If you answer yes to all questions, all rooftop area draining to each downspout will be subtracted from your proposed rooftop impervious coverage.

Downspout Disconnection Credit Criteria					
Do downspouts and any extensions extend at least six feet from a basement and two feet from a crawl space or concrete slab?				○ Yes	◉ No
Is the area of rooftop connecting to each disconnected downspout 600 square feet or less?				○ Yes	◉ No
Is the roof runoff from the design storm event fully contained in a raised bed or planter box or does it drain as sheet flow to a landscaped area large enough to contain the roof runoff from the design storm event?				○ Yes	◉ No
The Stream Buffer and/or Vegetated Swale credits **will not** be taken in this sub-watershed area?				○ Yes	◉ No
Percentage of existing	0.00	Acres	of rooftop surface has disconnected downspouts		
Percentage of the proposed	0.00	Acres	of rooftop surface has disconnected downspouts	50	
				Return to Calculator	

Impervious Area Disconnection Credit Worksheet

Please fill out an impervious area disconnection credit worksheet for each project sub-watershed. If you answer yes to all questions, all non-rooftop impervious surface area will be subtracted from your proposed non-rooftop impervious coverage.

Non-Rooftop Disconnection Credit Criteria	Response
Is the maximum contributing impervious flow path length less than 75 feet or, if equal or greater than 75 feet, is a storage device (e.g. French drain, bioretention area, gravel trench) implemented to achieve the required disconnection length?	◉ Yes ○ No
Is the impervious area to any one discharge location less than 5,000 square feet?	◉ Yes ○ No
The Stream Buffer credit **will not** be taken in this sub-watershed area?	◉ Yes ○ No

Percentage of existing	0.00	Acres non-rooftop surface area disconnected	
Percentage of the proposed	0.00	Acres non-rooftop surface area disconnected	70

Return to Calculator

Green Roof Credit Worksheet

Please fill out a greenroof credit worksheet for each project sub-watershed. If you answer yes to all questions, 70% of the greenroof area will be subtracted from your proposed rooftop impervious coverage.

Green Roof Credit Criteria	Response
Is the roof slope less than 15% or does it have a grid to hold the substrate in place until it forms a thick vegetation mat?	◉ Yes ○ No
Has a professional engineer assessed the necessary load reserves and designed a roof structure to meet state and local codes?	◉ Yes ○ No
Is the irrigation needed for plant establishment and/or to sustain the green roof during extended dry periods, is the source from stored, recycled, reclaimed, or reused water?	◉ Yes ○ No
Percentage of existing 0.00 Acres rooftop surface area in greenroof	
Percentage of the proposed 0.00 Acres rooftop surface area in greenroof	

Return to Calculator

Stream Buffer Credit Worksheet

Please fill out a stream buffer credit worksheet for each project sub-watershed. If you answer yes to all questions, you may subtract all impervious surface draining to each stream buffer that has not been addressed using the Downspout and/or Impervious Area Disconnection credits.

Stream Buffer Credit Criteria				Response
Does runoff enter the floodprone width* or within 500 feet (whichever is larger) of a stream channel as sheet flow**?				○ Yes ◉ No
Is the contributing overland slope 5% or less, or if greater than 5%, is a level spreader used?				○ Yes ◉ No
Is the buffer area protected from vehicle or other traffic barriers to reduce compaction?				○ Yes ◉ No
Will the stream buffer be maintained in an ungraded and uncompacted condition and will the vegetation be maintained in a natural condition?				○ Yes ◉ No
Percentage of existing	0.00	Acres	impervious surface area draining into a stream buffer:	
Percentage of the proposed	0.00	Acres	impervious surface area that will drain into a stream buffer:	
Please describe below how the project will ensure that the buffer areas will remain in ungraded and uncompacted condition and that the vegetation will be maintained in a natural condition.				

Return to Calculator

* floodprone width is the width at twice the bankfull depth.
** the maximum contributing length shall be 75 feet for impervious area

Vegetated Swale Credit Worksheet

Please fill out a vegetated swale worksheet for each project subwatershed. If you answer yes to all questions, you may subtract all impervious surface draining to each stream buffer that has not been addressed using the Downspout Disconnection credit.

Vegetated Swale Credit Criteria

Have all vegetated swales been designed in accordance with Treatment Control BMP 30 (TC-30 - Vegetated Swale) from the California Stormwater BMP Handbook, New Development and Redevelopment (available at www.cabmphandbooks.com)?	○ Yes ◉ No
Is the maximum flow velocity for runoff from the design storm event less than or equal to 1.0 foot per second?	○ Yes ◉ No

Percentage of existing	0.00	Acres of impervious area draining to a vegetated swale	
Percentage of the proposed	0.00	Acres of impervious area draining to a vegetated swale	

Return to Calculator

Rain Barrel/Cistern Credit Worksheet

Please fill out a rain barrel/cistern worksheet for each project sub-watershed.

Rain Barrel/Cistern Credit Criteria	Response
Total number of rain barrel(s)/cisterns	
Average capacity of rain barrel(s)/cistern(s) (in gallons)	
Total capacity rain barrel(s)/cistern(s) (in cu ft) [1]	0

[1] accounts for 10% loss

Return to Calculator

Please fill out a soil quality worksheet for each project sub-watershed.

	Response
Will the landscaped area be lined with an impervious membrane?	
Will the soils used for landscaping meet the ideal bulk densities listed in Table 1 below? [1]	○ Yes ◉ No
If you answered yes to the question above, and you know the area-weighted bulk density within the top 12 inches for soils used for landscaping (in g/cm^3)* , fill in the cell to the right and skip to cell G11. If not select from the drop-down menu in G10.	1.3
If you answered yes to the question above, but you do not know the exact bulk density, which of the soil types in the drop down menu to the right best describes the top 12 inches for soils used for landscaping (in g/cm^3).	Sandy loams, loams
What is the average depth of your landscaped soil media meeting the above criteria (inches)?	12
What is the total area of the landscaped areas meeting the above criteria (in acres)?	2.97

Return to Calculator

Table 1

Sands, loamy sands	<1.6
Sandy loams, loams	<1.4
Sandy clay loams, loams, clay loams	<1.4
Silts, silt loams	<1.3
Silt loams, silty clay loams	<1.1
Sandy clays, silty clays, some clay loams (35-45% clay)	<1.1
Clays (>45% clay)	<1.1

Porosity (%) 50.94%

Mineral grains in many soils are mainly quartz and feldspar, so 2.65 a good average for particle density. To determine percent porosity, use the formula: Porosity (%) = (1-Bulk Density/2.65) X 100

[1] USDA NRCS. "Soil Quality Urban Technical Note No.2-Urban Soil Compaction". March 2000. http://soils.usda.gov/sqi/management/files/sq_utn_2.pdf

* To determine how to calculate density see: http://www.globe.gov/tctg/bulkden.pdf?sectionID=94

APPENDIX 2:
Post-Construction Water Balance Performance Standard Spreadsheet

The discharger shall submit with their Notice of Intent (NOI) the following information to demonstrate compliance with the New and Re-Development Water Balance Performance Standard.

Map Instructions

The discharger must submit a small-scale topographic map of the site to show the existing contour elevations, pre- and post-construction drainage divides, and the total length of stream in each watershed area. Recommended scales include 1 in. = 20 ft., 1 in. = 30 ft., 1 in. = 40 ft., or 1 in = 50 ft. The suggested contour interval is usually 1 to 5 feet, depending upon the slope of the terrain. The contour interval may be increased on steep slopes. Other contour intervals and scales may be appropriate given the magnitude of land disturbance.

Spreadsheet Instructions

The intent of the spreadsheet is to help dischargers calculate the project-related increase in runoff volume and select impervious area and runoff reduction credits to reduce the project-related increase in runoff volume to pre-project levels.

The discharger has the option of using the spreadsheet (**Appendix 2.1)** or a more sophisticated, watershed process-based model (e.g. Storm Water Management Model, Hydrological Simulation Program Fortran) to determine the project-related increase in runoff volume.

In* Appendix 4.1**, ***you must complete the worksheet for each land use/soil type combination for each project sub-watershed.

Steps 1 through 9 pertain specifically to the Runoff Volume Calculator:

Step 1: Enter the county where the project is located in cell H3.

Step 2: Enter the soil type in cell H6.

Step 3: Enter the existing pervious (dominant) land use type in cell H7.

Step 4: Enter the proposed pervious (dominant) land use type in cell H8.

Step 5: Enter the total project site area in cell H11 or J11.

Step 6: Enter the sub-watershed area in cell H12 or J12.

Step 7: Enter the existing rooftop area in cell H17 or J17, the existing non-rooftop impervious area in cell H18 or J18, the proposed rooftop area in cell H19 or J19, and the proposed non-rooftop impervious area in cell H20 or J20

Step 8: Work through each of the impervious area reduction credits and claim credits where applicable. Volume that cannot be addressed using non-structural practices must be captured in structural practices and approved by the Regional Water Board.

Step 9: Work through each of the impervious volume reduction credits and claim credits where applicable. Volume that cannot be addressed using non-structural practices must be captured in structural practices and approved by the Regional Water Board.

Non-structural Practices Available for Crediting

- ***Porous Pavement***
- ***Tree Planting***
- ***Downspout Disconnection***
- ***Impervious Area Disconnection***
- ***Green Roof***
- ***Stream Buffer***
- ***Vegetated Swales***
- ***Rain Barrels and Cisterns***
- ***Landscaping Soil Quality***

APPENDIX 3
Bioassessment Monitoring Guidelines

Bioassessment monitoring is required for projects that meet all of the following criteria:

1. The project is rated Risk Level 3 or LUP Type 3
2. The project directly discharges runoff to a freshwater wadeable stream (or streams) that is either: (a) listed by the State Water Board or USEPA as impaired due to sediment, and/or (b) tributary to any downstream water body that is listed for sediment; and/or have the beneficial use SPAWN & COLD & MIGRATORY
3. Total project-related ground disturbance exceeds 30 acres.

For all such projects, the discharger shall conduct bioassessment monitoring, as described in this section, to assess the effect of the project on the biological integrity of receiving waters.
Bioassessment shall include:

1. The collection and reporting of specified instream biological data
2. The collection and reporting of specified instream physical habitat data

<u>Bioassessment Exception</u>
If a site qualifies for bioassessment, but construction commences out of an index period for the site location, the discharger shall:

1. Receive Regional Water Board approval for the sampling exception
2. Make a check payable to: Cal State Chico Foundation (SWAMP Bank Account) or San Jose State Foundation (SWAMP Bank Account) and include the WDID# on the check for the amount calculated for the exempted project.
3. Send a copy of the check to the Regional Water Board office for the site's region
4. Invest **7,500.00 X The number of samples required** into the SWAMP program as compensation (upon Regional Water Board approval).
5. Conduct bioassessment monitoring, as described in Appendix 4
6. Include the collection and reporting of specified instream biological data and physical habitat
7. Use the bioassessment sample collection and Quality Assurance & Quality Control (QA/QC) protocols developed by the State of California's Surface Water Ambient Monitoring Program (SWAMP)

<u>Site Locations and Frequency</u>
Macroinvertebrate samples shall be collected both before ground disturbance is initiated and after the project is completed. The "after" sample(s) shall be collected after at least one winter season resulting in surface runoff has transpired after project-related ground disturbance has ceased. "Before" and "after" samples shall be collected both upstream and downstream of the project's

discharge. Upstream samples should be taken immediately before the sites outfall and downstream samples should be taken immediately after the outfall (when safe to collect the samples). Samples should be collected for each freshwater wadeable stream that is listed as impaired due to sediment, or tributary to a water body that is listed for sediment. Habitat assessment data shall be collected concurrently with all required macroinvertebrate samples.

Index Period (Timing of Sample Collection)
Macroinvertebrate sampling shall be conducted during the time of year (i.e., the "index period") most appropriate for bioassessment sampling, depending on ecoregion. This map is posted on the State Water Board's Website: http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml

Field Methods for Macroinvertebrate Collections
In collecting macroinvertebrate samples, the discharger shall use the "Reachwide Benthos (Multi-habitat) Procedure" specified in *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* (Ode 2007).[1]

Physical - Habitat Assessment Methods
The discharger shall conduct, concurrently with all required macroinvertebrate collections, the "Full" suite of physical habitat characterization measurements as specified in *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* (Ode 2007), and as summarized in the Surface Water Ambient Monitoring Program's *Stream Habitat Characterization Form — Full Version*.

Laboratory Methods
Macroinvertebrates shall be identified and classified according to the Standard Taxonomic Effort (STE) Level I of the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT),[2] and using a fixed-count of 600 organisms per sample.

Quality Assurance
The discharger or its consultant(s) shall have and follow a quality assurance (QA) plan that covers the required bioassessment monitoring. The QA plan shall include, or be supplemented to include, a specific requirement for external QA checks (i.e., verification of taxonomic identifications and correction of data where errors are identified). External QA checks shall be performed on one of the

[1] This document is available on the Internet at: http://www.swrcb.ca.gov/swamp/docs/phab_sopr6.pdf.
[2] The current SAFIT STEs (28 November 2006) list requirements for both the Level I and Level II taxonomic effort, and are located at: http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf. When new editions are published by SAFIT, they will supersede all previous editions. All editions will be posted at the State Water Board's SWAMP website.

discharger's macroinvertebrate samples collected per calendar year, or ten percent of the samples per year (whichever is greater). QA samples shall be randomly selected. The external QA checks shall be paid for by the discharger, and performed by the California Department of Fish and Game's Aquatic Bioassessment Laboratory. An alternate laboratory with equivalent or better expertise and performance may be used if approved in writing by State Water Board staff.

Sample Preservation and Archiving

The original sample material shall be stored in 70 percent ethanol and retained by the discharger until: 1) all QA analyses specified herein and in the relevant QA plan are completed; and 2) any data corrections and/or re-analyses recommended by the external QA laboratory have been implemented. The remaining subsampled material shall be stored in 70 percent ethanol and retained until completeness checks have been performed according to the relevant QA plan. The identified organisms shall be stored in 70 percent ethanol, in separate glass vials for each final ID taxon. (For example, a sample with 45 identified taxa would be archived in a minimum of 45 vials, each containing all individuals of the identified taxon.) Each of the vials containing identified organisms shall be labeled with taxonomic information (i.e., taxon name, organism count) and collection information (i.e., site name/site code, waterbody name, date collected, method of collection). The identified organisms shall be archived (i.e., retained) by the discharger for a period of not less than three years from the date that all QA steps are completed, and shall be checked at least once per year and "topped off" with ethanol to prevent desiccation. The identified organisms shall be relinquished to the State Water Board upon request by any State Water Board staff.

Data Submittal

The macroinvertebrate results (i.e., taxonomic identifications consistent with the specified SAFIT STEs, and number of organisms within each taxa) shall be submitted to the State Water Board in electronic format. The State Water Board's Surface Water Ambient Monitoring Program (SWAMP) is currently developing standardized formats for reporting bioassessment data. All bioassessment data collected after those formats become available shall be submitted using the SWAMP formats. Until those formats are available, the biological data shall be submitted in MS-Excel (or equivalent) format.[3]

The physical/habitat data shall be reported using the standard format titled *SWAMP Stream Habitat Characterization Form — Full Version*.[4]

[3] Any version of Excel, 2000 or later, may be used.
[4] Available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/reports/fieldforms_fullversion052908.pdf

Invasive Species Prevention

In conducting the required bioassessment monitoring, the discharger and its consultants shall take precautions to prevent the introduction or spread of aquatic invasive species. At minimum, the discharger and its consultants shall follow the recommendations of the California Department of Fish and Game to minimize the introduction or spread of the New Zealand mudsnail.[5]

[5] Instructions for controlling the spread of NZ mudsnails, including decontamination methods, can be found at: http://www.dfg.ca.gov/invasives/mudsnail/
More information on AIS More information on AIS
http://www.waterboards.ca.gov/water_issues/programs/swamp/ais/

Appendix 4 Sediment TMDLs

Implemented Sediment TMDLs in California. Construction was listed as a source in all fo these TMDLs in relation to road construction. Although construction was mentioned as a source, it was not given a specific allocation amount. The closest allocation amount would be for the road activity management WLA. **Implementation Phase** – Adoption process by the Regional Board, the State Water Resources Control Board, the Office of Administrative Law, and the US Environmental Protection Agency completed and TMDL being implemented.

A. Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres**	**WLA** tons mi^2 yr
1 R1.epa.albionfinaltmdl	R	Albion River	Sedimentation	Road Construction	2001	43 acres	See A (table 6)

B Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres**	**WLA** tons mi^2 yr
1 R1.epa.EelR-middle.mainSed.temp	R	Middle Main Eel River and Tributaries (from Dos Rios to the South Fork)	Sedimentation Road	Construction	2005-2006 521	mi^2	100

C Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres**	**WLA** tons mi^2 yr
1 R1.epa.EelRsouth.sed.temp	R	South Fork Eel River	Sedimentation	Road Construction	12 1999	See chart	473

D Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres**	**WLA** tons mi^2 yr
1 R1.epa.bigfinaltmdl	R Big	River	Sedimentation	Road Construction	12 2001	181 mi^2 watershed drainage	TMDL = loading capacity = nonpoint sources + background =

							393 t mi2 yr

E Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres	WLA tons mi^2 yr
1 R1.epa.EelR-lower.Sed.temp-121807-signed	R	Lower Eel River	Sedimentation	Road Construction	12 2007	300 square-mile watershed	898

F Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres	WLA tons mi^2 yr
1 R1.epa.EelR-middle.Sed.temp-	R	Middle Fork Eel River	Sedimentation	Road Construction	12 2003	753 mi^2 (approx. 482,000 acres)	82

G Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres Mi^2	WLA tons mi^2 yr
1 R1.epa.EelRnorth-Sed.temp.final-121807-signed	R	North Fork Eel River	Sedimentation	Road Construction	12 30 2002	289 (180,020 acres)	20

H Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres Mi^2	WLA tons mi^2 yr
1 R1.epa.EelR-upper.mainSed.temp-	R	Upper Main Eel River and Tributaries (including Tomki Creek, Outlet Creek and Lake Pillsbury)	Sedimentation	Road Construction	12 29 2004	688 (approx. 440,384 acres)	14

I Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres	WLA tons mi^2 yr
1 R1.epa.gualalafinaltmdl	R	Gualala River	Sedimentation	Road Construction	Not sure	300 (191,145 acres)	7

J Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA tons mi^2 yr
1 R1.epa.Mad-sed.turbidity	R	Mad River	Sedimentation	Road Construction	12 21 2007	480	174

K Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA tons mi^2 yr
1 R1.epa.mattole.sediment	R	Mattole River	Sedimentation	Road Construction	12 30 2003	296	27 or 520+27 = 547

L Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA tons mi^2 yr
1 R1.epa.navarro.sed.temp	R	Navarro River	Sedimentation	Road Construction	Not sure	315 (201,600 acres).	50

M Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA tons mi^2 yr
1 R1.epa.noyo.sediment	R	Noyo River	Sedimentation	Road Construction	12 16 1999	113 (72,323 acres)	68 (three areas measured) Table 16 in the TMDL

N Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA tons mi^2 yr
1 R1.epa.RedwoodCk.sed	Cr	Redwood Creek	Sedimentation	Road Construction	12 30 1998	278	1900 Total allocation

O Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA – Roads tons mi^2 yr
1 R1.epa.tenmile.sed	R	Ten Mile River	Sedimentation	Road Construction	2000	120	9

P Region	Type	Name	Pollutant Stressor	Potential Sources	TMDL Completion Date	Watershed Acres mi^2	WLA management tons mi^2 yr
1 R1.epa.trinity.sed	R	Trinity River	Sedimentation	Road Construction	12 20 2001	2000 of 3000 covered in this TMDL	See rows below
1	Cr	Horse Linto Creek	Sedimentation	Road Construction	12 20 2001	64	528
1	Cr	Mill creek and Tish Tang	Sedimentation	Road Construction	12 20 2001	39	210
1	Cr	Willow Creek	Sedimentation	Road Construction	12 20 2001	43	94
1	Cr	Campbell Creek and Supply Creek	Sedimentation	Road Construction	12 20 2001	11	1961
1	Cr	Lower Mainstem and Coon Creek	Sedimentation	Road Construction	12 20 2001	32	63
1 R		Reference Subwatershed [1]	Sedimentation	Road Construction	12 20 2001	434	24
1	Cr	Canyon Creek	Sedimentation	Road	12 20 2001	64	326

				Construction			
1 R		Upper Tributaries[2]	Sedimentation	Road Construction	12 20 2001	72	67
1 R		Middle Tributaries[3]	Sedimentation	Road Construction	12 20 2001	54	53
1 R		Lower Tributaries[4]	Sedimentation	Road Construction	12 20 2001	96	55
1	Cr	Weaver and Rush Creeks	Sedimentation	Road Construction	12 20 2001	72	169
1 Cr		Deadwood Creek Hoadley Gulch Poker Bar	Sedimentation	Road Construction	12 20 2001	47	68
1	L	Lewiston Lake	Sedimentation	Road Construction	12 20 2001	25	49
1 Cr		Grassvalley Creek	Sedimentation	Road Construction	12 20 2001	37	44
1	Cr	Indian Creek	Sedimentation	Road Construction	12 20 2001	34	81
1	Cr	Reading and Browns Creek	Sedimentation	Road Construction	12 20 2001	104	66
1 Cr		Reference Subwatersheds[5]	Sedimentation	Road Construction	12 20 2001	235	281
1	L, Cr	Westside tributaries[6]	Sedimentation	Road Construction	12 20 2001	93	105
1 R,	Cr, G	Upper trinity[7]	Sedimentation	Road Construction	12 20 2001	161	690
1 R,	Cr, G	East Fork Tributaries[8]	Sedimentation	Road Construction	12 20 2001	115	65
1	R, L	Eastside Tributaries[9]	Sedimentation	Road Construction	12 20 2001	89	60

1 New River, Big French, Manzanita, North Fork, East Fork, North Fork
2 Dutch, Soldier, Oregon gulch, Conner Creek
3 Big Bar, Prairie Creek, Little French Creek
4 Swede, Italian, Canadian, Cedar Flat, Mill, McDonald, Hennessy, Quimby, Hawkins, Sharber
5 Stuarts Fork, Swift Creek, Coffee Creek
6 Stuart Arm, Stoney Creek, Mule Creek, East Fork, Stuart Fork, West Side Trinity Lake, Hatchet Creek, Buckeye Creek,
7 Upper Trinity River, Tangle Blue, Sunflower, Graves, Bear Upper Trinity Mainstream, Ramshorn Creek, Ripple Creek, Minnehaha Creek, Snowslide Gulch, Scorpion Creek
8 East Fork Trinity, Cedar Creek, Squirrel Gulch

9 East Side Tributaries, Trinity Lake

Q Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres** mi^2	**WLA** tons mi^2 yr
1 R1.epa.trinity.so.sed	R, Cr	South Fork Trinity River and Hayfork Creek	Sedimentation	Road Construction	12 1998	Not given, 19 miles long	33 (road total)

R Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres** mi^2	**WLA** tons mi^2 yr
1 R1.epa.vanduzen.sed	R, Cr	Van Duzen River and Yager Creek	Sedimentation	Various	12 16 1999	429	1353 total allocation
1		Upper Basin	Sedimentation	Road Construction			7
1		Middle Basin	Sedimentation	Road Construction			22
1		Lower Basin	Sedimentation	Road Construction			20

S Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres** mi^2	**WLA** tons mi^2 yr
6 R6.blackwood.sed Cr		Blackwood Creek (Placer County)	Bedded Sediment	Various	9 2007	11	17272 total

T Region	**Type**	**Name**	**Pollutant Stressor**	**Potential Sources**	**TMDL Completion Date**	**Watershed Acres** mi^2	**WLA** tons mi^2 yr
6 R6.SquawCk.sed R		Squaw Creek (Placer County)	Sedimentation /controllable sources	Various – basin plan amendment	4 13 2006	8.2	10,900

Adopted TMDLs for Construction Sediment Sources

Region	Type	Name	Pollutant Stressor	Potential Sources	**TMDL Completion Date**	**Watershed Area** mi^2	Waste load Allocation tons mi^2 yr
8 R		Newport Bay San Diego Creek Watershed	Sedimentation	Construction Land Development	1999 2.24	(1432 acres)	125,000 tons per Year (no more than 13,000 tons per year from construction sites)

Appendix 4 Non Sediment TMDLs

Region 1 Lost River-DIN and CBOD

Region 1 Source: Cal Trans Construction TMDL Completion Date: 12 30 2008 TMDL Type: River, Lake Watershed Area= 2996 mi^2	**Pollutant Stressors/WLA**	
	Dissolved inorganic nitrogen (DIN) (metric tons/yr)	**Carbonaceous biochemical oxygen demand (CBOD) (metric tons/yr)**
Lost River from the Oregon border to Tule Lake	.1 .2	
Tule Lake Refuge	.1	.2
Lower Klamath Refuge	.1	.2

Region 2 San Francisco Bay-Mercury

Region 2 Source:Non-Urban Stormwater Runoff TMDL Type: Bay	**Name**	**Pollutant Stressor/WLA**	**TMDL Completion Date**
	San Francisco Bay	Mercury 25 kg/year	08 09 2006

Region 4 Machado Lake Nutrients - Resolution No. 2008-006
(Effective Date - March 11, 2009)

General Construction Stormwater Permit WLAs	Years After Effective Date	Total Phosphorus (mg/L)	Total Nitrogen (TKN + NO3-N + NO2-N) (mg/L)
Interim WLAs[1]	At Effective Date	1.25	3.50
Interim WLAs[2] 5	years	1.25	2.45
Final WLAs[2]	9.5 years	0.10	1.00

[1] The compliance points for effective date interim WLAs are measured in the lake.
[2] No compliance points are specified for general construction stormwater permits for the year 5 interim WLAs and final WLAs

Region 4 Ballona Creek-Metals and Selenium – Resolution No. 2007-015
(Effective Date October 29, 2008)

Wet Weather WLAs

Region 4 Source: NPDES General Construction TMDL Completion Date: 10 29 2008 TMDL Type: Creek								
	Copper (Cu)		**Lead (Pb)**		**Selenium (Se)**		**Zinc (Zn)**	
	g/day	g/day/acre	g/day	g/day/acre	g/day	g/day/acre	g/day	g/day/acre
Ballona Creek	4.94E-07 x Daily storm volume (L)	2.20E-10 x Daily storm volume (L)	1.62E-06 x Daily storm volume (L)	7.20E-10 x Daily storm volume (L)	1.37E-07 x Daily storm volume (L)	6.10E-11 x Daily storm volume (L)	3.27E-06 x Daily storm volume (L)	1.45E-09 x Daily storm volume (L)

Wet-weather WLA Implementation

- Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the final waste load allocations assigned to construction storm water permittees.
- Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the effective date of the TMDL.
- General construction storm water permittees will be considered in compliance with final waste load allocations if they implement these Regional Board approved BMPs. All permittees must implement the approved BMPs within nine years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of the TMDL, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with final waste load allocations.

Dry-weather WLAs

A waste load allocation of zero is assigned to all general construction storm water permits during dry weather.

Dry-weather WLA Implementation

Non-storm water flows authorized by the General Permit for Storm Water Discharges Associated with Construction Activity (Water Quality Order No. 99-08 DWQ), or any successor order, are exempt from the dry-weather waste load allocation equal to zero as long as they comply with the provisions of sections C.3 and A.9 of the Order No. 99-08 DWQ, which state that these authorized non-storm discharges shall be:

(1) infeasible to eliminate
(2) comply with BMPs as described in the Storm Water Pollution Prevention Plan prepared by the permittee, and
(3) not cause or contribute to a violation of water quality standards, or comparable provisions in any successor order.

Unauthorized non-storm water flows are already prohibited by Order No. 99-08 DWQ.

Region 4 Los Angeles River and Tributaries-Metals– Resolution No. 2007-014
(Effective Date October 29, 2008)

Wet Weather WLAs

	Cadmium (Cd)		**Copper (Cu)**		**Lead (Pb)**		**Zinc (Zn)**	
	kg/day g/day/acre		kg/day g/day/acre		kg/day g/day/acre		kg/day g/day/acre	
5.9x10	$^{-11}$ x Daily storm volume (L)	7.6×10^{-12} x Daily storm volume (L)	3.2×10^{-10} x Daily storm volume (L)	4.2×10^{-11} x Daily storm volume (L)	1.2×10^{-9} x Daily storm volume (L)	1.5×10^{-10} x Daily storm volume (L)	3.01×10^{-9} x Daily storm volume (L)	3.9×10^{-10} x Daily storm volume (L)

Wet-weather WLA Implementation

- Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the final waste load allocations assigned to construction storm water permittees.
- Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the effective date of the TMDL.
- General construction storm water permittees will be considered in compliance with final waste load allocations if they implement these Regional Board approved BMPs. All permittees must implement the approved BMPs within nine years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of the TMDL, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with final waste load allocations.

Dry-weather WLAs

A waste load allocation of zero is assigned to all general construction storm water permits during dry weather.

Dry-weather WLA Implementation

Non-storm water flows authorized by the General Permit for Storm Water Discharges Associated with Construction Activity (Water Quality Order No. 99-08 DWQ), or any successor order, are exempt from the dry-weather waste load allocation equal to zero as

long as they comply with the provisions of sections C.3 and A.9 of the Order No. 99-08 DWQ, which state that these authorized non-storm discharges shall be:

(1) infeasible to eliminate
(2) comply with BMPs as described in the Storm Water Pollution Prevention Plan prepared by the permittee, and
(3) not cause or contribute to a violation of water quality standards, or comparable provisions in any successor order.

Unauthorized non-storm water flows are already prohibited by Order No. 99-08 DWQ.

Region 4 Calleguas Creek Metals TMDL – Resolution No. 2006-012 (Effective Date - March 26, 2007)

Interim Limits and Final WLAs for Total Recoverable Copper, Nickel, and Selenium

Interim limits and waste load allocations are applied to receiving water.

A. Interim Limits

Constituents	Calleguas and Conejo Creek			Revolon Slough		
	Dry CMC (ug/L)	Dry CCC (ug/L)	Wet CMC (ug/L)	Dry CMC (ug/L)	Dry CCC (ug/L)	Wet CMC (ug/L)
Copper*	23	19	204	23	19	204
Nickel	15	13	(a)	15	13	(a)
Selenium	(b)	(b)	(b)	14	13	(a)

(a) The current loads do not exceed the TMDL under wet conditions; interim limits are not required.
(b) Selenium allocations have not been developed for this reach as it is not on the 303(d) list.
(c) Attainment of interim limits will be evaluated in consideration of background loading data, if available.

B. Final WLAs for Total Recoverable Copper, Nickel, and Selenium

Dry-Weather WLAs in Water Column

Flow Range	Calleguas and Conejo Creek			Revolon Slough		
	Low Flow	Average Flow	Elevated Flow	Low Flow	Average Flow	Elevated Flow
Copper1 (lbs/day)	0.04*WER - 0.02	0.12*WER - 0.02	0.18*WER - 0.03	0.03*WER - 0.01	0.06*WER - 0.03	0.13*WER - 0.02
Nickel (lbs/day)	0.100	0.120	0.440	0.050	0.069	0.116
Selenium (lbs/day)	(a)	(a)	(a)	0.004	0.003	0.004

[1] If site-specific WERs are approved by the Regional Board, TMDL waste load allocations shall be implemented in accordance with the approved WERs using the equations set forth above. Regardless of the final WERs, total copper loading shall not exceed current loading.

(a) Selenium allocations have not been developed for this reach as it is not on the 303(d) list.

Wet-Weather WLAs in Water Column

Constituent	Calleguas Creek	Revolon Slough
Copper[1] (lbs/day)	(0.00054*Q^2*0.032*Q - 0.17)*WER - 0.06	(0.0002*Q2+0.0005*Q)*WER
Nickel[2] (lbs/day)	0.014*Q^2+0.82*Q	0.027*Q^2+0.47*Q
Selenium[2] (lbs/day)	(a)	0.027*Q^2+0.47*Q

[1] If site-specific WERs are approved by the Regional Board, TMDL waste load allocations shall be implemented in accordance with the approved WERs using the equations set forth above. Regardless of the final WERs, total copper loading shall not exceed current loading.

[2] Current loads do not exceed loading capacity during wet weather. Sum of all loads cannot exceed loads presented in the table

(a) Selenium allocations have not been developed for this reach as it is not on the 303(d) list.

Q: Daily storm volume.

Interim Limits and Final WLAs for Mercury in Suspended Sediment

Flow Range	Calleguas Creek		Revolon Slough	
	Interim (lbs/yr)	Final (lbs/yr)	Interim (lbs/yr)	Final (lbs/yr)
0-15,000 MGY	3.3	0.4	1.7	0.1
15,000-25,000 MGY	10.5	1.6	4	0.7
Above 25,000 MGY	64.6	9.3	10.2	1.8

MGY: million gallons per year.

In accordance with current practice, a group concentration-based WLA has been developed for all permitted stormwater discharges, including municipal separate storm sewer systems (MS4s), Caltrans, general industrial and construction stormwater permits, and Naval Air Weapons Station Point Mugu. Dischargers will have a required 25%, 50% and 100% reduction in the difference between the current loadings and the load allocations at 5, 10 and 15 years after the effective date, respectively. Achievement of required reductions will be evaluated based on progress towards BMP implementation as outlined in the urban water quality management plans (UWQMPs). If the interim reductions are not met, the dischargers will submit a report to the Executive Officer detailing why the reductions were not met and the steps that will be taken to meet the required reductions.

Region 4 Calleguas Creek-OC Pesticides, PCBs, and Siltation (Resolution 2005-010)
Effective Date - March 24, 2006

Interim Requirements

Region 4 Calleguas Creek Source: Minor NPDES point sources/WDRs TMDL Completion Date: 3 24 2006 TMDL Type:Creek	**Pollutant Stressor**	**WLA Daily Max (µg/L)**	**WLA Monthly Ave (µg/L)**
	Chlordane 1.2		0.59
	4,4-DDD 1.7		0.84
	4,4-DDE 1.2		0.59
	4,4-DDT 1.2		0.59
	Dieldrin 0.28		0.14
	PCB's 0.34		0.17
	Toxaphene 0.33		0.16

Region 4 Calleguas Creek-Calleguas Creek Toxicicity (Resolution 2005-009)
Effective Date - March 24, 2006

Minor sources include NPDES permittees other than POTWs and MS4s, discharging to the Calleguas Creek Watershed. A wasteload of 1.0 TUc is allocated to the minor point sources discharging to the Calleguas Creek Watershed. Additionally, the following wasteloads for chlorpyrifos and diazinon are established. Final WLAs apply as of March 24, 2006.

Chlorpyrifos WLAs, ug/L
Final WLA
(4 day)
0.014
Diazinon WLAs, ug/L
Final WLA
Acute and Chronic
0.10

Region 4 Calleguas Creek-Salts (Resolution 2007-016)
Effective Date – December 2, 2008

Final Dry Weather Pollutant WLA (mg/L)					
Region 4 Calleaguas Creek Source Permitted Stormwater Dischargers TMDL Completion Date: 12 2 2008 TMDL Type:Creek	**Critical Condition Flow Rate (mgd)**	**Chloride (lb/day)**	**TDS (lb/day)**	**Sulfate (lb/day)**	**Boron (lb/day)**
Simi	1.39	1738 9849 2897 12			
Las Posas	0.13	157 887 261 N/A			
Conejo	1.26	1576 8931 2627 N/A			
Camarillo	0.06	72	406 119 N/A		
Pleasant Valley (Calleguas)	0.12	150 850 250 N/A			
Pleasant Valley (Revolon)	0.25	314	1778	523	2
Dry Weather Interim Pollutant WLA (mg/L)					
	Chloride (mg/L)	**TDS (mg/L)**	**Sulfate (mg/L)**	**Boron (mg/L)**	

Simi 230.0		1720.0	1289.0	1.3
Las Posas	230	1720	1289	1.3
Conejo 230		1720	1289	1.3
Camarillo 230		1720	1289	1.3
Pleasant Valley (Calleguas)	230	1720	1289	1.3
Pleasant Valley (Revolon)	230	1720	1289	1.3

- Dry- weather waste load allocations apply in the receiving water at the base of each subwatershed. Dry weather allocations apply when instream flow rates are below the 86th percentile flow and there has been no measurable precipitation in the previous 24 hours.
- Because wet weather flows transport a large mass of salts at low concentrations, these dischargers meet water quality objectives during wet weather. No wet weather allocations are assigned.

Ballona Creek Toxic Pollutants (Resolution No. 2005-008)
Effective Date - January 11, 2006

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive an individual waste load allocation on a per acre basis, based on the acreage of their facility.

Metals per Acre WLAs for Individual General Construction or Industrial Storm Water Permittees (g/yr/ac)

Cadmium	Copper	Lead	Silver	Zinc
0.1	3 4 0.1			13

Organics per Acre WLAs for Individual General Construction or Industrial Storm Water Permittees (mg/yr/ac)

Chlordane	DDTs	Total PCBs	Total PAHs
0.04	0.14	2	350

Waste load allocations will be incorporated into the State Board general permit upon renewal or into a watershed specific general construction storm water permit developed by the Regional Board.

Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the waste load allocations assigned to construction storm water permittees. Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the

effective date of the TMDL. General construction storm water permittees will be considered in compliance with waste load allocations if they implement these Regional Board approved BMPs.

All general construction permittees must implement the approved BMPs within nine years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of the TMDL, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with waste load allocations.

Region 4 Marina Del Rey Harbor Toxic Pollutants TMDL (Resolution No. 2005-012)
Effective Date March 22, 2006

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive an individual waste load allocation on a per acre basis, based on the acreage of their facility.

Metals per Acre WLAs for Individual General Construction or Industrial Storm Water Permittees (g/yr/ac)

Copper	Lead	Zinc
2.3	3.1	10

Organics per acre WLAs for Individual General Construction or Industrial Storm Water Permittees (mg/yr/ac)

Chlordane	Total PCBs
0.03	1.5

Waste load allocations will be incorporated into the State Board general permit upon renewal or into a watershed specific general construction storm water permit developed by the Regional Board.

Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the waste load allocations assigned to construction storm water permittees. Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the effective date of the TMDL. General construction storm water permittees will be considered in compliance with waste load allocations if they implement these Regional Board approved BMPs.

All general construction permittees must implement the approved BMPs within nine years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of

the TMDL, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with waste load allocations.

Region 4 San Gabriel River and Tributaries-Metals and Selenium (EPA-established TMDL – Effective date: 3/26/07)

Wet-weather allocations

Waterbody	Copper	Lead	Zinc
San Gabriel River Reach 2*		0.8 kg/d	
Coyote Creek**	0.513 kg/d	2.07 kg/d	3.0 kg/d

*Mass-based allocations are based on a flow of 260 cfs (daily storm volume = 6.4×10^8 liters)

**Mass-based allocations are based on a flow of 156 cfs (daily storm volume = 3.8×10^8 liters)

Dry-weather allocations

The dry-weather copper waste load allocation for general construction storm water permittees that discharge to San Gabriel Reach 1, Coyote Creek, and the Estuary is zero.

The dry-weather selenium allocation for general construction storm water permittees that discharge to San Jose Creek Reach 1 and Reach 2 is 5 µg/L (total recoverable metals).

Region 4 Upper Santa Clara River Chloride TMDL Adopted by Resolution No 2006-016 Effective Date June 12, 2008

“Other NPDES dischargers” have a chloride WLA equal to 100 mg/L.

This TMDL was revised by Resolution No 2008-012, which, when it becomes effective, includes the following conditional WLAs for “Other minor NPDES discharges”:

Reach	Concentration-based Conditional WLA for Chloride (mg/L)*
6	150 (12-month Average), 230 (Daily Maximum)
5	150 (12-month Average), 230 (Daily Maximum)
4B	117 (3-month Average), 230 (Daily Maximum)

*The conditional WLAs for chloride for all point sources shall apply only when chloride load reductions and/or chloride export projects are in operation by the Santa Clarita Valley Sanitation District according to the implementation plan for the TMDL. If these conditions are not met, WLAs shall be based on existing water quality objectives for chloride of 100 mg/L.

Region 4 The Harbor Beaches of Ventura County-Bacteria (Adopted by Resolution No. 2007-017)
Effective Date – December 18, 2008

Current and future enrollees in the Statewide Construction Activity Storm Water General Permit in the Channel Islands Harbor subwatershed are assigned WLAs of zero (0) days of allowable exceedances of the single sample limits and the rolling 30-day geometric mean limits.

Single Sample Limits are:
a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

Rolling 30-day Geometric Mean Limits are:
a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

Los Angeles Harbor Bacteria TMDL (Adopted by Resolution No. 2004-001)
Effective Date – March 10, 2005

Current and future enrollees in the Statewide Construction Activity Storm Water General Permit in the watershed are assigned WLAs of zero (0) days of allowable exceedances of the single sample limits and the rolling 30-day geometric mean.

Single Sample Limits are:
a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

Rolling 30-day Geometric Mean Limits are:
a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

Ballona Creek Bacteria TMDL (Adopted by Resolution No. 2006-011)
Effective Date – April 27, 2007

Current and future enrollees in the Statewide Construction Activity Storm Water General Permit in the watershed are assigned WLAs of zero (0) days of allowable exceedances of the single sample limits and the rolling 30-day geometric mean.

Single Sample Limits are:
a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

Rolling 30-day Geometric Mean Limits are:
a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

Region 4 Resolution No. 03-009 Los Angeles River and Tributaries-Nutrients

Minor Point Sources

Waste loads are allocated to minor point sources enrolled under NPDES or WDR permits including but not limited to Tapia WRP, Whittier Narrows WRP, Los Angeles Zoo WRP, industrial and construction stormwater, and municipal storm water and urban runoff from municipal separate storm sewer systems (MS4s)

Region 4 Minor Point Sources for NPDES/WDR Permits TMDL Effective Date: 3 23 2004 TMDL Type: River	Pollutant Stressor/WLA				
	Total Ammonia (NH_3)		**Nitrate-nitrogen (NO_3-N)**	**Nitrite-nitrogen (NO_2-N)**	**NO_3-N + NO_3-N**
	1 Hr Ave mg/l	30 Day Ave mg/l	30 Day Ave mg/l		30 Day Ave mg/l
LA River Above Los Angeles-Glendale WRP (LAG)	4.7 1.6 8.0			1.0	8.0
LA River Below LAG	8.7	2.4	8.0	1.0	8.0
Los Angeles Tributaries 10.1		2.3	8.0	1.0	8.0

Malibu Creek Attachment A to Resolution No. 2004-019R-Bacteria

Effective date: 1 24 2006. The WLAs for permittees under the NPDES General Stormwater Construction Permit are zero (0) days of allowable exceedances for the single sample limits and the rolling 30-day geometric mean.

Single Sample Limits are:
a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

Rolling 30-day Geometric Mean Limits are:
a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

Region 4 Marina del Rey Harbor, Mothers' Beach and Back Basins
Attachment A to Resolution No. 2003-012-Bacteria

Effective date: 3 18 2004. Discharges from general construction storm water permits are not expected to be a significant source of bacteria. Therefore, the WLAs for these discharges are zero (0) days of allowable exceedances for the single sample limits and the rolling 30-day geometric mean. Any future enrollees under a general NPDES permit, general industrial storm water permit or general construction storm water permit within the MdR Watershed will also be subject to a WLA of zero days of allowable exceedances.

Single Sample Limits are:
a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

Rolling 30-day Geometric Mean Limits are:
a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

Santa Clara River Nutrients TMDL (Adopted by Resolution No. 2003-011
Effective Date - March 23, 2004

Concentration-based wasteloads are allocated to municipal, industrial and construction stormwater sources regulated under NPDES permits. For stormwater permittees discharging into Reach 7, the thirty-day WLA for ammonia as nitrogen is 1.75 mg/L and the one-hour WLA for ammonia as nitrogen is 5.2 mg/L; the thirty-day average WLA for nitrate plus nitrite as nitrogen is 6.8 mg/L. For stormwater permittees discharging into Reach 3, the thirty-day WLA for ammonia as nitrogen is 2.0 mg/L and the one-hour WLA for ammonia as nitrogen is 4.2 mg/L; the thirty-day average WLA for nitrate plus nitrite nitrogen is 8.1 mg/L.

Region 8 RESOLUTION NO. R8-2007- 0024

Total Maximum Daily Loads (TMDLs) for San Diego Creek,
Upper and Lower Newport Bay, Orange County, California

Region 8 NPDES Construction Permit TMDL Completion Date: 1 24 1995 TMDL Type: River. Cr, Bay	Organochlorine Compounds							
	Total DDT		**Chlordane**		**Total PCBs**		**Toxaphene**	
	g/day	g/yr	g/day	g/yr	g/day	g/yr	g/day	g/yr
San Diego Creek	.27	99.8	**.18***	**64.3***	**.09***	**31.5***	.004	1.5
Upper Newport Bay	.11	40.3	.06	23.4	.06	23.2	**X**	**X**
Lower Newport Bay	.04	14.9	.02	8.6	.17	60.7	**X**	**X**

*Red= Informational WLA only, not for enforcement purposes

Organochlorine Compounds TMDLs Implementation Tasks and Schedule

Regional Board staff shall develop a SWPPP Improvement Program that identifies the Regional Board's expectations with respect to the content of SWPPPs, including documentation regarding the selection and implementation of BMPs, and a sampling and analysis plan. The Improvement Program shall include specific guidance regarding the development and implementation of monitoring plans, including the constituents to be monitored, sampling frequency and analytical protocols. The SWPPP Improvement Program shall be completed by (*the date of OAL approval of this BPA*). ***No later than two months*** from completion of the Improvement Program, Board staff shall assure that the requirements of the Program are communicated to interested parties, including dischargers with existing authorizations under the General Construction Permit. Existing, authorized dischargers shall revise their project SWPPPs as needed to address the Program requirements as soon as possible but ***no later than (three months of completion of the SWPPP Improvement Program)***. Applicable SWPPPs that do not adequately address the Program requirements shall be considered inadequate and enforcement by the Regional Board shall proceed accordingly. The Caltrans and Orange County MS4 permits shall be revised as needed to assure that the permittees communicate the Regional Board's SWPPP expectations, based on the SWPPP Improvement Program, with the Standard Conditions of Approval.

APPENDIX 5:
Glossary

Active Areas of Construction
All areas subject to land surface disturbance activities related to the project including, but not limited to, project staging areas, immediate access areas and storage areas. All previously active areas are still considered active areas until final stabilization is complete. [The construction activity Phases used in this General Permit are the Preliminary Phase, Grading and Land Development Phase, Streets and Utilities Phase, and the Vertical Construction Phase.]

Active Treatment System (ATS)
A treatment system that employs chemical coagulation, chemical flocculation, or electrocoagulation to aid in the reduction of turbidity caused by fine suspended sediment.

Acute Toxicity Test
A chemical stimulus severe enough to rapidly induce a negative effect; in aquatic toxicity tests, an effect observed within 96 hours or less is considered acute.

Air Deposition
Airborne particulates from construction activities. .

Approved Signatory
A person who has legal authority to sign, certify, and electronically submit Permit Registration Documents and Notices of Termination on behalf of the Legally Responsible Person.

Beneficial Uses
As defined in the California Water Code, beneficial uses of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

Best Available Technology Economically Achievable (BAT)
As defined by USEPA, BAT is a technology-based standard established by the Clean Water Act (CWA) as the most appropriate means available on a national basis for controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. The BAT effluent limitations guidelines, in general, represent the best existing performance of treatment technologies that are economically achievable within an industrial point source category or subcategory.

Best Conventional Pollutant Control Technology (BCT)

As defined by USEPA, BCT is a technology-based standard for the discharge from existing industrial point sources of conventional pollutants including biochemical oxygen demand (BOD), total suspended sediment (TSS), fecal coliform, pH, oil and grease.

Best Professional Judgment (BPJ)
The method used by permit writers to develop technology-based NPDES permit conditions on a case-by-case basis using all reasonably available and relevant data.

Best Management Practices (BMPs)
BMPs are scheduling of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Chain of Custody (COC)
Form used to track sample handling as samples progress from sample collection to the analytical laboratory. The COC is then used to track the resulting analytical data from the laboratory to the client. COC forms can be obtained from an analytical laboratory upon request.

Coagulation
The clumping of particles in a discharge to settle out impurities, often induced by chemicals such as lime, alum, and iron salts.

Common Plan of Development
Generally a contiguous area where multiple, distinct construction activities may be taking place at different times under one plan. A plan is generally defined as any piece of documentation or physical demarcation that indicates that construction activities may occur on a common plot. Such documentation could consist of a tract map, parcel map, demolition plans, grading plans or contract documents. Any of these documents could delineate the boundaries of a common plan area. However, broad planning documents, such as land use master plans, conceptual master plans, or broad-based CEQA or NEPA documents that identify potential projects for an agency or facility are not considered common plans of development.

Daily Average Discharge
The discharge of a pollutant measured during any 24-hour period that reasonably represents a calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged during the day. For pollutants with limitations expressed in other units of measurement (e.g., concentration) the daily discharge is calculated as the average measurement of the pollutant

throughout the day (40 CFR 122.2). In the case of pH, the pH must first be converted from a log scale.

Debris
Litter, rubble, discarded refuse, and remains of destroyed inorganic anthropogenic waste.

Direct Discharge
A discharge that is routed directly to waters of the United States by means of a pipe, channel, or ditch (including a municipal storm sewer system), or through surface runoff.

Discharger
The Legally Responsible Person (see definition) or entity subject to this General Permit.

Dose Rate (for ATS)
In exposure assessment, dose (e.g. of a chemical) per time unit (e.g. mg/day), sometimes also called dosage.

Drainage Area
The area of land that drains water, sediment, pollutants, and dissolved materials to a common outlet.

Effluent
Any discharge of water by a discharger either to the receiving water or beyond the property boundary controlled by the discharger.

Effluent Limitation
Any numeric or narrative restriction imposed on quantities, discharge rates, and concentrations of pollutants which are discharged from point sources into waters of the United States, the waters of the contiguous zone, or the ocean.

Erosion
The process, by which soil particles are detached and transported by the actions of wind, water, or gravity.

Erosion Control BMPs
Vegetation, such as grasses and wildflowers, and other materials, such as straw, fiber, stabilizing emulsion, protective blankets, etc., placed to stabilize areas of disturbed soils, reduce loss of soil due to the action of water or wind, and prevent water pollution.

Field Measurements
Testing procedures performed in the field with portable field-testing kits or meters.

Final Stabilization
All soil disturbing activities at each individual parcel within the site have been completed in a manner consistent with the requirements in this General Permit.

First Order Stream
Stream with no tributaries.

Flocculants
Substances that interact with suspended particles and bind them together to form flocs.

Good Housekeeping BMPs
BMPs designed to reduce or eliminate the addition of pollutants to construction site runoff through analysis of pollutant sources, implementation of proper handling/disposal practices, employee education, and other actions.

Grading Phase (part of the Grading and Land Development Phase)
Includes reconfiguring the topography and slope including; alluvium removals; canyon cleanouts; rock undercuts; keyway excavations; land form grading; and stockpiling of select material for capping operations.

Hydromodification
Hydromodification is the alteration of the hydrologic characteristics of coastal and non-coastal waters, which in turn could cause degradation of water resources. Hydromodification can cause excessive erosion and/or sedimentation rates, causing excessive turbidity, channel aggradation and/or degradation.

Identified Organisms
Organisms within a sub-sample that is specifically identified and counted.

Inactive Areas of Construction
Areas of construction activity that are not active and those that have been active and are not scheduled to be re-disturbed for at least 14 days.

Index Period
The period of time during which bioassessment samples must be collected to produce results suitable for assessing the biological integrity of streams and rivers. Instream communities naturally vary over the course of a year,and sampling during the index period ensures that samples are collected during a time frame when communities are stable so that year-to-year consistency is obtained. The index period approach provides a cost-effective alternative to year-round sampling. Furthermore, sampling within the appropriate index period will yield results that are comparable to the assessment thresholds or criteria for a given region, which are established for the same index period. Because index

periods differ for different parts of the state, it is essential to know the index period for your area.

K Factor
The soil erodibility factor used in the Revised Universal Soil Loss Equation (RUSLE). It represents the combination of detachability of the soil, runoff potential of the soil, and the transportability of the sediment eroded from the soil.

Legally Responsible Person
The person who possesses the title of the land or the leasehold interest of a mineral estate upon which the construction activities will occur for the regulated site. For linear underground/overhead projects, it is in the person in charge of the utility company, municipality, or other public or private company or agency that owns or operates the LUP.

Likely Precipitation Event
Any weather pattern that is forecasted to have a 50% or greater chance of producing precipitation in the project area. The discharger shall obtain likely precipitation forecast information from the National Weather Service Forecast Office (e.g., by entering the zip code of the project's location at http://www.srh.noaa.gov/forecast).

Maximum Allowable Threshold Concentration (MATC)
The allowable concentration of residual, or dissolved, coagulant/flocculant in effluent. The MATC shall be coagulant/flocculant-specific, and based on toxicity testing conducted by an independent, third-party laboratory. A typical MATC would be:

The MATC is equal to the geometric mean of the NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) Acute and Chronic toxicity results for most sensitive species determined for the specific coagulant. The most sensitive species test shall be used to determine the MATC.

Natural Channel Evolution
The physical trend in channel adjustments following a disturbance that causes the river to have more energy and degrade or aggrade more sediment. Channels have been observed to pass through 5 to 9 evolution types. Once they pass though the suite of evolution stages, they will rest in a new state of equilibrium.

Non-Storm Water Discharges
Discharges are discharges that do not originate from precipitation events. They can include, but are not limited to, discharges of process water, air conditioner condensate, non-contact cooling water, vehicle wash water, sanitary wastes, concrete washout water, paint wash water, irrigation water, or pipe testing water.

Non-Visible Pollutants

Pollutants associated with a specific site or activity that can have a negative impact on water quality, but cannot be seen though observation (ex: chlorine). Such pollutants being discharged are not authorized.

Numeric Action Level (NAL)
Level is used as a warning to evaluate if best management practices are effective and take necessary corrective actions. Not an effluent limit.

Original Sample Material
The material (i.e., macroinvertebrates, organic material, gravel, etc.) remaining after the subsample has been removed for identification.

pH
Unit universally used to express the intensity of the acid or alkaline condition of a water sample. The pH of natural waters tends to range between 6 and 9, with neutral being 7. Extremes of pH can have deleterious effects on aquatic systems.

Post-Construction BMPs
Structural and non-structural controls which detain, retain, or filter the release of pollutants to receiving waters after final stabilization is attained.

Preliminary Phase (Pre-Construction Phase - Part of the Grading and Land Development Phase)
Construction stage including rough grading and/or disking, clearing and grubbing operations, or any soil disturbance prior to mass grading.

Project

Qualified SWPPP Developer
Individual who is authorized to develop and revise SWPPPs.

Qualified SWPPP Practitioner
Individual assigned responsibility for non-storm water and storm water visual observations, sampling and analysis, and responsibility to ensure full compliance with the permit and implementation of all elements of the SWPPP, including the preparation of the annual compliance evaluation and the elimination of all unauthorized discharges.

Qualifying Rain Event
Any event that produces 0.5 inches or more precipitation with a 48 hour or greater period between rain events.

R Factor
Erosivity factor used in the Revised Universal Soil Loss Equation (RUSLE). The R factor represents the erosivity of the climate at a particular location. An

average annual value of R is determined from historical weather records using erosivity values determined for individual storms. The erosivity of an individual storm is computed as the product of the storm's total energy, which is closely related to storm amount, and the storm's maximum 30-minute intensity.

Rain Event Action Plan (REAP)
Written document, specific for each rain event, that when implemented is designed to protect all exposed portions of the site within 48 hours of any likely precipitation event.

Remaining Sub sampled Material
The material (e.g., organic material, gravel, etc.) that remains after the organisms to be identified have been removed from the subsample for identification. (Generally, no macroinvertebrates are present in the remaining subsampled material, but the sample needs to be checked and verified using a complete Quality Assurance (QA) plan)

Routine Maintenance
Activities intended to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

Runoff Control BMPs
Measures used to divert runon from offsite and runoff within the site.

Run-on
Discharges that originate offsite and flow onto the property of a separate project site.

Revised Universal Soil Loss Equation (RUSLE)
Empirical model that calculates average annual soil loss as a function of rainfall and runoff erosivity, soil erodibility, topography, erosion controls, and sediment controls.

Sampling and Analysis Plan
Document that describes how the samples will be collected, under what conditions, where and when the samples will be collected, what the sample will be tested for, what test methods and detection limits will be used, and what methods/procedures will be maintained to ensure the integrity of the sample during collection, storage, shipping and testing (i.e., quality assurance/quality control protocols).

Sediment
Solid particulate matter, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Sedimentation
Process of deposition of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material.

Sediment Control BMPs
Practices that trap soil particles after they have been eroded by rain, flowing water, or wind. They include those practices that intercept and slow or detain the flow of storm water to allow sediment to settle and be trapped (e.g., silt fence, sediment basin, fiber rolls, etc.).

Settleable Solids (SS)
Solid material that can be settled within a water column during a specified time frame. It is typically tested by placing a water sample into an Imhoff settling cone and then allowing the solids to settle by gravity for a given length of time. Results are reported either as a volume (mL/L) or a mass (mg/L) concentration.

Sheet Flow
Flow of water that occurs overland in areas where there are no defined channels where the water spreads out over a large area at a uniform depth.

Site

Soil Amendment
Any material that is added to the soil to change its chemical properties, engineering properties, or erosion resistance that could become mobilized by storm water.

Streets and Utilities Phase
Construction stage including excavation and street paving, lot grading, curbs, gutters and sidewalks, public utilities, public water facilities including fire hydrants, public sanitary sewer systems, storm sewer system and/or other drainage improvements.

Structural Controls
Any structural facility designed and constructed to mitigate the adverse impacts of storm water and urban runoff pollution

Suspended Sediment Concentration (SSC)
The measure of the concentration of suspended solid material in a water sample by measuring the dry weight of all of the solid material from a known volume of a collected water sample. Results are reported in mg/L.

Total Suspended Solids (TSS)
The measure of the suspended solids in a water sample includes inorganic substances, such as soil particles and organic substances, such as algae,

aquatic plant/animal waste, particles related to industrial/sewage waste, etc. The TSS test measures the concentration of suspended solids in water by measuring the dry weight of a solid material contained in a known volume of a sub-sample of a collected water sample. Results are reported in mg/L.

Toxicity
The adverse response(s) of organisms to chemicals or physical agents ranging from mortality to physiological responses such as impaired reproduction or growth anomalies.

Turbidity
The cloudiness of water quantified by the degree to which light traveling through a water column is scattered by the suspended organic and inorganic particles it contains. The turbidity test is reported in Nephelometric Turbidity Units (NTU) or Jackson Turbidity Units (JTU).

Vertical Construction Phase
The Build out of structures from foundations to roofing, including rough landscaping.

Waters of the United States
Generally refers to surface waters, as defined by the federal Environmental Protection Agency in 40 C.F.R. § 122.2.[1]

Water Quality Objectives (WQO)
Water quality objectives are defined in the California Water Code as limits or levels of water quality constituents or characteristics, which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.

[1] The application of the definition of "waters of the United States" may be difficult to determine; there are currently several judicial decisions that create some confusion. If a landowner is unsure whether the discharge must be covered by this General Permit, the landowner may wish to seek legal advice.

APPENDIX 6:
Acronym List

ASBS	Areas of Special Biological Significance
ASTM	American Society of Testing and Materials; Standard Test Method for Particle-Size Analysis of Soils
ATS	Active Treatment System
BASMAA	Bay Area Storm water Management Agencies Association
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgment
CAFO	Confined Animal Feeding Operation
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CGP	NPDES General Permit for Storm Water Discharges Associated with Construction Activities
CIWQS	California Integrated Water Quality System
CKD	Cement Kiln Dust
COC	Chain of Custody
CPESC	Certified Professional in Erosion and Sediment Control
CPSWQ	Certified Professional in Storm Water Quality
CSMP	Construction Site Monitoring Program
CTB	Cement Treated Base
CTR	California Toxics Rule
CWA	Clean Water Act
CWC	California Water Code
CWP	Center for Watershed Protection
DADMAC	Diallyldimethyl-ammonium chloride
DDNR	Delaware Department of Natural Resources
DFG	Department of Fish and Game
DHS	Department of Health Services
DWQ	Division of Water Quality
EC	Electrical Conductivity
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
ESA	Environmentally Sensitive Area
ESC	Erosion and Sediment Control
HSPF	Hydrologic Simulation Program Fortran
JTU	Jackson Turbidity Units
LID	Low Impact Development
LOEC	Lowest Observed Effect Concentration
LRP	Legally Responsible Person
LUP	Linear Underground/Overhead Projects

MATC	Maximum Allowable Threshold Concentration
MDL	Method Detection Limits
MRR	Monitoring and Reporting Requirements
MS4	Municipal Separate Storm Sewer System
MUSLE	Modified Universal Soil Loss Equation
NAL	Numeric Action Level
NEL	Numeric Effluent Limitation
NICET	National Institute for Certification in Engineering Technologies
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTR	National Toxics Rule
NTU	Nephelometric Turbidity Units
O&M	Operation and Maintenance
PAC	Polyaluminum chloride
PAM	Polyacrylamide
PASS	Polyaluminum chloride Silica/sulfate
POC	Pollutants of Concern
PoP	Probability of Precipitation
POTW	Publicly Owned Treatment Works
PRDs	Permit Registration Documents
PWS	Planning Watershed
QAMP	Quality Assurance Management Plan
QA/QC	Quality Assurance/Quality Control
REAP	Rain Event Action Plan
Regional Board	Regional Water Quality Control Board
ROWD	Report of Waste Discharge
RUSLE	Revised Universal Soil Loss Equation
RW	Receiving Water
SMARTS	Storm water Multi Application Reporting and Tracking System
SS	Settleable Solids
SSC	Suspended Sediment Concentration
SUSMP	Standard Urban Storm Water Mitigation Plan
SW	Storm Water
SWARM	Storm Water Annual Report Module
SWAMP	Surface Water Ambient Monitoring Program
SWMM	Storm Water Management Model
SWMP	Storm Water Management Program
SWPPP	Storm Water Pollution Prevention Plan
TC	Treatment Control
TDS	Total Dissolved Solids

TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USACOE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WDID	Waste Discharge Identification Number
WDR	Waste Discharge Requirements
WLA	Waste Load Allocation
WET	Whole Effluent Toxicity
WRCC	Western Regional Climate Center
WQBEL	Water Quality Based Effluent Limitation
WQO	Water Quality Objective
WQS	Water Quality Standard

APPENDIX 7:
State and Regional Water Resources Control Board Contacts

NORTH COAST REGION (1)
5550 Skylane Blvd, Ste. A
Santa Rose, CA 95403
(707) 576-2220 FAX: (707)523-0135

SAN FRANCISCO BAY REGION (2)
1515 Clay Street, Ste. 1400
Oakland, CA 94612
(510) 622-2300 FAX: (510) 622-2640

CENTRAL COAST REGION (3)
895 Aerovista Place, Ste 101
San Luis Obispo, CA 93401
(805) 549-3147 FAX: (805) 543-0397

LOS ANGELES REGION (4)
320 W. 4th Street, Ste. 200
Los Angeles, CA 90013
(213) 576-6600 FAX: (213) 576-6640

CENTRAL VALLEY REGION (5S)
11020 Sun Center Dr., #200
Rancho Cordova, CA 95670-6114
(916) 464-3291 FAX: (916) 464-4645

FRESNO BRANCH OFFICE (5F)
1685 E St.
Fresno, CA 93706
(559) 445-5116 FAX: (559) 445-5910

REDDING BRANCH OFFICE (5R)
415 Knollcrest Drive, Ste. 100
Redding, CA 96002
(530) 224-4845 FAX: (530) 224-4857

LAHONTAN REGION (6 SLT)
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
(530) 542-5400 FAX: (530) 544-2271

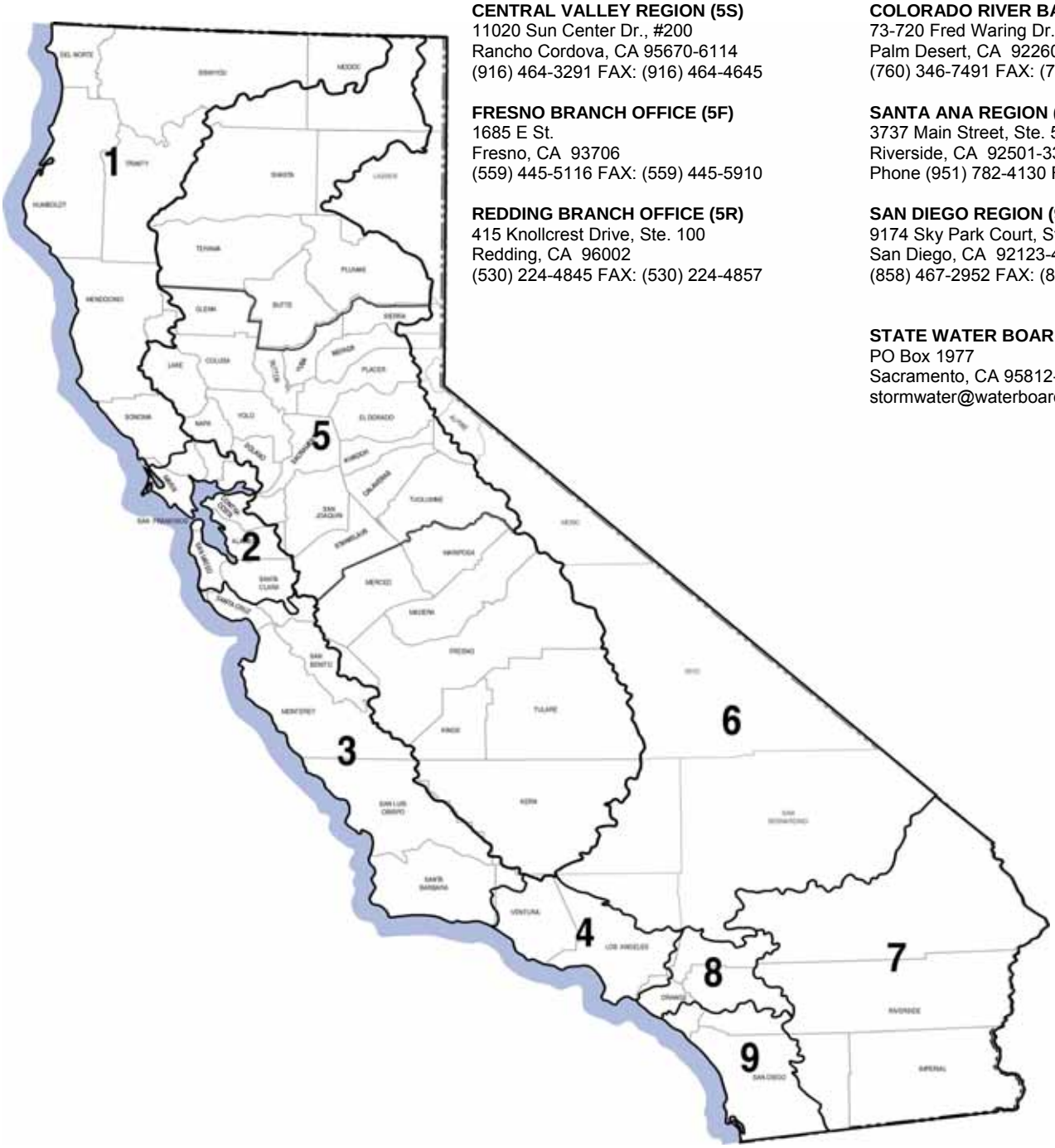
VICTORVILLE OFFICE (6V)
14440 Civic Drive, Ste. 200
Victorville, CA 92392-2383
(760) 241-6583 FAX: (760) 241-7308

COLORADO RIVER BASIN REGION (7)
73-720 Fred Waring Dr., Ste. 100
Palm Desert, CA 92260
(760) 346-7491 FAX: (760) 341-6820

SANTA ANA REGION (8)
3737 Main Street, Ste. 500
Riverside, CA 92501-3339
Phone (951) 782-4130 FAX: (951) 781-6288

SAN DIEGO REGION (9)
9174 Sky Park Court, Ste. 100
San Diego, CA 92123-4340
(858) 467-2952 FAX: (858) 571-6972

STATE WATER BOARD
PO Box 1977
Sacramento, CA 95812-1977
stormwater@waterboards.ca.gov



Appendix B
Submitted Permit Registration Documents:
NOI, Risk Assessment (Construction Site Sediment and Receiving Water Risk Determination); Site Map (including vicinity map); Signed Certification Statement.

Submitted Permit Registration Documents included in this Appendix are listed below:

- NOI
- Risk Assessment (Construction Site Sediment and Receiving Water Risk Determination)
- Site Map (including vicinity map)
- Signed Certification Statement.

Appendix C
SWPPP Amendment Log

Amendment Log

Project Name: _____

Any amendments shall be documented in a letter format and kept with the site copy of the SWPPP. Include figures as needed. See Section 1-4 for further details. Amendments must be signed by the QSD.

Amendment Number	Date	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

SWPPP Amendment No._____

Project Name: _____

To Be Completed by QSD

'I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.'

QSD's Signature	Date
QSD's Name and Title	QSD's Telephone Number

Appendix D
Submitted Changes to PRDS
(due to change in ownership or acreage)

Submitted Permit Registration Documents

Include the following Permit Registration Documents that were submitted to the SMARTS System:

- NOI
- Risk Assessment (Construction Site Sediment and Receiving Water Risk Determination)
- Site Map (including vicinity map)
- Signed Certification Statement

Appendix E
Preliminary Stormwater Management Design

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 26

Project Name: Tenaska Project No.: 163994

Calculation Title: IMP Sizing for Laydown Area

Calculation No./File No.: 52.5406.1001

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To determine the minimum required size of bioswale to satisfy Stormwater C.3 requirements for treatment and flow control for the construction laydown area for the proposed Tenaska Project.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page 2 of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: Version:

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	J Zhong Jimmy Zhong	March 25, 2009	PL Nelson PL Nelson	31 MAR 09	PL Nelson	31 MAR 09

Purpose

To determine the minimum required size of bioswale to satisfy Stormwater C.3 requirements for treatment and flow control for the construction laydown area for the proposed Tenaska Project.

References

1. Black & Veatch Drawing:
   - 163994-SS-3002, Rev. A, "Grading & Drainage - Site Plan - Sheet 2"
   - 163994-SS-3202, Rev. A, "Surfacing/Fencing/Roadway - Site Plan - Sheet 2"
2. Contra Costa Clean Water Program; Stormwater C.3 Guidebook; Stormwater Quality Requirements for Development Applications; Fourth Edition; September 10, 2008.
3. Contra Costa County Public Works Department; Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973; Drawing No. B-166; December 1977.
4. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
5. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
6. Email Communications between Black & Veatch and Contra Costa Clean Water Program; March 2009.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)

Drainage area in acres (ac)

Attachments

1. Black & Veatch Drawings SS-3002 and SS-3202
2. Reference 2 – Select Pages
3. Reference 3 – Drawing No. B-166
4. Reference 4 – Select Pages
5. Reference 5 – Select Pages
6. Email Communications

Summary

Based on the Stormwater C.3 requirements, the required bioswale surface area is 9,638 ft^2; the required bioswale volume is 7,986 ft^3 for the construction laydown area.

The design bioswale has a length of 1154 feet. The bioswale cross section will be trapezoidal with a bottom width of 2 feet and a side slope of 3 (h) to 1 (v). The proposed depth of the bioswale is 2 feet. The design free board is 6 inches which gives an effective depth of 1.5 feet.

The design bioswale in the construction laydown area has sufficient surface area (12,694 ft^2) and volume (11,252 ft^3) to satisfy the Stormwater C.3 requirements.

Construction Laydown Area

Most of the construction laydown area is covered by bare soil with little vegetation. The northeast portion of this area is covered by existing asphalt pavement. See B&V Drawing SS-3002.

The existing asphalt area will not be graded and will remain "as is". From the topography, this asphalt area slopes downward towards the north. Consequently rainfall on the asphalt pavement will flow offsite and will not enter the bioswale. Therefore, stormwater from the existing asphalt pavement area will not be included in the sizing calculations for the bioswale.

Only the bare soil area will be graded during construction. See B&V Drawing SS-3002. A gravel loop road will be built over the bare soil area. A bioswale will be constructed at the center of the bare soil area to collect and infiltrate stormwater. The bare soil area is graded in such a pattern that stormwater will flow towards the center of this area and be collected in the bioswale. The gravel road will be installed in a trench so that its surface will be even with its adjacent ground surface. In this way, stormwater will be able to flow over the gravel road and be collected in the bioswale. At the east end of the bioswale, a pump station will be installed so that if the storm water in the bioswale exceeds its volume capacity, the excess water will be pumped out to a location offsite.

Two drainage management areas (DMA) were identified based on the type of their ground covers: (1) Bare Soil; and (2) Gravel Road. See B&V Drawing SS-3202. The measured areas are:

DMA-1	Bare Soil	547,461 ft^2
DMA-2	Gravel Road	72,205 ft^2

The above measurements were made by using AutoCAD.

NRCS Soil Group

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the project site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 5. Per Ref. 5, this type of soil can be classified as Hydrologic Soil Group A soil.

Runoff Coefficients

Dense-graded aggregate (Caltran Class 2 aggregate) will be utilized to build the gravel road. After being compacted, the dense-graded aggregate is estimated to have a runoff coefficient of 0.5 to 0.7. See communications with Contra Costa County Clean Water Program (Attachment 6). Use 0.6 in this calculation.

From Table 4-2 of the Stormwater C.3 Guidebook, the "Landscape, Group A Soil" will have a runoff coefficient of 0.1 for treatment and flow control. Based on engineering experience and judgment, the "Bare soil, Group A Soil" will have a runoff coefficient of approximately 0.2.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (547{,}461 \text{x} 0.2 + 72{,}205 \text{x} 0.6) = 152{,}815 \text{ ft}^2.$$

IMP Sizing Factors

Since the project site is covered by hydrologic group A soil, the subsurface reservoir volume (V_2) is not needed per Stormwater C.3 Guidebook. From this guidebook, for "treatment and flow control", the IMP sizing factor for the area (A) of bioswale is 0.07. The IMP sizing factor for the surface reservoir volume (V_1) of bioswale is 0.058. (Ref. 2, Table 4-6).

Rain Adjustment Factor

Per the Isohyetal Map by Contra Costa County Public Works, Figure B-166 (Ref. 3), the mean annual precipitation (MAP) at the project site is 12.5 inches. Consequently, for group A soils,

$$\text{Rain Adjustment Factor} = \frac{0.0009 \times (MAP - 20.2) + 0.07}{0.07} \qquad \text{(Ref. 2, Equation 4-3)}$$

$$= \frac{0.0009 \times (12.5 - 20.2) + 0.07}{0.07}$$

$$= 0.901.$$

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

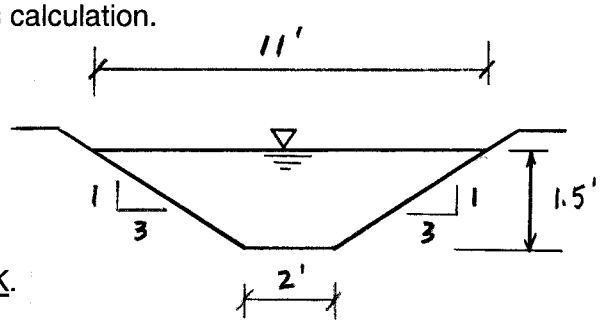
$$= 152{,}815 \text{ x } 0.07 \text{ x } 0.901 = 9{,}638 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 152{,}815 \text{ x } 0.058 \text{ x } 0.901 = 7{,}986 \text{ ft}^3.$$

The proposed bioswale in the construction laydown area will be 1154 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The proposed depth of the bioswale is 2 feet, but the top 6 inches is reserved as free board. Consequently, use 1.5 feet as the bioswale depth in this calculation.



The surface area of the proposed bioswale is:

$11 \text{ x } 1154 = 12{,}694 \text{ ft}^2 > 9{,}638 \text{ ft}^2$, OK.

The volume of the proposed bioswale is:

$\frac{2+11}{2} \text{ x } 1.5 \text{ x } 1154 = 11{,}252 \text{ ft}^3 > 7{,}986 \text{ ft}^3$, OK.

In summary, the proposed size of the bioswale in the construction laydown area is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy			COMP'D BY	J. Zhong
PLANT	Tenaska	Unit No.		DATE	17-Mar-2009
PROJECT NO.	163994	File No.	52.5406.1001	CKD BY	Plovelan
TITLE	IMP Sizing for Laydown Area			DATE	31 MAR 09
				PAGE	7 OF 26

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA-1	547,461	Bare Soil, Group A Soil	0.20	109,492
DMA-2	72,205	Gravel Road	0.60	43,323
			Total:	152,815

Soil Type	IMP Name			
A	Bioswale (1154' long)			
IMP Sizing Factor	**Rain Adjustment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**	
0.070	0.901	9,638	12,694	**IMP Area (ft^2)**
0.058	0.901	7,986	11,252	**V_1 (ft^3)**
NA	0.901	NA	NA	**V_2 (ft^3)**
			Orifice Size:	NA

Radback Tenaska project

project # 163994 File # 52.5406.1001

IMP sizing for Laydown Area

prepared by: Jzhong

Date: 3/24/09

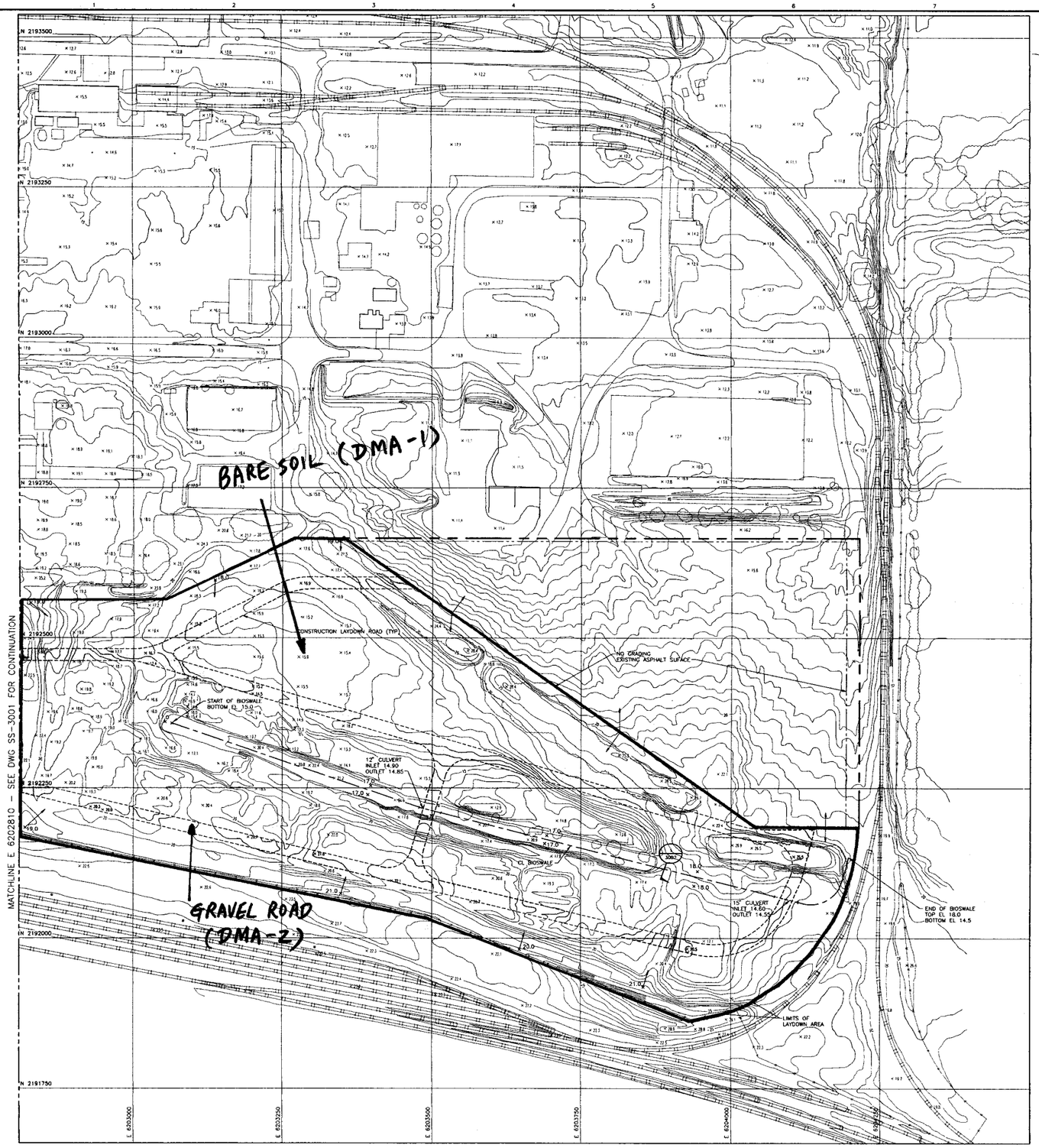
# of pages: 3

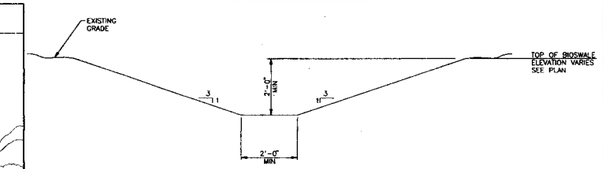
Attachment 1

Black & Veatch Dwgs SS-3002

and SS-3202

DWG40999 24-MAR-2009 07:50:35





SECTION 1
TYPICAL BIOSWALE
NO SCALE

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. ALL TREES WITHIN LAYDOWN AREA SHALL BE REMOVED.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
A	20/MAR/09	ISSUED FOR CLIENT REVIEW	NAW	PLN		PLN	DVW

60' 30' 0 60' 120'
1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

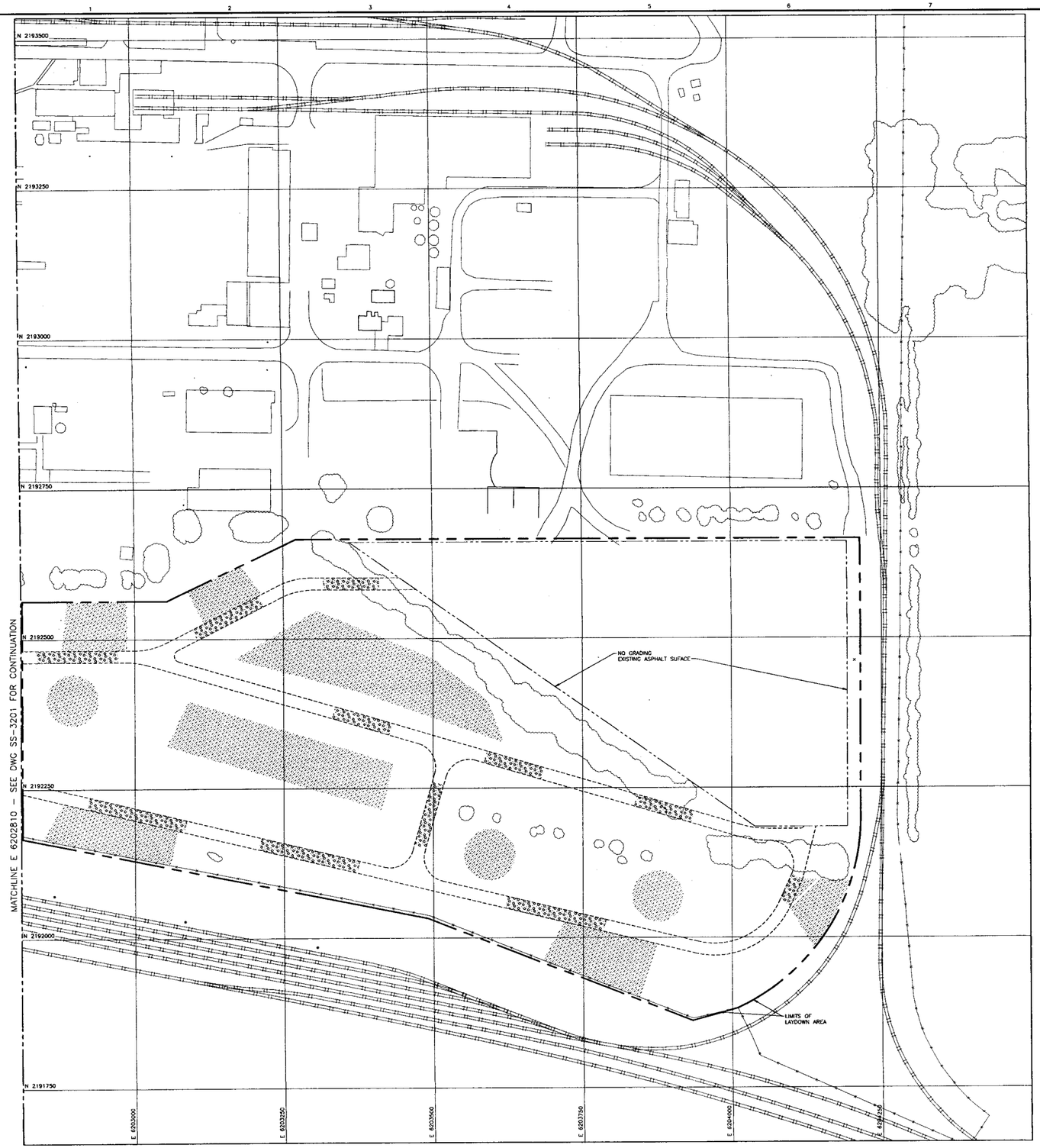
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GRADING AND DRAINAGE – SITE PLAN – SHEET 2

PROJECT DRAWING NUMBER 163994–SS–3002
REV A
CODE
AREA

WEB15411 ACAD 16.1s (LMS Tech)
Plotted by: PLN on 03/20/09
Scale: 1:1 1=1

DWG40999 26-MAR-2009 15:27:50



NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED
FOR CONSTRUCTION

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDL	APP
A	OPEN	ISSUED FOR	NAW	PLN		PLN	DVW

60' 30' 0 60' 120'
1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SURFACING/FENCING/ROADWAY – SITE PLAN – SHEET 2

PROJECT DRAWING NUMBER REV
163994–SS–3202 A
CODE
AREA

ACAD 16.1s (LMS Tech)
SPU37182
01/26/07
02/02/09

Radback Tenaska project
project # 163994 File # 52.5406.1001
IMP sizing for Laydown Area

prepared by: JZhong
Date: 3/24/09
# of pages: 5

Attachment 2

Reference 2

select pages

(Runoff factor) x (tributary area) ≤ 2 x (self-retaining area) *Equation 4-1*

For treatment-only sites, and

(Runoff factor) x (tributary area) ≤ 1 x (self-retaining area) *Equation 4-2*

for sites subject to flow-control requirements. Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors to be used when sizing IMPs.

Surface	Treatment and Flow Control	Treatment only
Roofs	1.0	1.0
Concrete or Asphalt	1.0	1.0
Pervious Concrete	0.1	0.1
Porous Asphalt	0.1	0.1
Grouted Unit Pavers	1.0	1.0
Solid Unit Pavers	0.5	0.2
Crushed Aggregate	0.1	0.1
Turfblock	0.1	0.1
Landscape, Group A Soil	0.1	0.1
Landscape, Group B Soil	0.3	0.1
Landscape, Group C Soil	0.5	0.1
Landscape, Group D Soil	0.7	0.1

Areas draining to IMPs are used to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

The CCCWP has developed sizing factors (ratios of IMP area to impervious DMA area). For each IMP design, factors are provided for:

TABLE 4-6. Sizing Factors

Treatment and Flow Control	NRCS Soil Group			
IMP	**A**	**B**	**C**	**D**
Bioretention Facility				
A	0.07	0.11	0.06	0.05
V_1	0.058	0.092	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Flow-through Planter				
A	N/A	N/A	0.06	0.05
V_1	N/A	N/A	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Dry Well				
A	0.05	0.06	N/A	N/A
V	0.130	0.204	N/A	N/A
Cistern + bioretention facility				
A (bioretention facility)	*0.04*	*0.04*	*0.04*	*0.04*
V (cistern)	0.193	0.228	0.088	0.060

* Cistern sized for flow control when used in conjunction with a treatment IMP. IMP underdrain required in B, C and D soils.

Treatment Only

Bioretention Facility				
A	*0.04*	*0.04*	*0.04*	*0.04*
Flow-through Planter				
A	*0.04*	*0.04*	*0.04*	*0.04*
Dry Well (treatment only)				
A	0.02	0.04	N/A	N/A
V	0.068	0.136	N/A	N/A

Units Notes:
A = ft^2 of IMP footprint per ft^2 of tributary impervious area (unitless)
V, V_1, V_2 = ft^3 per ft^2 of equivalent tributary impervious area (ft.)

STEP 5: OBTAIN SIZING AND RAIN ADJUSTMENT FACTORS FOR EACH IMP

For each of the IMPs, obtain the appropriate **area** sizing factor from Table 4-6.

Sizing factors for treatment-only IMPs (in *italics*) do not require any adjustment for differing rainfall patterns.

Both area (A) and volume (V_1, V_2) sizing factors for treatment-plus-flow-control IMPs, however, must be adjusted to account for the effects of differing rainfall patterns on pre-project and post-project runoff.

Use the equations below to compute the rainfall adjustment:

Equation 4-3

$$\text{For Group A soils, } Rain\ Adjustment = \frac{0.0009 \times \left(MAP_{project\ site} - 20.2\right) + 0.07}{0.07}$$

Equation 4-4

$$\text{For Group B soils, } Rain\ Adjustment = \frac{-0.0005 \times \left(MAP_{project\ site} - 20.2\right) + 0.11}{0.11}$$

Equation 4-5

$$\text{For Group C soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.06}{0.06}$$

Equation 4-6

$$\text{For Group D soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.05}{0.05}$$

where *MAP* is the mean annual precipitation at the site as shown on the isohyetal map, Contra Costa County Public Works Figure B-166, available on the CCCWP C.3 web pages.

► STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

The minimum area and storage volumes of each IMP are found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

$$Min.\ IMP\ Area\ or\ Volume = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Bioretention facilities and flow-through planters have two storage volumes. V_1 is the floodable volume above the soil layer. V_2 is the storage volume below the soil layer, calculated by multiplying the volume of gravel by an assumed porosity of 0.4. See Figure 4-6. Note these volumes can be configured in a variety of practical combinations of depth and area to best fit into your landscape design.

Cisterns and dry wells have a single storage volume (V).

V is calculated using Equation 4-8:

Equation 4-8

$$Min.V = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP\,Volume \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes of the receiving IMP:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas and Volumes

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*	*Soil Type:*	*IMP Name*			
					IMP Sizing factor	*Rain Adjust-ment Factor*	*Minimum Area or Volume*	*Proposed Area or Volume*	
			Total						***IMP Area***
									V or V1
									V2
								Orifice Size:	

► STEP 7: DETERMINE IF IMP AREA AND VOLUME ARE ADEQUATE

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1–6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the Provision C.3 sizing requirements. If not, revise the plan accordingly. Revisions may include:

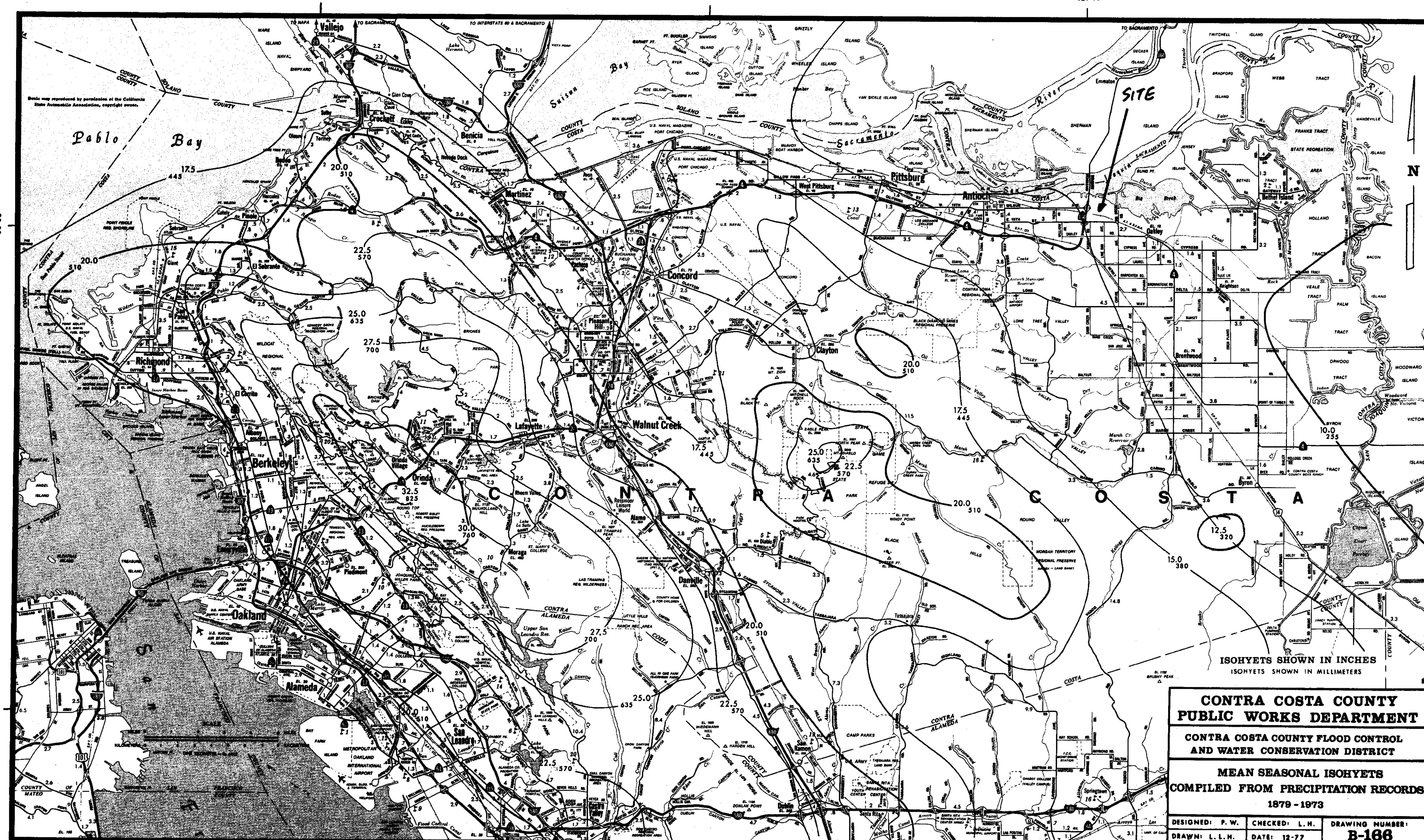
Radback Tenaska project
project # 163994 File # 52.5406.1001
IMP Sizing for Laydown Area

prepared by: JZhong
Date: 3/24/09
# of pages: 2

Attachment 3

Reference 3

Drawing No. B-166


CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
MEAN SEASONAL ISOHYETS
COMPILED FROM PRECIPITATION RECORDS
1879 - 1973
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
B-166
DRAWN: L. L. H.
DATE: 12-77
ISOHYETS SHOWN IN INCHES
ISOHYETS SHOWN IN MILLIMETERS
SITE
N
122°15′
122°00′
121°45′
38°00′
37°45′
Basic map reproduced by permission of the California State Automobile Association, copyright owner.
Pablo Bay
Suisun Bay
CONTRA COSTA
Vallejo
Crockett
Benicia
Martinez
Pittsburg
West Pittsburg
Antioch
Oakley
Bethel Island
Concord
Pleasant Hill
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Danville
San Ramon
Dublin
Brentwood
Knightsen
Byron
Richmond
El Cerrito
Berkeley
Oakland
Alameda
San Leandro
Castro Valley
Springtown
17.5
445
20.0
510
22.5
570
25.0
635
27.5
700
30.0
760
32.5
825
15.0
380
12.5
320
10.0
255

Radback Tenaska project

project # 163994 File # 52.5406.1001

IMP sizing for Laydown Area

prepared by: JZhong

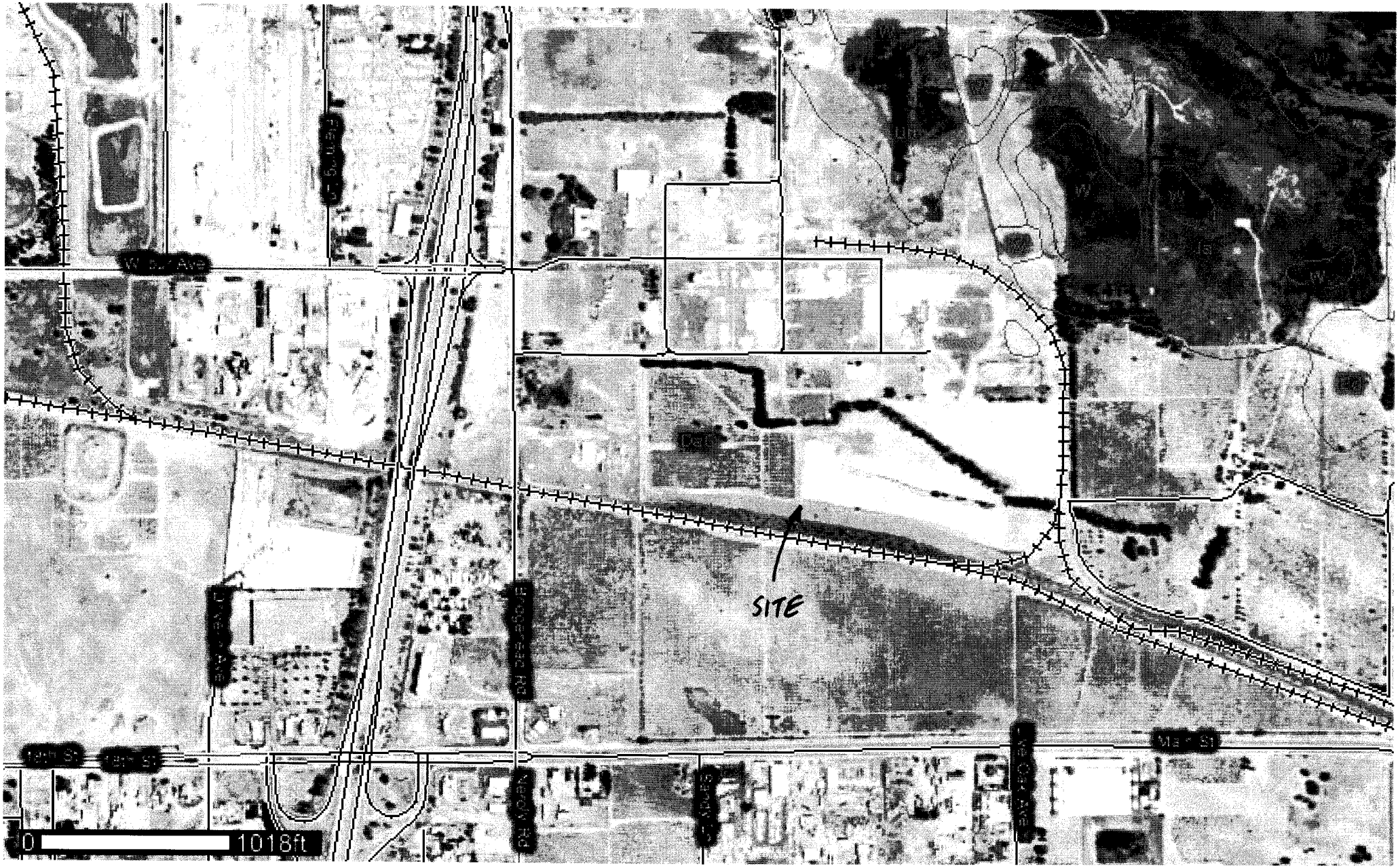
Date: 3/24/09

# of pages: 4

Attachment 4

Reference 4

select pages


W 6th Ave
19th St
18th St
Merritt St
SITE
0
1018ft

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour
Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Radback Tenaska project

project # 163994 File # 52.5406.1001

Imp sizing for Laydown Area

prepared by: JZhong

Date: 3/24/09

# of pages: 2

Attachment 5

Reference 5

select page

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once the soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Radback Tenaska project

project # 163994 File # 52.5406.1001

IMP sizing for Laydown Area

prepared by: Jzhong

Date: 3/24/09

# of pages: 3

Attachment 6

Email communications with contra costa county clean water program

Zhong, Jimmy

From: Dan Cloak [dan@dancloak.com]
Sent: Monday, March 02, 2009 3:54 PM
To: 'Tom Dalziel'; Zhong, Jimmy
Subject: RE: Stormwater C.3 Question

Hi,

It is correct that dense-graded aggregates are not very pervious. Why not use an open-graded aggregate, such as ½ in. crushed rock? Be sure to use a rigid frame around the gravel area.

"Porous Pavements" by Bruce Ferguson is a good reference for porous pavement design.

If dense-graded aggregate is used, I would suggest a runoff coefficient of 0.5 to 0.7, depending on slope.

Dan

From: Tom Dalziel [mailto:tdalz@pw.cccounty.us]
Sent: Monday, March 02, 2009 11:04 AM
To: Zhong, Jimmy; Dan@dancloak.com
Subject: RE: Stormwater C.3 Question

Hi Dan,

Can you review and respond, as appropriate, to Jimmy on my behalf?

Thanks.

Tom Dalziel
Assistant Program Manager
Contra Costa Clean Water Program
tdalz@pw.cccounty.us
Ph. (925) 313-2392, Fax (925) 313-2301

From: Zhong, Jimmy [mailto:ZhongJ@bv.com]
Sent: Wednesday, February 25, 2009 1:11 PM
To: Tom Dalziel
Subject: Stormwater C.3 Question

Tom,

I talked to you and Dan this morning regarding runoff factor for Class 2 aggregates (Caltran Standard Specification Section 26). After our phone call, I had a discussion with my supervisor. He indicated that this type of material is **dense-graded** aggregate which is typically used as pavement base material. After being compacted, this type of material is not that pervious based on his experience. Dense-graded aggregates have much lower porosity than open-graded aggregates after compaction. As such, my supervisor thinks the runoff factor of 0.1 can apply to open-graded aggregate but may not be able to apply to dense-graded aggregate. Would you please forward this email to Dan and ask him again if a runoff factor of 0.1 can still be applied to Class 2 aggregates (compacted)? If not, what kind of runoff factor should be used?

I apologize if I did not communicate clearly this morning on the type of material we are using and for any confusions it caused.

Thanks again for your help.

Jimmy Zhong, P.E.
Geotechnical/Civil Engineer
Energy Division
Black & Veatch Corporation
3550 Green Court, Ann Arbor, MI 48105
P: (734) 622-8533 F: (734) 622-8700

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 43

Project Name: Tenaska Project No.: 163994

Calculation Title: IMP Sizing for Plant Area

Calculation No./File No.: 52.5406.1002

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To determine the minimum required size of bioswales to satisfy Stormwater C.3 requirements for treatment and flow control for the plant area for the proposed Tenaska Project.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page 2 of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: Version:

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	J Zhong Jimmy Zhong	March 31, 2009	PNelson	15 APR 09	PNelson	15 APR 09

Purpose

To determine the minimum required size of bioswales to satisfy Stormwater C.3 requirements for treatment and flow control for the plant area for proposed Tenaska Project.

References

1. Black & Veatch Drawing:
   - 163994-SS-3001, Rev. A, "Grading & Drainage - Site Plan - Sheet 1"
   - 163994-SS-3201, Rev. A, "Surfacing/Fencing/Roadway - Site Plan - Sheet 1"
   - 163994-SS-3050, Rev. A, "Site Sections and Details"
   - 163994-SS-1002, Rev. 1, "General Arrangement – Site"
2. Contra Costa Clean Water Program; Stormwater C.3 Guidebook; Stormwater Quality Requirements for Development Applications; Fourth Edition; September 10, 2008.
3. Contra Costa County Public Works Department; Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973; Drawing No. B-166; December 1977.
4. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
5. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
6. Email Communications between Black & Veatch and Contra Costa Clean Water Program; March 2009.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)
Drainage area in acres (ac)

Attachments

1. Black & Veatch Drawings SS1002, SS-3001, SS-3201 and SS-3050
2. Reference 2 – Select Pages
3. Reference 3 – Drawing No. B-166
4. Reference 4 – Select Pages
5. Reference 5 – Select Pages
6. Email Communications

Summary:

Five bioswales will be constructed within the plant area to collect and infiltrate stormwater.
Based on the Stormwater C.3 requirements, the required bioswale surface area and volume for each bioswale are listed in the following table.
The design bioswale length, shape, design surface area and volume are presented in the following table. The design bioswales in the plant area have sufficient surface areas and volume to satisfy the Stormwater C.3 requirements.

IMP ID	Shape	Length (feet)	Side Slope	Bottom Width (feet)	Design Surface Area (ft^2)	Design Volume (ft^3)	Required Surface Area (ft^2)	Required Volume (ft^3)
Bioswale #1	Trapezoidal	390	3 (h) to 1 (v)	2	7,800	12,870	5,406	4,479
Bioswale #2	Trapezoidal	933	3 (h) to 1 (v)	2	18,660	30,789	7,635	6,326
Bioswale #3	Trapezoidal	187	3 (h) to 1 (v)	2	2,618	2,992	740	613
Bioswale #4	Trapezoidal	391	3 (h) to 1 (v)	2	7,820	12,903	7,598	6,296
Bioswale #5	Trapezoidal	465	3 (h) to 1 (v)	2 ft for first 265 ft long section; 8 ft for remaining 200 ft long section	10,305	19,244	10,274	8,512

IMP Sizing for Plant Area

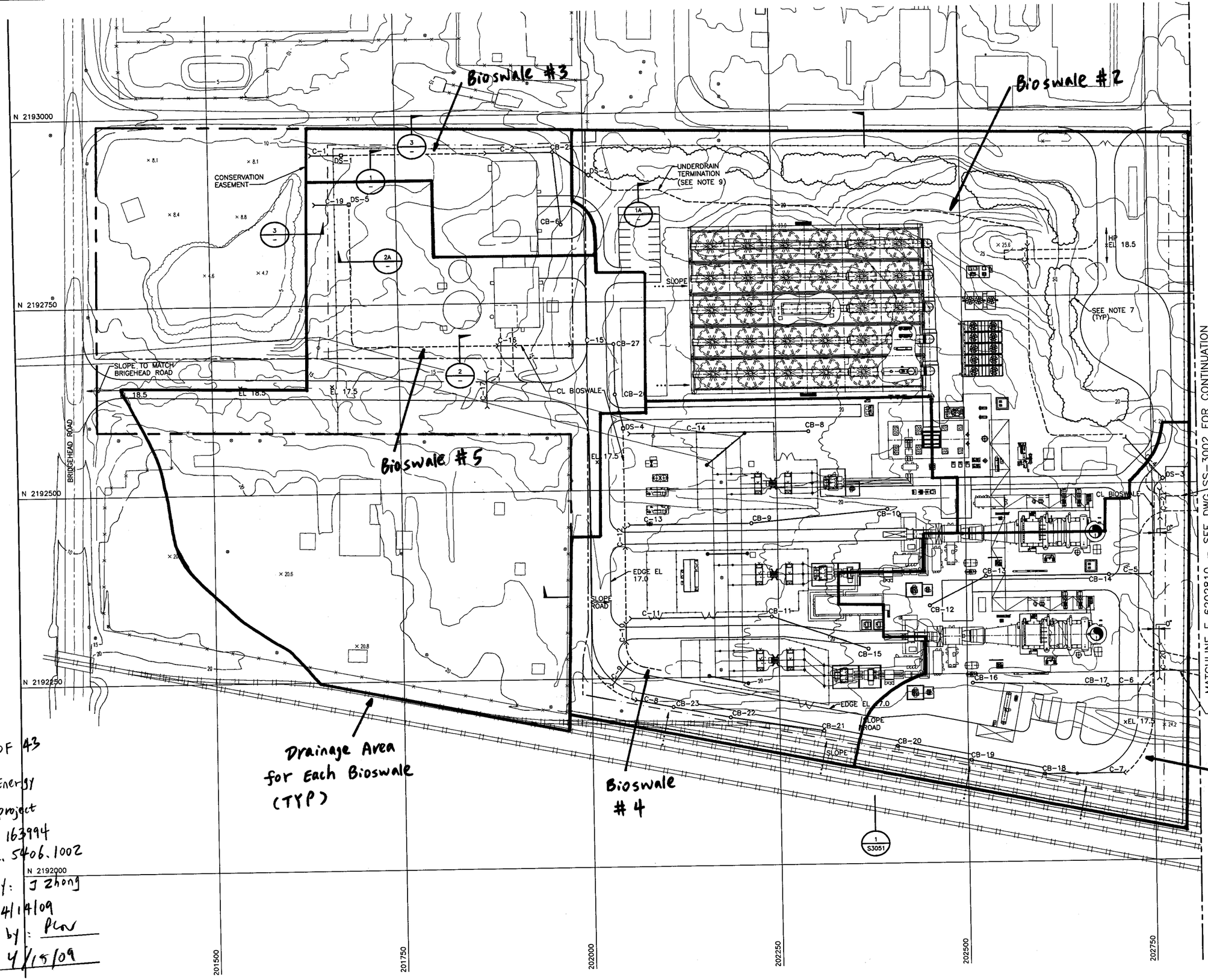
The generation area primarily consists of two combustion turbines, two heat recovery steam generators (HRSG), one air cooled condenser (ACC), three switchyards, one water treatment building, one warehouse building, two water storage tanks, one administration building, and other miscellaneous equipment/facilities. See B&V Drawing SS-1002 for plant general arrangement (Attachment 1). Plant loop road and major equipment access roads will be constructed within the plant. The areas adjacent to the buildings and equipment will have gravel surfacing. Other areas will be covered with vegetated grass. See B&V Drawing SS-3001 for proposed site surfacing of the plant (Attachment 1). The existing trees on this project site will be preserved.

Five bioswales will be constructed within the plant site to collect and infiltrate stormwater. See Page 5 for the locations of bioswales and delineated drainage area for each bioswale. Drop structures will be installed at the end of each bioswale such that sufficient depth (volume) of stormwater has to be collected in the bioswale before downstream discharge can occur.

An existing natural gas distribution facility is located west of the project and is outside the project limits. This area is generally covered by gravel surfacing. From the topography, most of the natural gas facility drains towards the wetland. After constructing the plant access road from Bridgehead Road, this area will continue to drain towards the wetland via a culvert being installed underneath the access road. The natural gas facility will be included in the IMP sizing for bioswale #5 since the stormwater from this area will flow to and accumulate in this bioswale.

NRCS Soil Group

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the project site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". Per Ref. 5, this type of soil can be classified as Hydrologic Soil Group A soil.



page 5 OF 43

Radback Energy
Tenaska project
project # 163994
File # 52.5406.1002
prepared by: J Zhong
Date: 4/14/09
checked by: PLW
Date: 4/15/09

IMP Sizing for Bioswale #1

Refer to Page 5, the total drainage area for bioswale #1 is measured to be: 153,520 ft^2 (3.52 ac). The bioswale #1 is measured to be 390 feet long.

Five drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; and (5) Transformer Containment.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	20,871
DMA-2	Asphalt Pavement	27,640
DMA-3	Gravel Surfacing	54,230
DMA-4	Grass/Landscape	46,694
DMA-5	Transformer Containment	4,085

Runoff Coefficients

Dense-graded aggregate (Caltran Class 2 aggregate) will be utilized as the materials for aggregate surfacing. After being compacted, the dense-graded aggregate is estimated to have a runoff coefficient of 0.5 to 0.7. See communications with Contra Costa County Clean Water Program (Attachment 6). Use 0.6 in this calculation.

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (20{,}871\text{x}1.0+27{,}640\text{x}1.0+54{,}230\text{x}0.6+46{,}694\text{x}0.1+4{,}085\text{x}0)$$

$$= 85{,}718\ ft^2.$$

IMP Sizing Factors

Since the project site is covered by hydrologic group A soil, the subsurface reservoir volume (V_2) is not needed per Stormwater C.3 Guidebook. From this guidebook, for "treatment and flow control", the IMP sizing factor for the area (A) of bioswale is 0.07. The IMP sizing factor for the surface reservoir volume (V_1) of bioswale is 0.058. (Ref. 2, Table 4-6).

Rain Adjustment Factor

Per the Isohyetal Map by Contra Costa County Public Works, Figure B-166 (Ref. 3), the mean annual precipitation (MAP) at the project site is 12.5 inches. Consequently, for group A soils,

$$\text{Rain Adjustment Factor} = \frac{0.0009 \times (MAP - 20.2) + 0.07}{0.07} \qquad \text{(Ref. 2, Equation 4-3)}$$

$$= \frac{0.0009 \times (12.5 - 20.2) + 0.07}{0.07}$$

$$= 0.901.$$

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 85{,}718 \times 0.07 \times 0.901 = 5{,}406 \text{ ft}^2.$$

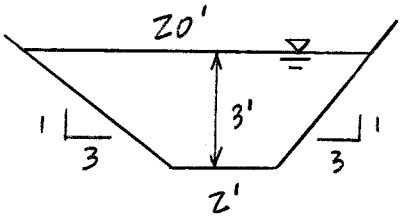
The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 85{,}718 \times 0.058 \times 0.901 = 4{,}479 \text{ ft}^3.$$

The proposed bioswale #1 is 390 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.5. Drop structure DS-3 will be installed at the end of bioswale #1. See B&V Drawing SS-3001

(Attachment 1). The top of grate elevation of DS-3 will be at EL 15.5 (see Drawing SS-3050). The effective depth of the bioswale is: 15.5 – 12.5 = 3 feet.



The surface area of bioswale #1 is:

$$20 \times 390 = 7{,}800 \text{ ft}^2 > 5{,}406 \text{ ft}^2, \quad \underline{\text{OK}}.$$

The volume of bioswale #1 is:

$$\frac{2+20}{2} \times 3 \times 390 = 12{,}870 \text{ ft}^3 > 4{,}479 \text{ ft}^3, \quad \underline{\text{OK}}.$$

Conclusion: The proposed size of bioswale #1 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	J. Zhong	
PLANT	Tenaska	Unit No.	DATE	20-Mar-2009	
PROJECT NO.	163994	File No. 52.5406.1002	CKD BY	PLN	
TITLE	IMP Sizing		DATE	4/15/09	
			PAGE	9	OF 43

Soil Type	IMP Name
A	Bioswale #1

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	20,871	Equipment/Roofs	1.00	20,871					
DMA-2	27,640	Asphalt Pavement	1.00	27,640					
DMA-3	54,230	Gravel Surfacing	0.60	32,538					
DMA-4	46,694	Landscape, Group A Soil	0.10	4,669					
DMA-5	4,085	Transformer Containment	0.00	0					
			Total:	85,718	0.070	0.901	5,406	7,800	IMP Area (ft^2)
					0.058	0.901	4,479	12,870	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

IMP Sizing for Bioswale #2

Refer to Page 5, the total drainage area for bioswale #2 is measured to be: 337,648 ft^2 (7.75 ac). The bioswale #2 is measured to be 933 feet long.

Six drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; (5) Transformer Containment; and (6) Open Graded Aggregates (ACC Area).

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	34,029
DMA-2	Asphalt Pavement	37,473
DMA-3	Gravel Surfacing	45,970
DMA-4	Grass/Landscape	151,570
DMA-5	Transformer Containment	406
DMA-6	Open Graded Aggregates	68,200

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Open Graded Aggregates" will have a runoff coefficient of 0.1. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (34{,}029\text{x}1.0+37{,}473\text{x}1.0+45{,}970\text{x}0.6+151{,}570\text{x}0.1+406\text{x}0+$$

$$68{,}200\text{x}0.1) = 121{,}061\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

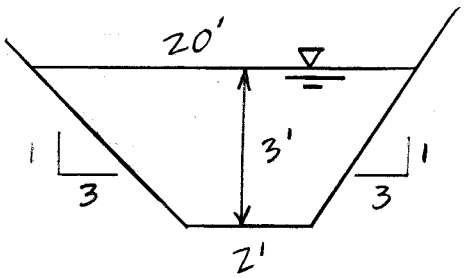
$$= 121{,}061 \times 0.07 \times 0.901 = 7{,}635 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 121{,}061 \times 0.058 \times 0.901 = 6{,}326 \text{ ft}^3.$$

The proposed bioswale #2 is 933 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.5. Drop structure DS-2 will be installed at the end of bioswale #2. See B&V Drawing SS-3001. The top of grate elevation of DS-2 will be at EL 15.5 (see Drawing SS-3050). The effective depth of the bioswale is: 15.5 – 12.5 = 3 feet.



The surface area of bioswale #2 is:

$20 \times 933 = 18{,}660 \text{ ft}^2 > 7{,}635 \text{ ft}^2$, OK.

The volume of bioswale #2 is:

$\frac{2+20}{2} \times 3 \times 933 = 30{,}789 \text{ ft}^3 > 6{,}326 \text{ ft}^3$, OK.

Conclusion: The proposed size of bioswale #2 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	J. Zhong	
PLANT	Tenaska	Unit No.	DATE	20-Mar-2009	
PROJECT NO.	163994	File No. 52.5406.1002	CKD BY	PLW	
TITLE	IMP Sizing		DATE	4/15/09	
			PAGE	12	OF 43

Soil Type	IMP Name
A	Bioswale #2

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	34,029	Equipment / Roofs	1.00	34,029					
DMA-2	37,473	Asphalt Pavement	1.00	37,473					
DMA-3	45,970	Gravel Surfacing	0.60	27,582					
DMA-4	151,570	Landscape, Group A Soil	0.10	15,157					
DMA-5	406	Transformer Containment	0.00	0					
DMA-6	68,200	Open Graded Aggregates	0.10	6,820					
			Total:	121,061	0.070	0.901	7,635	18,660	IMP Area (ft^2)
					0.058	0.901	6,326	30,789	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

IMP Sizing for Bioswale #3

Refer to Page 5, the total drainage area for bioswale #3 is measured to be: 40,711 ft^2 (0.93 ac). The bioswale #3 is measured to be 187 feet long.

Three drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; and (3) Grass/Landscape.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	6,423
DMA-2	Asphalt Pavement	2,086
DMA-3	Grass/Landscape	32,202

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (6{,}423\text{x}1.0+2{,}086\text{x}1.0+32{,}202\text{x}0.1)$$

$$= 11{,}729\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 11{,}729 \text{ x } 0.07 \text{ x } 0.901 = 740 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

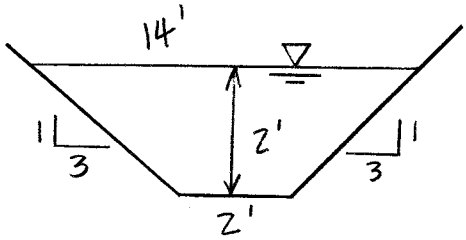
$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 11{,}729 \text{ x } 0.058 \text{ x } 0.901 = 613 \text{ ft}^3.$$

The proposed bioswale #3 is 187 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 11.0. Drop structure DS-1 will be installed at the end of bioswale #3. See B&V Drawing SS-3001. The top of grate elevation of DS-1 will be at EL 13.0 (see Drawing SS-3050). The effective depth of the bioswale is: 13.0 – 11.0 = 2 feet.

The surface area of bioswale #3 is:

$14 \text{ x } 187 = 2{,}618 \text{ ft}^2 > 740 \text{ ft}^2$, <u>OK</u>.



The volume of bioswale #3 is:

$$\frac{2+14}{2} \text{ x } 2 \text{ x } 187 = 2992 \text{ ft}^3 > 613 \text{ ft}^3, \text{ OK}.$$

A 6" perforated underdrain will be installed in bioswale #3 and a portion of bioswale #2 to discharge stormwater runoff from less intensive storm events to the wetland to allow the wetland to continue to have water. See Dwg SS-3001 (Attachment 1).

<u>Conclusion</u>: The proposed size of bioswale #3 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	J. Zhong	
PLANT	Tenaska	Unit No.	DATE	20-Mar-2009	
PROJECT NO.	163994	File No. 52.5406.1002	CKD BY	PLN	
TITLE	IMP Sizing		DATE	4/05/09	
			PAGE	15	OF 43

Soil Type	IMP Name
A	Bioswale #3

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	6,423	Equipment / Roofs	1.00	6,423					
DMA-2	2,086	Asphalt Pavement	1.00	2,086					
DMA-3	32,202	Landscape, Group A Soil	0.10	3,220					
			Total:	11,729	0.070	0.901	740	2,618	IMP Area (ft^2)
					0.058	0.901	613	2,992	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

IMP Sizing for Bioswale #4

Refer to Page 5, the total drainage area for bioswale #4 is measured to be: 190,955 ft^2 (4.38 ac). The bioswale #4 is measured to be 391 feet long.

Five drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; and (5) Transformer Containment.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	19,314
DMA-2	Asphalt Pavement	33,262
DMA-3	Gravel Surfacing	109,208
DMA-4	Grass/Landscape	23,692
DMA-5	Transformer Containment	5,479

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (19{,}314\text{x}1.0+33{,}262\text{x}1.0+109{,}208\text{x}0.6+23{,}692\text{x}0.1+5{,}479\text{x}0)$$

$$= 120{,}470\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

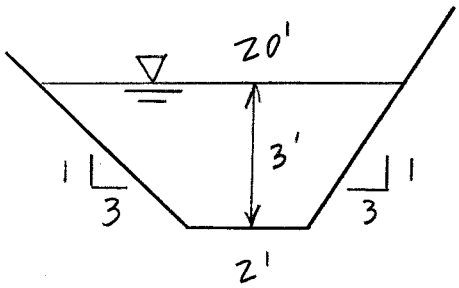
$$= 120{,}470 \text{ x } 0.07 \text{ x } 0.901 = 7{,}598 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 120{,}470 \text{ x } 0.058 \text{ x } 0.901 = 6{,}296 \text{ ft}^3.$$

The proposed bioswale #4 is 391 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.5. Drop structure DS-4 will be installed at the end of bioswale #4. See B&V Drawing SS-3001. The top of grate elevation of DS-4 will be at EL 15.5 (see Drawing SS-3050). The effective depth of the bioswale is: 15.5 – 12.5 = 3 feet.



The surface area of bioswale #4 is:

20 x 391 = 7,820 ft^2 > 7,598 ft^2, OK.

The volume of bioswale #4 is:

$$\frac{2+20}{2} \text{ x } 3 \text{ x } 391 = 12{,}903 \text{ ft}^3 > 6{,}296 \text{ ft}^3, \text{ OK.}$$

Conclusion: The proposed size of bioswale #4 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	J. Zhong	
PLANT	Tenaska	Unit No.	DATE	20-Mar-2009	
PROJECT NO.	163994	File No. 52.5406.1002	CKD BY	PLN	
TITLE	IMP Sizing		DATE	4/15/09	
			PAGE	18	OF 43

Soil Type	IMP Name
A	Bioswale #4

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	19,314	Equipment / Roofs	1.00	19,314					
DMA-2	33,262	Asphalt Pavement	1.00	33,262					
DMA-3	109,208	Gravel Surfacing	0.60	65,525					
DMA-4	23,692	Landscape, Group A Soil	0.10	2,369					
DMA-5	5,479	Transformer Containment	0.00	0					
			Total:	120,470	0.070	0.901	7,598	7,820	IMP Area (ft^2)
					0.058	0.901	6,296	12,903	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

IMP Sizing for Bioswale #5

Refer to Page 5, the total drainage area for bioswale #5 is measured to be: 318,309 ft^2 (7.31 ac) (natural gas facility included). The bioswale #5 is measured to be 465 feet long total.

Four drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; and (4) Grass/Landscape.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	15,984
DMA-2	Asphalt Pavement	25,905
DMA-3	Gravel Surfacing	186,725
DMA-4	Grass/Landscape	89,695

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (15{,}984\text{x}1.0+25{,}905\text{x}1.0+186{,}725\text{x}0.6+89{,}695\text{x}0.1)$$

$$= 162{,}894\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 162{,}894 \text{ x } 0.07 \text{ x } 0.901 = 10{,}274 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 162{,}894 \text{ x } 0.058 \text{ x } 0.901 = 8{,}512 \text{ ft}^3.$$

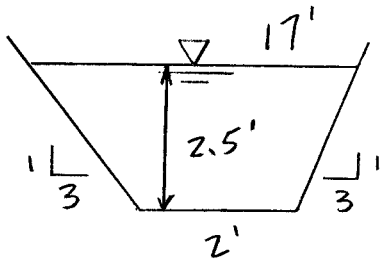
The proposed bioswale #5 is 465 feet long total. The bioswale cross section will be trapezoidal. Bottom width = 2 feet for the first 265 feet long section (Section 2 on SS-3001) and 8 feet for the remaining 200 feet long section (Section 2A on SS-3001). Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.0 for Section 2 and EL 11.0 for Section 2A. Drop structure DS-5 will be installed at the end of bioswale #5. See B&V Drawing SS-3001. The top of grate elevation of DS-5 will be at EL 15.0 (see Drawing SS-3050). The effective depth of the bioswale is: 14.5 – 11.0 = 3.5 feet for Section 2A and 14.5 – 12.0 = 2.5 feet for Section 2. See Dwg SS-3001 in Attachment 1.

The surface area of bioswale #5 is:

$17 \text{ x } 265 + 29 \text{ x } 200 = 10{,}305 \text{ ft}^2 > 10{,}274 \text{ ft}^2$, <u>OK</u>.

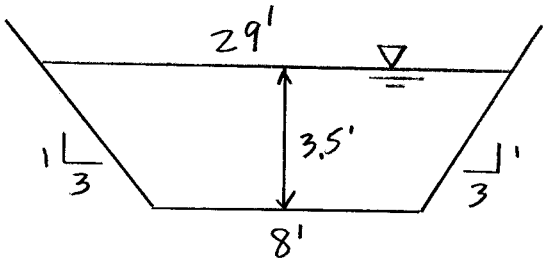
The volume of bioswale #5 is:

$$\frac{2+17}{2} \text{ x } 2.5 \text{ x } 265 + \frac{8+29}{2} \text{ x } 3.5 \text{ x } 200 = 19{,}244 \text{ ft}^3 > 8{,}512 \text{ ft}^3, \text{ OK}.$$



Section 2

DWG SS-3001



Section 2A

DWG SS-3001

Conclusion: The proposed size of bioswale #5 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	J. Zhong	
PLANT	Tenaska	Unit No.	DATE	20-Mar-2009	
PROJECT NO.	163994	File No. 52.5406.1002	CKD BY	PLN	
TITLE	IMP Sizing		DATE	4/15/09	
			PAGE	22	OF 43

Soil Type	IMP Name
A	Bioswale #5

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	15,984	Equipment / Roofs	1.00	15,984					
DMA-2	25,905	Asphalt Pavement	1.00	25,905					
DMA-3	186,725	Gravel Surfacing	0.60	112,035					
DMA-4	89,695	Landscape, Group A Soil	0.10	8,970					
			Total:	162,894	0.070	0.901	10,274	10,305	IMP Area (ft^2)
					0.058	0.901	8,512	19,244	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

Radback Tenaska project

project # 163994 File # 52.5406.1002

Imp sizing for plant Area

prepared by: Jzhong

Date: 3/30/09

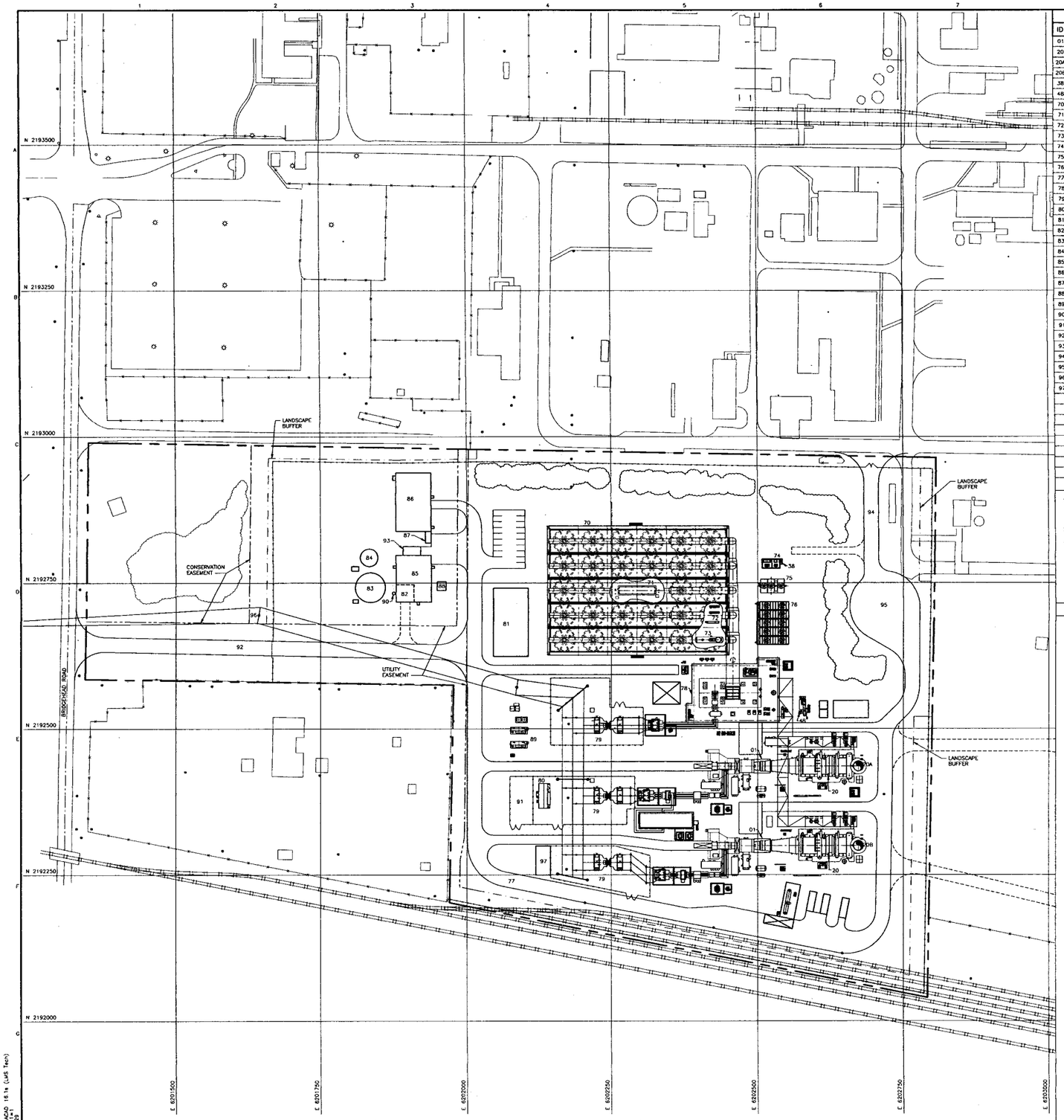
# of pages: 5

Attachment 1

Black & Veatch Dwgs

SS-1002, SS-3001, SS-3201, SS-3050

DWG40999 31-MAR-2009 09:29:37



FACILITIES LEGEND

ID	FACILITY	STRUCTURE HEIGHT	TIEDOWN LOCATION NORTH	TIEDOWN LOCATION EAST	REMARKS
01	COMBUSTION TURBINE	70'	–	–	–
20	HEAT RECOVERY STEAM GENERATOR (HRSG)	103'	–	–	–
20A	HRSG EXHAUST STACK A	155'	2192436.00	6202665.00	CL EXHAUST STACK
20B	HRSG EXHAUST STACK B	155'	2192300.00	6202665.00	CL EXHAUST STACK
38	SAFETY SHOWER EYEWASH STATION	–	–	–	–
48	AUXILIARY BOILER	50'	2192527.61	6202572.26	CL EXHAUST STACK
70	AIR COOLED CONDENSER (ACC)	124'	–	–	–
71	ACC ELECTRICAL ENCLOSURE	14'	–	–	–
72	CONDENSER AIR EXTRACTION SKIDS	6'	–	–	–
73	ACC CONDENSATE COLLECTION TANK	28'	–	–	–
74	WET SURFACE AIR COOLER CHEMICAL FEED SKIDS	8'	–	–	–
75	WET SURFACE AIR COOLER	23'	2192744.67	6202523.00	CL COOLER
76	CLOSED CYCLE COOLING WATER HEAT EXCHANGER	19'	–	–	–
77	LOOP ROAD	–	–	–	–
78	STEAM TURBINE FOUNDATION	–	–	–	–
79	SWITCHYARD	18' & 45'	–	–	–
80	SWITCHYARD CONTROL ENCLOSURE	12'	–	–	–
81	CONTROL & ADMIN BUILDING	14'	–	–	–
82	FIRE WATER PUMP ROOM	20'	–	–	–
83	FIRE/SERVICE WATER STORAGE TANK	32'	–	–	–
84	DEMIN WATER STORAGE TANK	24'	–	–	–
85	WATER TREATMENT BUILDING	20'	–	–	–
86	WAREHOUSE/MAINTENANCE BUILDING	16'	–	–	–
87	LUBRICANT STORAGE SHED	10'	–	–	–
88	WASTE WATER LIFT STATION (IF REQUIRED)	–	–	–	–
89	GAS COMPRESSORS & GAS CONDITIONING	13'	–	–	–
90	DIESEL FIRE PUMP EXHAUST	16'	2192732.52	6201874.72	CL EXHAUST STACK
91	GAS METERING STATION	–	–	–	–
92	ACCESS ROAD	–	–	–	–
93	LEASED MIX BED EXCHANGER CONCRETE SLAB	–	–	–	–
94	EMERGENCY ACCESS ROAD	–	–	–	–
95	CUL DA SAC (TURNAROUND)	–	–	–	–
96	230KV POWER POLE	106'	–	–	–
97	OUTAGE MAINTENANCE TRAILERS AREA	–	–	–	–

NOTES

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. SEE PLANT ARRANGEMENT DRAWING SM-2001, FOR LEGEND OF MAIN POWER BLOCK.
3. PROPERTY AND EASEMENT BOUNDARY INFORMATION IS BASED UPON DRAWING EXHIBIT D, BY RONALD GREENWELL & ASSOCIATES, INC. REVISION DATED 05/FEB/09.

GENERAL LEGEND

- NEW FENCE
- EXISTING FENCE
- PROPERTY BOUNDRY (SEE NOTE 3)
- EASEMENT BOUNDARY (SEE NOTE 3)
- LANDSCAPE BUFFER

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
1	30/MAR/09	ISSUED PER ECN-N-S-0001	NAW	PLN		PLN	DVW
0	13/MAR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____ REG NO. _____

DATE _____

BLACK & VEATCH CORPORATION

ENGINEER PLN DRAWN NAW

CHECKED DATE

CONTRA COSTA GENERATING STATION LLC

CONTRA COSTA COMBINED CYCLE FACILITY

GENERAL ARRANGEMENT SITE

PROJECT DRAWING NUMBER: 163994-SS-1002

REV: 1

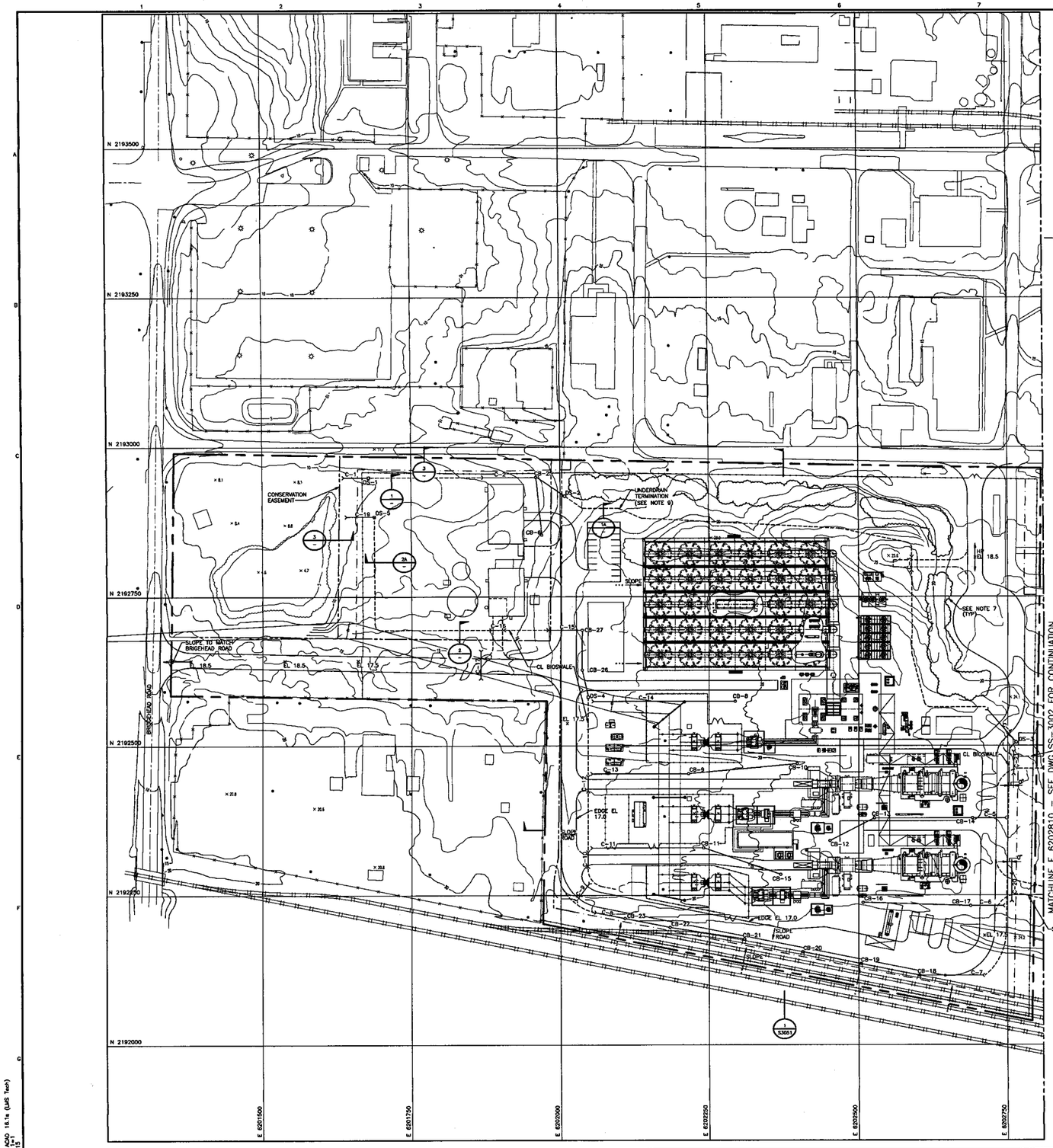
CODE

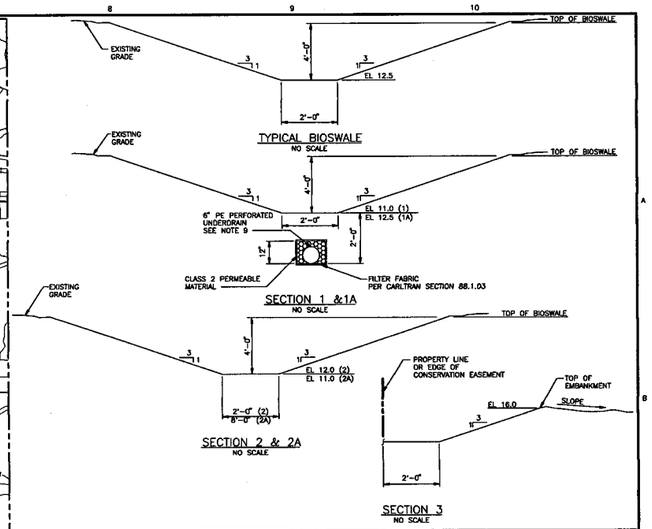
AREA

ACAD 16.1s (LMS Tech)

WEB:6411 PAGE:001 E1 03/30/09 15:09:29

DWG40999 14-APR-2009 15:06:53





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	APPROXIMATE	LTR	LATER
ASPH	ASPHALT	MAX	MAXIMUM
AVG	AVERAGE	MH	MANHOLE
BND	BEND	MIN	MINIMUM
BLDG	BUILDING	MJ	MECHANICAL JOINT
B/MH	BOTTOM OF MANHOLE ELEVATION	MSL	MEAN SEA LEVEL
BOC	BOTTOM OF CONDUIT ELEVATION	NO.	NUMBER
BOD	BOTTOM OF DUCTBANK ELEVATION	NTS	NOT TO SCALE
BOP	BOTTOM OF PIPE ELEVATION	OD	OUTSIDE DIAMETER
BU	BELL-UP	OWS	OIL WATER SEPARATOR
C	CULVERT	OWMH	OILYWASTE MANHOLE
CB	CATCH BASIN	PC	POINT OF CURVATURE
CD	CABLE DUCT	PE	PLAIN END
CHDPE	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	POINT OF INTERSECTION
CL	CENTERLINE	PLCS	PLACES
CLR	CLEAR	PM	PLANT MANHOLE
CMH	CHEMICAL MANHOLE	POT	POINT OF TANGENT
CND	CONDUIT	PT	PIPE TERMINATION
CONC	CONCRETE	PVC	POLYVINYL CHLORIDE PIPE
CO	CLEAN OUT	QTY	QUANTITY
CS	CARBON STEEL	R	RADIUS
CW	CIRCULATING WATER	RCP	REINFORCED CONCRETE PIPE
DB	DUCTBANK	RD	ROOF DRAIN
DBC	DIRECT BURIED CABLE	REV	REVISION
DET	DETAIL	RGS	RIGID GALVANIZED STEEL
DIA	DIAMETER	RR	RAILROAD
DIP	DUCTILE IRON PIPE	SECT	SECTION
DWG	DRAWING	SIM	SIMILAR
DWP	DOUBLE WALL PIPE	SLS	SANITARY LIFT STATION
EC	ELECTRICAL CONDUIT	SMH	SANITARY MANHOLE
ECC	ECCENTRIC	STMH	STORM MANHOLE
EF	EACH FACE	STRL	STRUCTURAL
EHH	ELECTRICAL HANDHOLE	T/C	TOP OF CONCRETE ELEVATION
EL	ELEVATION	T/G	TOP OF GRADE ELEVATION
EMH	ELECTRICAL MANHOLE	THH	TELEPHONE SERVICE HANDHOLE
EW	EACH WAY	T/MH	TOP OF MANHOLE ELEVATION
FC	FIELD CHECK	T/P	TOP OF PAVEMENT ELEVATION
FDN	FOUNDATION	TP	MECH PIPE TERMINAL POINT
FF	FLAT FACE	TYP	TYPICAL
FRP	FIBERGLASS REINFORCED PIPE	UGL	UNDERGROUND LIGHTING CONDUIT
GR	GRADE	UNO	UNLESS NOTED OTHERWISE
HDM	HOT DRAIN MANHOLE	VERT	VERTICAL
HDPE	HIGH DENSITY POLYETHYLENE PIPE	WGT	WEIGHT
HP	HIGH POINT	WTR	WATER
HYD	HYDRANT	W/	WITH
ID	INSIDE DIAMETER	W/O	WITHOUT
INV	INVERT	WP	WORK POINT
JBX	JUNCTION BOX	XFMR	TRANSFORMER
L	LENGTH		
LP	LOW POINT		

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

	NEW CULVERT		NEW SLIDE GATE
	CL BIOSWALE		NEW SWING GATE
S3000	SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER		EXISTING POWER POLE
× 326.5	FINISHED SPOT ELEVATIONS	CB-101	NEW CATCH BASIN
			NEW DROP STRUCTURE
BM-1	SURVEY MONUMENT/CONTROL POINT		PROPERTY LINE
	EXISTING FENCE		BOUNDARY LINE
	NEW SECURITY FENCE	126	EXISTING CONTOURS
	TEMPORARY CONSTRUCTION FENCE		GRADE TO DRAIN (DIRECTION OF ARROW)
TR-1	EROSION CONTROL METHOD		

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE. ELEVATION = 11.188 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN AND DROP STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.
9. UNDERDRAIN CONTINUOUS UNDER BIOSWALE FROM UNDERDRAIN TERMINATION TO CONSERVATION EASEMENT. UTILIZE UNPERFORATED PIPE BETWEEN DS-2 TO C-2 OUTLET AND DS-1 TO C-1 OUTLET.

OPEN
04/01/09

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	18/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1" =60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRWN NAW
CHECKED DATE

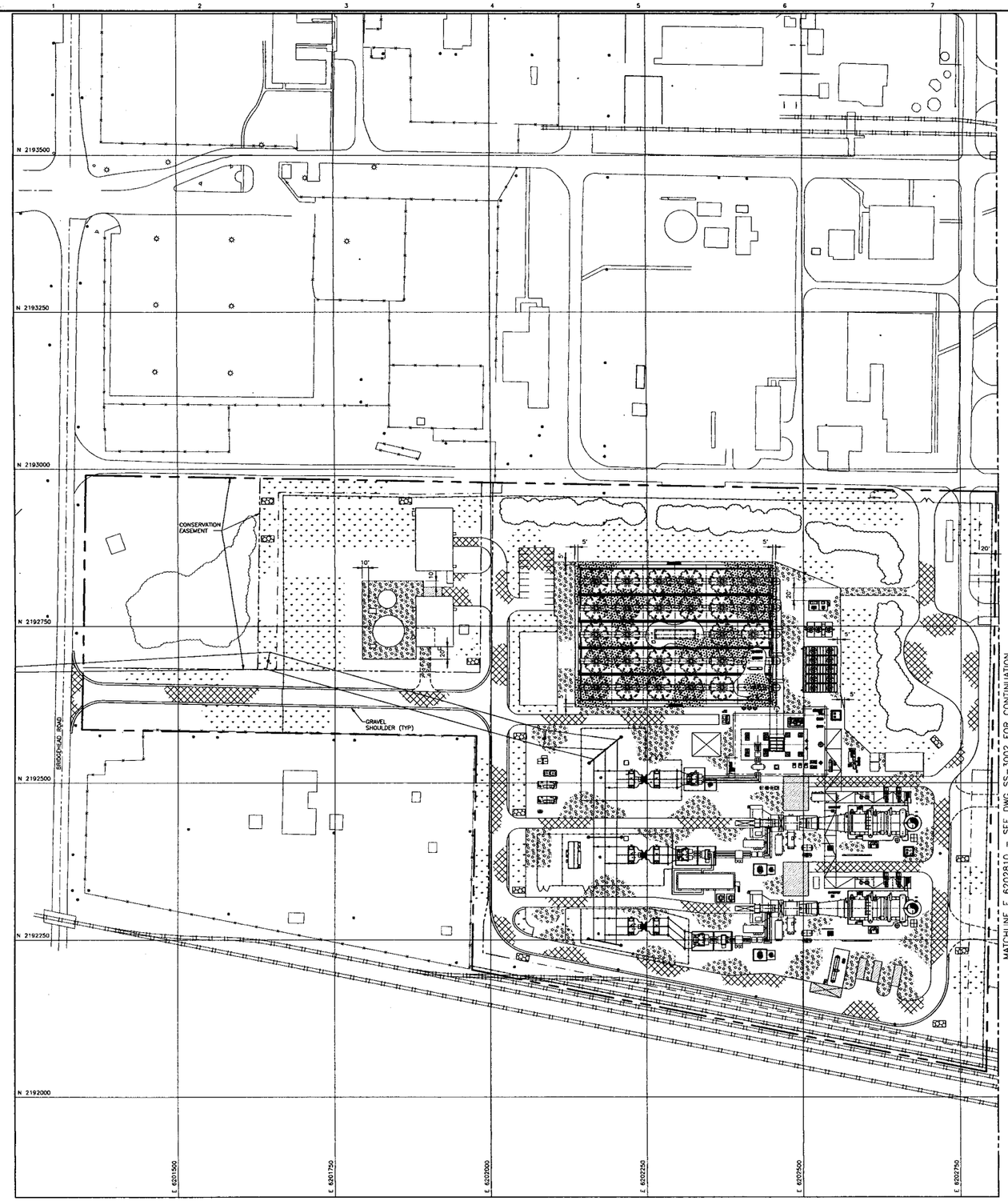
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GRADING AND DRAINAGE – SITE PLAN – SHEET 1

PROJECT 163994 DRAWING NUMBER SS-3001 REV 0
CODE
AREA

SRU37162 ACAD 16.1a (LMS Tech)
AJRUDD E1 = 1-1
04/16/09 07:17:13

DWG40999 31-MAR-2009 09:31:01



SITE SURFACING LEGEND

- ASPHALT SURFACING
- AGGREGATE SURFACING
- CONCRETE
- GRASS
- OPEN GRADED STONE SURFACING
- RIPRAP
- EXISTING FACILITY
- NEW FACILITY
- NATURAL SOIL

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED
FOR CONSTRUCTION

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PGE	APP
A	27/MAR/09	ISSUED FOR CLIENT REVIEW	NAW	PLN		PLN	WA

60' 30' 0 60' 120'
SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

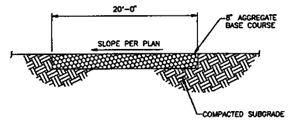
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SURFACING/FENCING/ROADWAY – SITE PLAN – SHEET 1

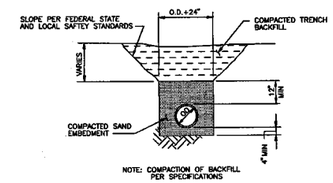
PROJECT DRAWING NUMBER REV
163994–SS–3201 A
CODE
AREA

WE31641 ACAD 16.1s (LMS Tech)
LAYOUT: 1 Plot: 1=1
07/27/08 8:46:53

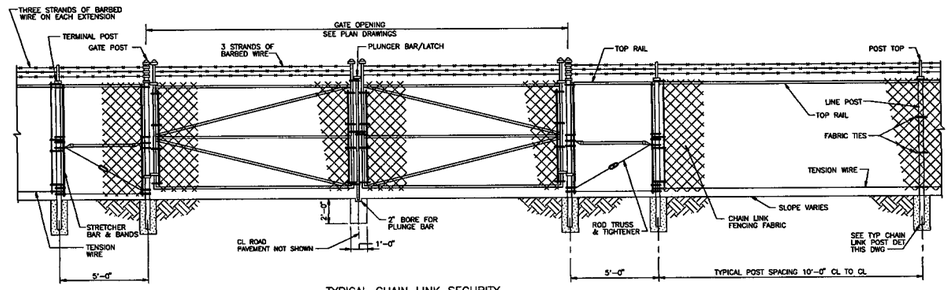
DWG40999 14-APR-2009 15:07:20



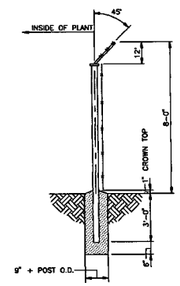
TYPICAL CONSTRUCTION LAYDOWN ROAD
NO SCALE



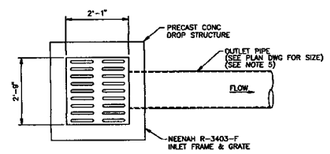
TYPICAL PIPE EMBEDMENT
NO SCALE



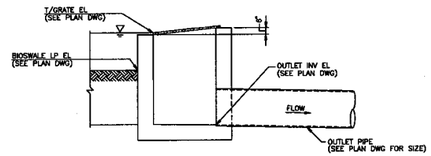
TYPICAL CHAIN LINK SECURITY FENCE AND GATE DETAIL
NO SCALE



TYPICAL SECURITY FENCE POST DETAIL
NO SCALE

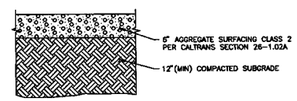


PLAN

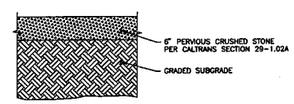


SECTION

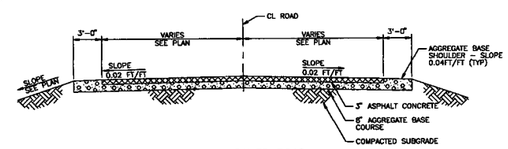
TYPICAL BIOSWALE DROP STRUCTURE DETAIL
NO SCALE



TYPICAL AGGREGATE SURFACING SECTION
NO SCALE

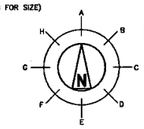


TYPICAL PERVIOUS CRUSHED STONE SURFACING SECTION
NO SCALE



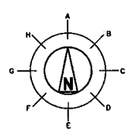
TYPICAL PAVED ROAD
NO SCALE
SEE DWG SS-3201

CULVERT TABLE						
CULVERT NO.	INLET INV ELEVATION	OUTLET INV ELEVATION	LENGTH	PIPE DIAMETER	PIPE MATERIAL	REMARKS
C-1	8.2	8.0	–	18"	–	
C-2	11.8	11.5	–	18"	–	
C-3	13.0	13.0	–	18"	–	
C-4	13.2	13.0	–	18"	–	
C-5	13.1	13.0	–	12"	–	
C-6	13.1	13.0	–	12"	–	
C-7	13.3	13.0	–	12"	–	
C-8	13.2	13.0	–	12"	–	
C-9	13.0	13.0	–	12"	–	
C-10	13.0	13.0	–	15"	–	
C-11	13.4	13.0	–	12"	–	
C-12	13.0	13.0	–	18"	–	
C-13	13.4	13.0	–	12"	–	
C-14	13.5	13.0	–	12"	–	
C-15	12.8	12.5	–	18"	–	
C-16	12.5	12.5	–	18"	–	
C-17	14.7	14.4	–	12"	–	
C-19	8.7	8.5	–	18"	–	
C-20	–	–	–	18"	–	
C-21	–	–	–	18"	–	



CATCH BASIN TABLE																					
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																	REMARKS
				A		B		C		D		E		F		G		H			
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA		
CB-6	–	–	16.0	–	–	13.2	12"	–	–	–	–	13.2	12"	–	–	–	–	–	–		
CB-7	NOT USED																				
CB-8	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.5	12"		
CB-9	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–		
CB-10	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–		
CB-11	–	–	17.0	–	–	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–		
CB-12	–	–	17.0	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	–	–		
CB-13	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	–	–		
CB-14	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–		
CB-15	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"		
CB-16	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–		
CB-17	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–		
CB-18	–	–	16.5	–	–	13.2	12"	–	–	–	–	–	–	–	–	13.2	12"	–	–		
CB-19	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–		
CB-20	–	–	16.5	–	–	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–		
CB-21	–	–	16.5	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	–	–		
CB-22	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–		
CB-23	–	–	16.5	–	–	–	–	13.2	12"	–	–	–	–	–	–	13.2	12"	–	–		
CB-24	NOT USED																				
CB-25	–	–	15.0	–	–	–	–	–	–	11.8	18"	12.3	12"	–	–	11.8	18"	–	–		
CB-26	–	–	16.0	13.2	18"	–	–	–	–	–	–	13.2	18"	–	–	–	–	–	–		
CB-27	–	–	16.5	–	–	–	–	–	–	–	–	12.8	18"	–	–	12.8	18"	–	–		

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST



DROP STRUCTURE (DS) TABLE																					
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																	REMARKS
				A		B		C		D		E		F		G		H			
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA		
DS-1	–	–	13.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12.1	18"		
DS-2	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	11.8	18"	–	–		
DS-3	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.2	18"		
DS-4	–	–	15.5	13.5	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
DS-5	–	–	14.5	8.7	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–		

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST

NOTES

1. FILTER FABRIC SHALL BE UV-STABILIZED NONWOVEN GEOTEXTILE HAVING A MINIMUM WEIGHT OF 135 g/M^2 PER CALTRANS SS 88-1.03.
2. SEE DWG SS-3001 FOR GENERAL NOTES AND LEGEND.

OPEN
04/01/09

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1" = 50'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SITE
SECTIONS AND DETAILS

PROJECT DRAWING NUMBER 163994-SS-3050
REV 0
CODE
AREA

ACAD 16.1a (LMS Tech)
E1 1=1
SP:\371.65 A1-R0.DWG
04/14/09 07:16:52

Radback Tenaska project

project # 163994 File # 52.5406.1002

IMP sizing for plant Area

prepared by: J zhong

Date: 3/30/09

# of pages: 5

Attachment 2

Reference 2

Select pages

(Runoff factor) x (tributary area) $\leq$ 2 x (self-retaining area) *Equation 4-1*

For treatment-only sites, and

(Runoff factor) x (tributary area) $\leq$ 1 x (self-retaining area) *Equation 4-2*

for sites subject to flow-control requirements. Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors to be used when sizing IMPs.

Surface	Treatment and Flow Control	Treatment only
Roofs	1.0	1.0
Concrete or Asphalt	1.0	1.0
Pervious Concrete	0.1	0.1
Porous Asphalt	0.1	0.1
Grouted Unit Pavers	1.0	1.0
Solid Unit Pavers	0.5	0.2
Crushed Aggregate	0.1	0.1
Turfblock	0.1	0.1
Landscape, Group A Soil	0.1	0.1
Landscape, Group B Soil	0.3	0.1
Landscape, Group C Soil	0.5	0.1
Landscape, Group D Soil	0.7	0.1

Areas draining to IMPs are used to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

The CCCWP has developed sizing factors (ratios of IMP area to impervious DMA area). For each IMP design, factors are provided for:

TABLE 4-6. Sizing Factors

Treatment and Flow Control	NRCS Soil Group			
IMP	**A**	**B**	**C**	**D**
Bioretention Facility				
A	0.07	0.11	0.06	0.05
V_1	0.058	0.092	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Flow-through Planter				
A	N/A	N/A	0.06	0.05
V_1	N/A	N/A	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Dry Well				
A	0.05	0.06	N/A	N/A
V	0.130	0.204	N/A	N/A
Cistern + bioretention facility				
A (bioretention facility)	*0.04*	*0.04*	*0.04*	*0.04*
V (cistern)	0.193	0.228	0.088	0.060

* Cistern sized for flow control when used in conjunction with a treatment IMP. IMP underdrain required in B, C and D soils.

Treatment Only

Bioretention Facility				
A	*0.04*	*0.04*	*0.04*	*0.04*
Flow-through Planter				
A	*0.04*	*0.04*	*0.04*	*0.04*
Dry Well (treatment only)				
A	0.02	0.04	N/A	N/A
V	0.068	0.136	N/A	N/A

Units Notes:
A = ft^2 of IMP footprint per ft^2 of tributary impervious area (unitless)
V, V_1, V_2 = ft^3 per ft^2 of equivalent tributary impervious area (ft.)

STEP 5: OBTAIN SIZING AND RAIN ADJUSTMENT FACTORS FOR EACH IMP

For each of the IMPs, obtain the appropriate **area** sizing factor from Table 4-6.

Sizing factors for treatment-only IMPs (in *italics*) do not require any adjustment for differing rainfall patterns.

Both area (A) and volume (V_1, V_2) sizing factors for treatment-plus-flow-control IMPs, however, must be adjusted to account for the effects of differing rainfall patterns on pre-project and post-project runoff.

Use the equations below to compute the rainfall adjustment:

Equation 4-3

$$\text{For Group A soils, } Rain\ Adjustment = \frac{0.0009 \times \left(MAP_{project\ site} - 20.2\right) + 0.07}{0.07}$$

Equation 4-4

$$\text{For Group B soils, } Rain\ Adjustment = \frac{-0.0005 \times \left(MAP_{project\ site} - 20.2\right) + 0.11}{0.11}$$

Equation 4-5

$$\text{For Group C soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.06}{0.06}$$

Equation 4-6

$$\text{For Group D soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.05}{0.05}$$

where *MAP* is the mean annual precipitation at the site as shown on the isohyetal map, Contra Costa County Public Works Figure B-166, available on the CCCWP C.3 web pages.

► STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

The minimum area and storage volumes of each IMP are found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

$$Min.\ IMP\ Area\ or\ Volume = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Bioretention facilities and flow-through planters have two storage volumes. V_1 is the floodable volume above the soil layer. V_2 is the storage volume below the soil layer, calculated by multiplying the volume of gravel by an assumed porosity of 0.4. See Figure 4-6. Note these volumes can be configured in a variety of practical combinations of depth and area to best fit into your landscape design.

Cisterns and dry wells have a single storage volume (V).

V is calculated using Equation 4-8:

Equation 4-8

$$Min.V = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP\,Volume \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes of the receiving IMP:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas and Volumes

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*	*Soil Type:*	*IMP Name*			
					IMP Sizing factor	*Rain Adjust-ment Factor*	*Minimum Area or Volume*	*Proposed Area or Volume*	
			Total						***IMP Area***
									V or V1
									V2
								Orifice Size:	

► STEP 7: DETERMINE IF IMP AREA AND VOLUME ARE ADEQUATE

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1–6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the Provision C.3 sizing requirements. If not, revise the plan accordingly. Revisions may include:

Radback Tenaska project

Project # 163994 File # 52.5406.1002

IMP Sizing for ~~Laydown~~ plant Area

prepared by: JZhong

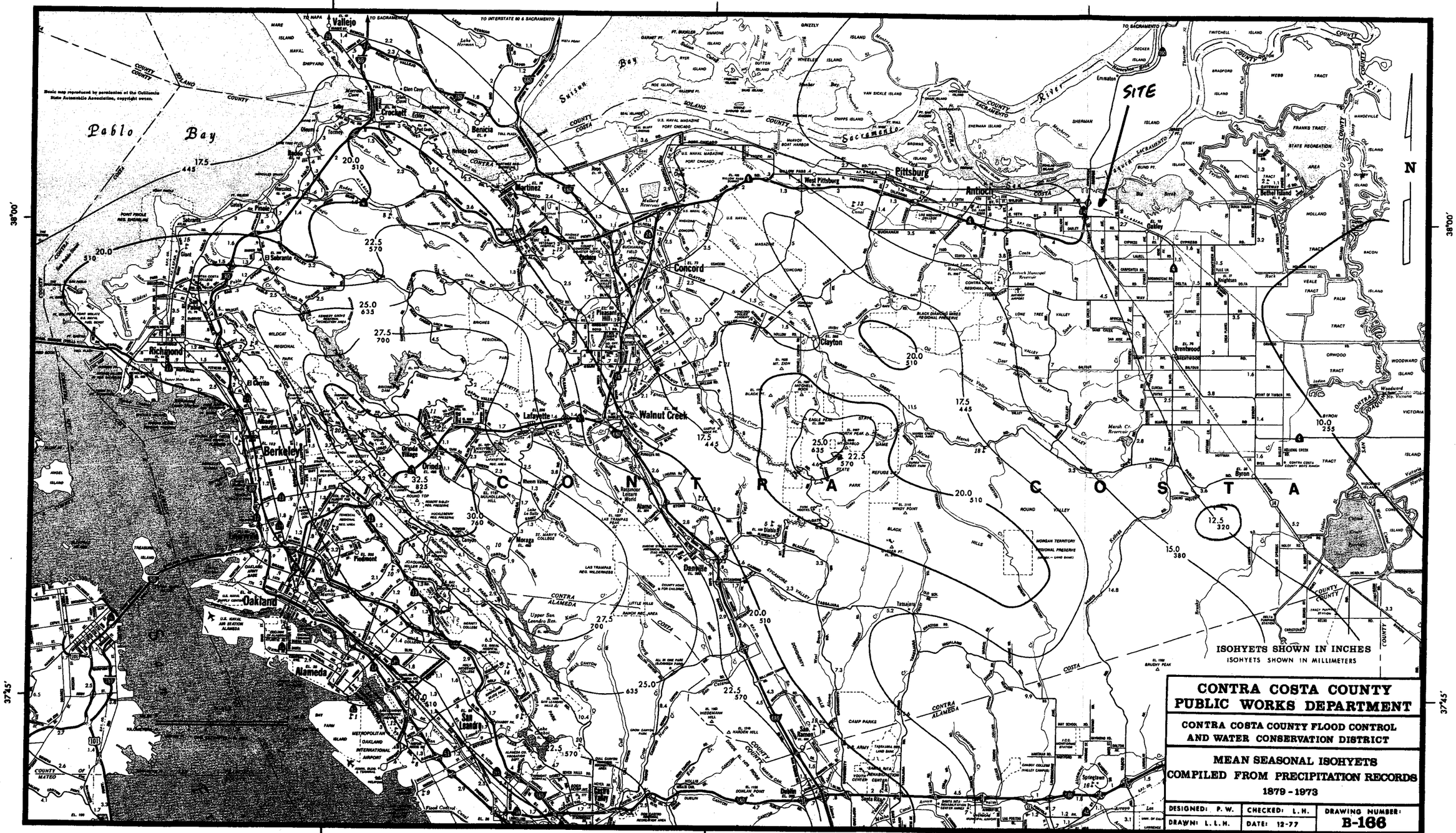
Date: 3/24/09

# of pages: 2

Attachment 3

Reference 3

Drawing No. B-166


122°15′
122°00′
121°45′
38°00′
37°45′
N
SITE
Pablo Bay
Suisun Bay
Sacramento River
Vallejo
Crockett
Benicia
Martinez
Pittsburg
Antioch
West Pittsburg
Concord
Pleasant Hill
Walnut Creek
Clayton
Richmond
El Cerrito
Berkeley
Lafayette
Orinda
Moraga
Alamo
Danville
San Ramon
Dublin
Pleasanton
Livermore
Oakland
Alameda
San Leandro
Hayward
Fremont
Brentwood
Oakley
Knightsen
Bethel Island
Byron
Springtown
C O N T R A C O S T A
ISOHYETS SHOWN IN INCHES
ISOHYETS SHOWN IN MILLIMETERS
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
MEAN SEASONAL ISOHYETS
COMPILED FROM PRECIPITATION RECORDS
1879 - 1973
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
B-166
DRAWN: L. L. H.
DATE: 12-77

Radback Tenaska project

Project # 163994 File # 52.5406.1002

IMP Sizing for ~~Laydown~~ plant Area

prepared by: JZhong

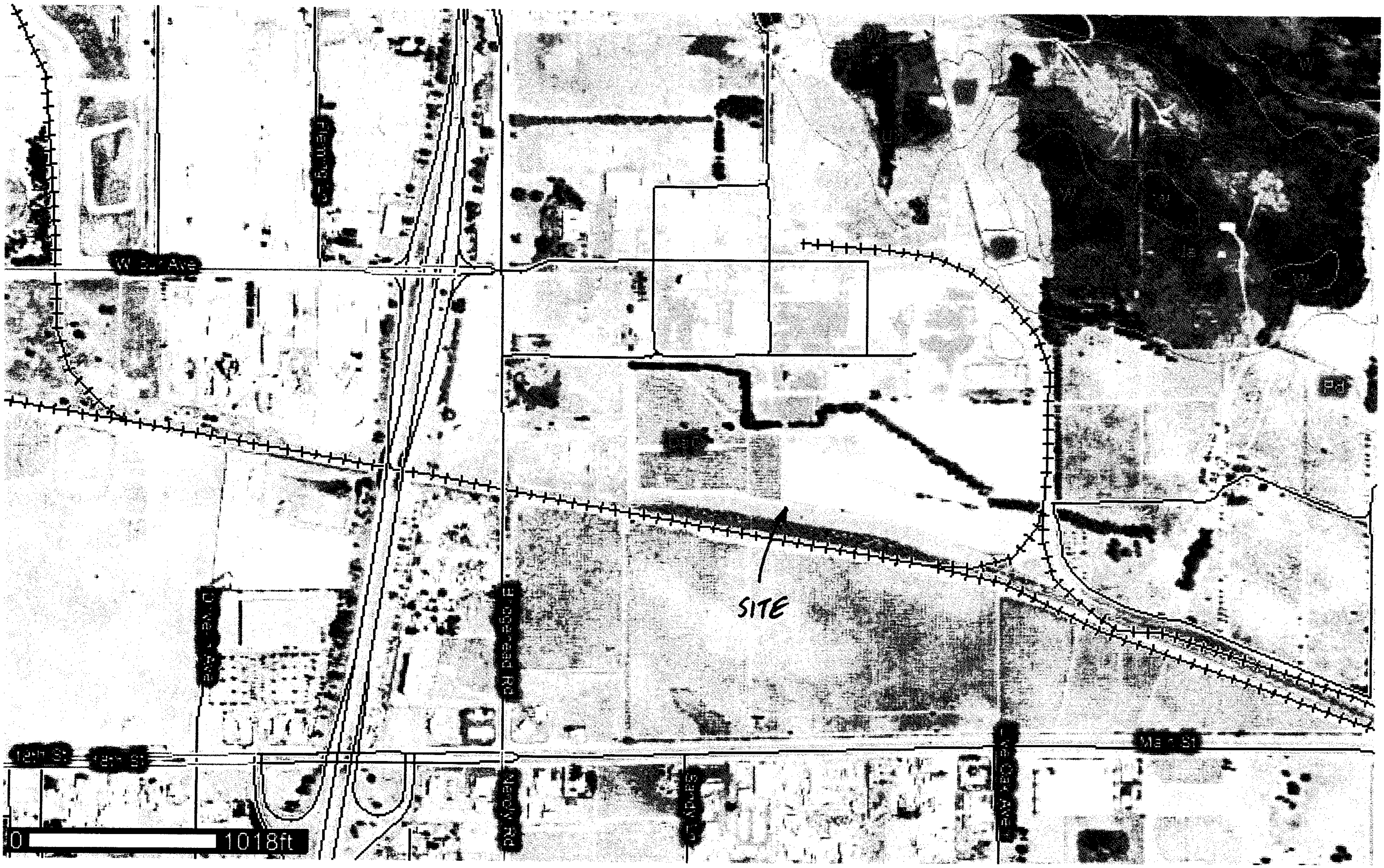
Date: 3/24/09

# of pages: 4

Attachment 4

Reference 4

Select pages


12th St
SITE
0
1018ft

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Radback Tenaska project

project # 163994 File # 52.5406.1002

Imp sizing for ~~Lagoon~~ Plant Area

prepared by: JZhong

Date: 3/24/09

# of pages: 2

Attachment 5

Reference 5

select page

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification ma no longer apply. In these circumstances, use the follov ing to determine HSG according to the texture of the new surface soil, provided that significant compactior has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a higl water table that creates a drainage problem. Once th soils are effectively drained, they are placed in a diff ent group. For example, Ackerman soil is classified a A/D. This indicates that the drained Ackerman soil is group A and the undrained soil is in group D.

Radback Tenaska project

Project # 163994 File # 52.5406.1002

IMP sizing for ~~Laydown~~ Plant Area

prepared by: Jzhong

Date: 3/24/09

# of pages: 3

Attachment 6

Email communications with contra costa county clean water program

Zhong, Jimmy

From: Dan Cloak [dan@dancloak.com]
Sent: Monday, March 02, 2009 3:54 PM
To: 'Tom Dalziel'; Zhong, Jimmy
Subject: RE: Stormwater C.3 Question

Hi,

It is correct that dense-graded aggregates are not very pervious. Why not use an open-graded aggregate, such as ½ in. crushed rock? Be sure to use a rigid frame around the gravel area.

"Porous Pavements" by Bruce Ferguson is a good reference for porous pavement design.

If dense-graded aggregate is used, I would suggest a runoff coefficient of 0.5 to 0.7, depending on slope.

Dan

From: Tom Dalziel [mailto:tdalz@pw.cccounty.us]
Sent: Monday, March 02, 2009 11:04 AM
To: Zhong, Jimmy; Dan@dancloak.com
Subject: RE: Stormwater C.3 Question

Hi Dan,

Can you review and respond, as appropriate, to Jimmy on my behalf?

Thanks.

Tom Dalziel
Assistant Program Manager
Contra Costa Clean Water Program
tdalz@pw.cccounty.us
Ph. (925) 313-2392, Fax (925) 313-2301

From: Zhong, Jimmy [mailto:ZhongJ@bv.com]
Sent: Wednesday, February 25, 2009 1:11 PM
To: Tom Dalziel
Subject: Stormwater C.3 Question

Tom,

I talked to you and Dan this morning regarding runoff factor for Class 2 aggregates (Caltran Standard Specification Section 26). After our phone call, I had a discussion with my supervisor. He indicated that this type of material is **dense-graded** aggregate which is typically used as pavement base material. After being compacted, this type of material is not that pervious based on his experience. Dense-graded aggregates have much lower porosity than open-graded aggregates after compaction. As such, my supervisor thinks the runoff factor of 0.1 can apply to open-graded aggregate but may not be able to apply to dense-graded aggregate. Would you please forward this email to Dan and ask him again if a runoff factor of 0.1 can still be applied to Class 2 aggregates (compacted)? If not, what kind of runoff factor should be used?

I apologize if I did not communicate clearly this morning on the type of material we are using and for any confusions it caused.

Thanks again for your help.

Jimmy Zhong, P.E.
Geotechnical/Civil Engineer
Energy Division
Black & Veatch Corporation
3550 Green Court, Ann Arbor, MI 48105
P: (734) 622-8533 F: (734) 622-8700

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 53

Project Name: Tenaska Project No.: 163994

Calculation Title: Stormwater Analysis for Wetland

Calculation No./File No.: 52, 5406, 1003

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To determine if the existing wetland at the Tenaska project site can retain the runoff of a 100-yr 24-hr storm without overflowing to other properties. The analysis is performed for pre-construction ground conditions at the site.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page 2 of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: HEC-HMS Version: 3.3

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	J Zhong Jimmy Zhong	March 5, 2009	[illegible]	6 MAR 09	[illegible]	6 MAR 09

Purpose

To determine if the existing wetland at the Tenaska project site can retain the runoff of a 100-year 24-hour storm without overflowing to other properties. The analysis is performed for pre-construction ground conditions at the project site. The existing wetland has no outlet structure.

References

1. Black & Veatch Drawings:
   - 163994-SS-3001, Rev. A, "Grading & Drainage - Site"
   - 163994-SS-3002, Rev. A, "Grading & Drainage - Site"
2. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
3. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, User's Manual, Version 3.3; September 2008.
4. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, Technical Reference Manual; March 2000.
5. US Department of Commerce; Technical Paper No. 40; Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years; May 1961.
6. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
7. Mays, L. W.; Stormwater Collection Systems Design Handbook, McGraw-Hill; 2001.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)

Drainage area in acres (ac)

Attachments

1. HEC-HMS Input
2. HEC-HMS Output
3. Reference 2 – Select Pages
4. Reference 6 – Select Pages

Summary

Based on the HEC-HMS analysis, the maximum water elevation in the wetland is determined to be EL 9.1 feet. The lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis with current ground cover conditions, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm.

Hydrology Modeling – HEC-HMS

There is one drainage area that will drain to the wetland. See Page 5 for the boundary delineation of this area. This drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

The stormwater runoff to the wetland for a 100-year 24-hour storm event was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

Section 1.0 Determine the Time of Concentration

Time of concentration (T_c) can be calculated as:

$$T_c = T_{sheet} + T_{shallow} + T_{channel} \qquad \text{(Ref. 4, Eq. 6-11)}$$

Where:

T_{sheet} = travel time in sheet flow;
$T_{shallow}$ = travel time in shallow concentrated flow;
$T_{channel}$ = travel time in open channels.

There is no open channel flow on this site. Thus $T_{channel} = 0$.

The flow path from the hydraulically most distant point of this drainage area to the wetland is identified as shown on Page 5.

The total flow length is measured to 1490 feet.

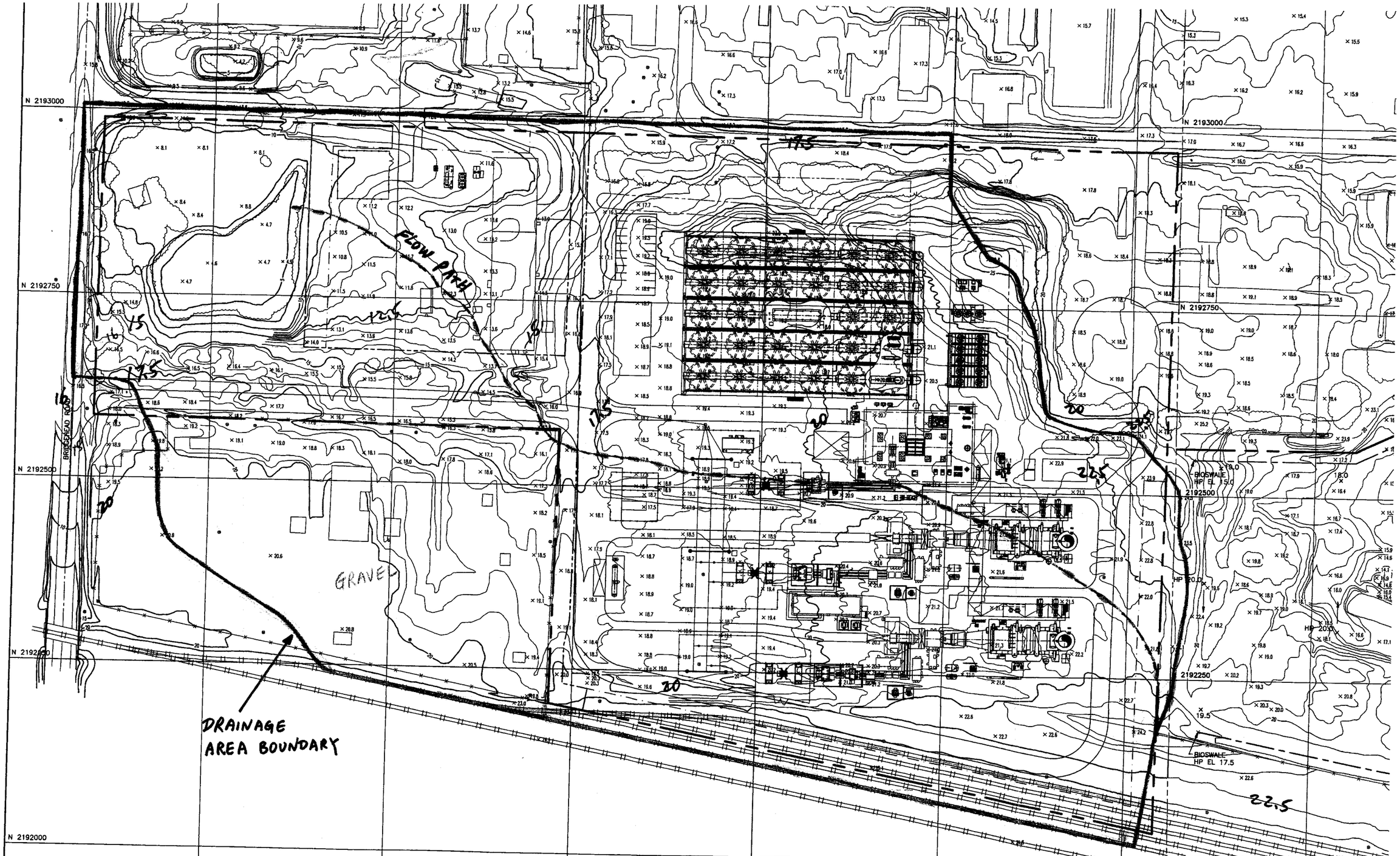
(1) Sheet Flow

Sheet flow travel time can be calculated as:

$$T_{sheet} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{(Ref. 2, Eq. 3-3)}$$

Where:

n = roughness coefficient;
L = flow length (ft);
P_2 = 2-year, 24-hour rainfall (in);
s = land slope (ft/ft).



Radback Tenaska project
project # 163994
52. 5466.1003

stormwater Analysis

page 5 of 53

prepared by: J zhong
Date: 3/4/09
checked by: PRN
Date: 3/6/09

NOTE: THIS PAGE IS A PORTION OF B&V Drawing 163994-SS-3001 Rev A.

AQAD 16.1s (LMS Tech)
1=1
E1
09:17:10

Roughness coefficient n = 0.17 for "cultivated soils, residue cover > 20%". (Ref. 2, Table 3-1)

Per Ref. 2, "After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow". Use sheet flow length L = 300 feet.

2-year, 24-hour rainfall P_2 = 2 inch for this site per Ref. 5 (see Page 8).

The land slope for the first 300 feet = (24.2-21.5)/300 = 0.009 ft/ft. (Refer to Page 5)

Thus, $T_{sheet} = \dfrac{0.007 \times (0.17 \times 300)^{0.8}}{2^{0.5} \times 0.009^{0.4}}$ = 0.76 hour.

(2) Shallow Concentrated Flow
The flow length for shallow concentrated flow L = 1490-300 = 1190 feet.
The average watercourse slope = (21.5-5) / 1190 = 0.014 ft/ft. (Refer to Page 5)

Based on a slope of 0.014 ft/ft, from Ref. 2, Figure 3-1, the average velocity (V) for "unpaved" surface is found to be:

V = 1.9 ft/sec.

Thus the travel time for shallow concentrated flow is calculated to be:

$$T_{shallow} = \frac{L}{3600 \times V} = \frac{1190}{3600 \times 1.9} = 0.17 \text{ hour.}$$

In summary, the time of concentration is calculated to be:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$
$= 0.76 + 0.17 + 0$
$= 0.93$ hour.

Per Ref. 4, "For ungaged watersheds, the SCS suggests that the UH (unit hydrograph) lag time may be related to the time of concentration, T_c, as: $T_{lag} = 0.6\ T_c$". See Page 7.

The SCS UH lag time (T_{lag}) is an input parameter into the HEC-HMS computer program. Thus

T_{lag} = 0.6 x 0.93 = 0.56 hour = 33.6 minutes.

Radback Tenaska project project # 163394 52.5406.1003 stormwater Analysis page 7 of 53

UH can be found from the dimensionless form, which is included in HEC-HMS, by multiplication.

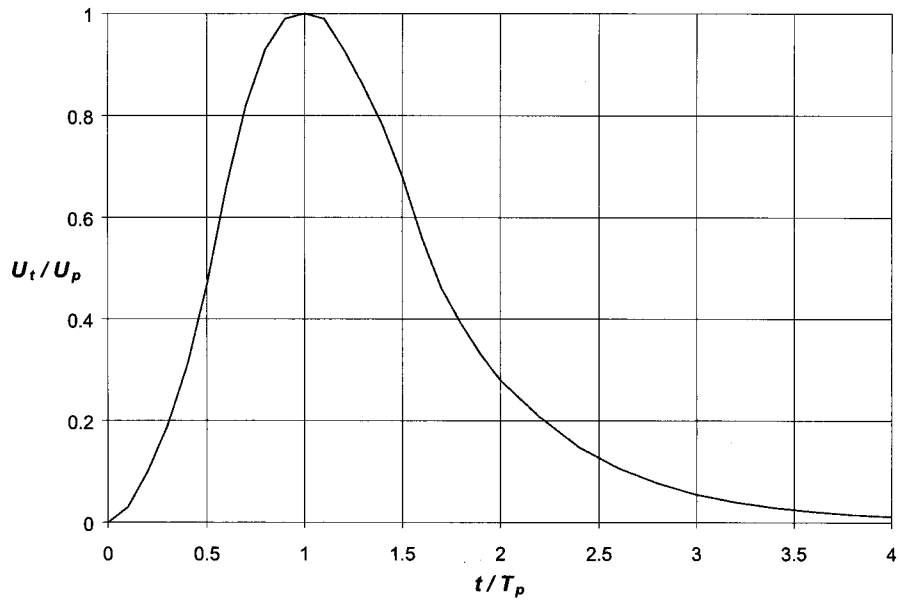


Figure 6-2. SCS unit hydrograph

Estimating the SCS UH Model Parameters

The SCS UH lag can be estimated via calibration, using procedures described in Chapter 9, for gaged headwater subwatersheds.

For ungaged watersheds, the SCS suggests that the UH lag time may be related to time of concentration, t_c, as:

$$t_{lag} = 0.6\, t_c \qquad (6\text{-}10)$$

Time of concentration is a quasi-physically based parameter that can be estimated as

$$t_c = t_{sheet} + t_{shallow} + t_{channel} \qquad (6\text{-}11)$$

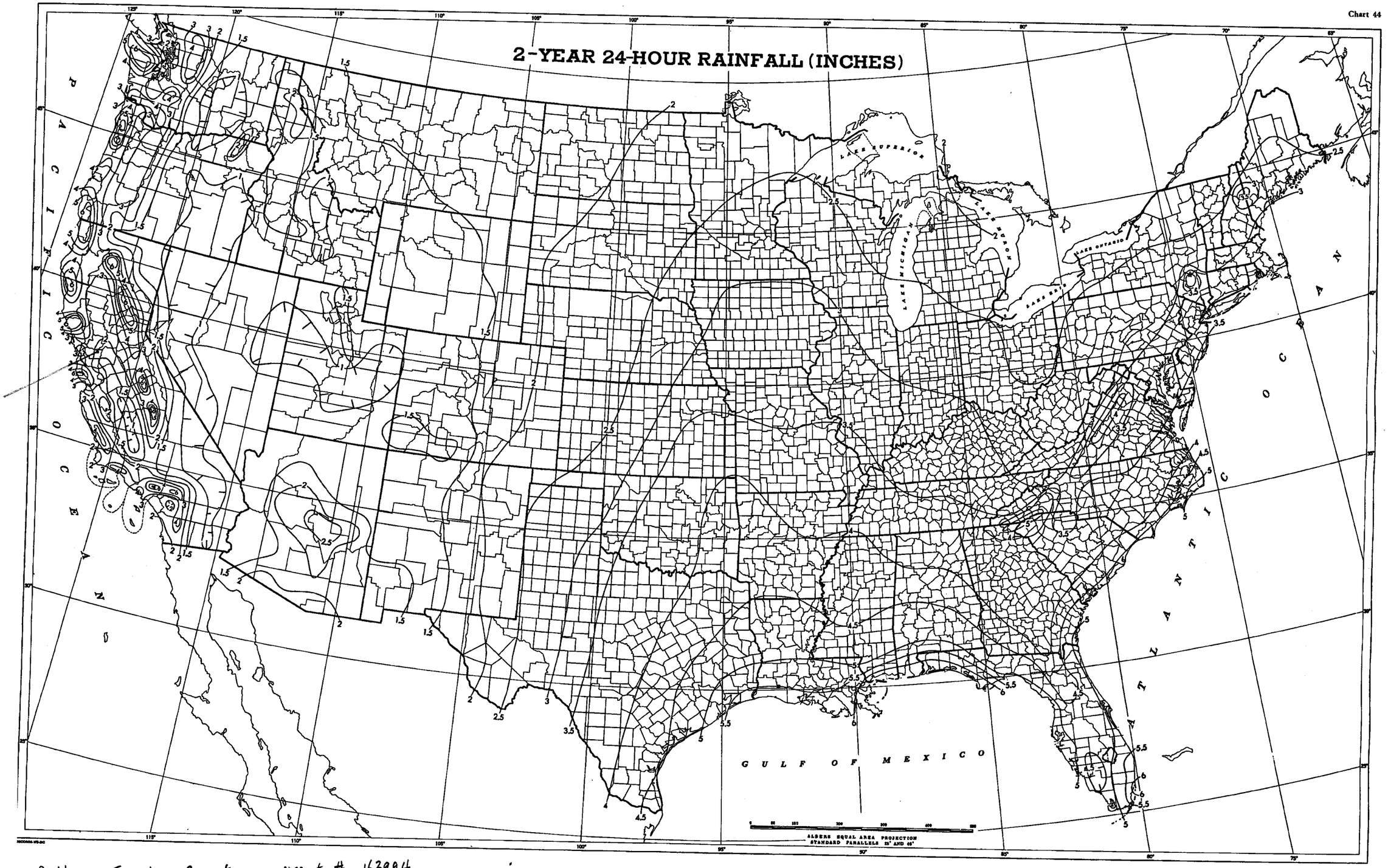
where t_{sheet} = sum of travel time in sheet flow segments over the watershed land surface; $t_{shallow}$ = sum of travel time in shallow flow segments, down streets, in gutters, or in shallow rills and rivulets; and $t_{channel}$ = sum of travel time in channel segments.

NOTE: THIS PAGE IS FROM REF. 4.

Identify open channels where cross section information is available. Obtain cross sections from field surveys, maps, or aerial photographs. For these channels, estimate velocity by Manning's equation:

$$V = \frac{CR^{2/3}S^{1/2}}{n} \qquad (6\text{-}12)$$

where V = average velocity; R = the hydraulic radius (defined as the ratio of channel cross-section area to wetted perimeter); S = slope of the energy grade



SITE
2"

Radback Tenaska Project
Stormwater Analysis

project # 163994
page 8 of 53
52.5416.1003

NOTE: THIS PAGE IS
FROM REF. 5.

Section 2.0 Rainfall Distribution

From Ref. 2, Figure B-2, the rainfall distribution for the site in Contra Costa County, California should be Type I distribution.

From Ref. 5, the 100-year 24-hour rainfall amount for the site is 4 inches. (See Page 10)

Section 3.0 Determine the Composite SCS Curve Number

"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area.

The drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

Per Ref. 2, Table 2-2b, the curve number (CN) for "Row Crops, straight row (SR) with crop residue cover (CR)" for Group A soil is between 64 (good condition) and 71 (poor condition). Use the average curve number 68 for the vineyard area.

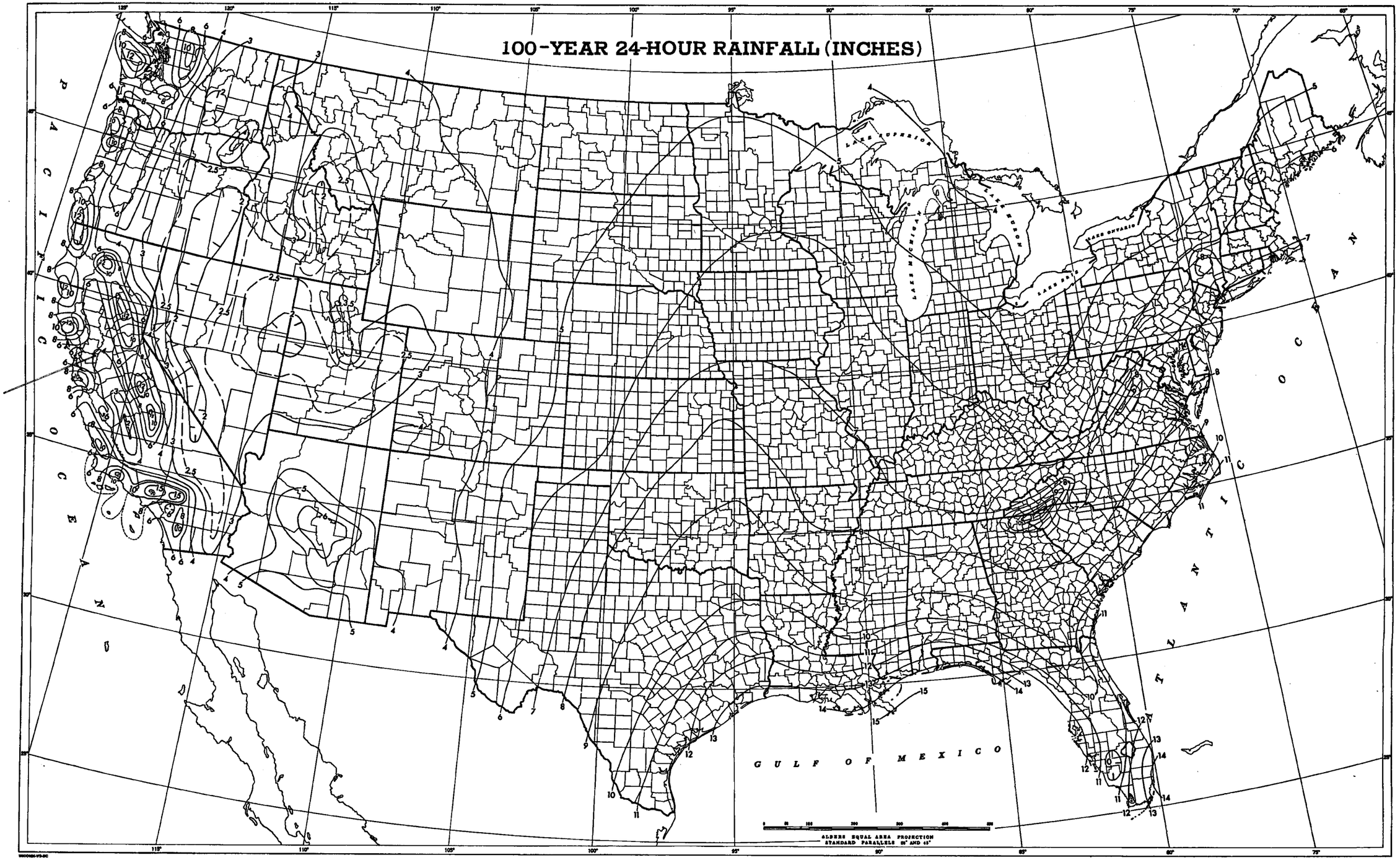
Per Ref. 2, Table 2-2a, the curve number for gravel area for Group A soil is 76. The ground cover in railroad yard is similar to the gravel area. Use the same curve number (76) for the railroad yard.

Treat the wetland as an impervious area since it may have standing water in it. Per Ref. 2, Table 2-2a, a curve number of 98 can be used for this area.

Thus the composite curve number (CN) for the drainage area is calculated as:

$$CN = (19.85 \times 68 + 3.96 \times 76 + 0.94 \times 76 + 0.40 \times 98) / 25.15 = 70.$$

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It



Radback Tenaska project
Stormwater Analysis

project # 163994
page 10 of 53
52.5406.1003

NOTE: THIS PAGE IS FROM REF. 5.

includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2)

Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 70, the initial abstraction is calculated to be:

$$I_a = 0.2 \times (1000/70 - 10) = 0.857 \text{ inch.}$$

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. The impervious area consists of the roofs of a few small buildings in the southwest portion of the drainage area. By using AutoCAD, the total roof area is measured to be 0.17 acre. Thus,

% impervious = 0.17 / 25.15 = 0.68%, say 1%.

Section 4.0 Wetland Area versus Elevation

The bottom of the wetland is at an approximate elevation of 5 feet. See B&V Drawing SS-3001 (Page 5). The relationship of Area versus Elevation for the wetland area was presented in the table below. The wetland area was measured by using AutoCAD. It should be noted that a small portion of the wetland at the east side within the project property will be filled at a later time. This area will be graded at a 4 (H) to 1 (V) slope towards the wetland. The area in the table below at Elevation 10 (1.44 acres) has already had the future fill area been deducted to accurately model the wetland storage capacity.

Elevation (ft)	Wetland Area (acre)
5.0	0.40
7.5	0.62
10.0	1.44

Section 5.0 HEC-HMS Output

The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The initial water elevation in the wetland is specified to be at

EL 5 assuming that standing water in the wetland is not higher than EL 5 before the 100-year 24-hour storm begins.

The maximum water elevation in the wetland was calculated by running the HEC-HMS program.

The output results are included in Attachment 2 and are summarized below.

Peak Inflow:	9.0 ft^3/sec.
Peak Storage:	2.8 acre-feet
Peak Elevation:	9.1 feet.

Conclusion:

Based on the HEC-HMS analysis, the existing wetland will be able to contain all the runoff from its drainage area at current ground cover conditions for a 100-year 24-hour storm.

From B&V Drawing SS-3001, the lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm.

Radback Tenaska project
project # 163994

Stormwater Analysis

JZ 3/4/09

# of pages : 12

52.5406.1003

Attachment 1

HEC-HMS Input

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

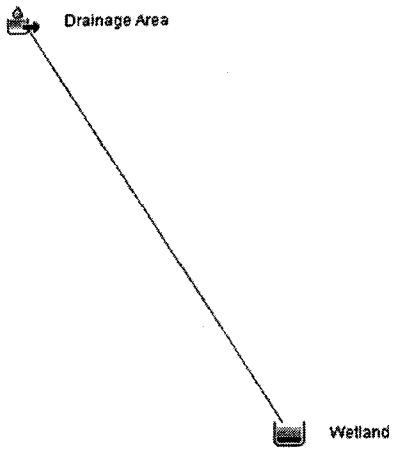
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Description:	Tenaska Site
Downstream:	Wetland
Area (MI2)	0.0393
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm...

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
  - Control Specifications
  - Time-Series Data
  - Paired Data

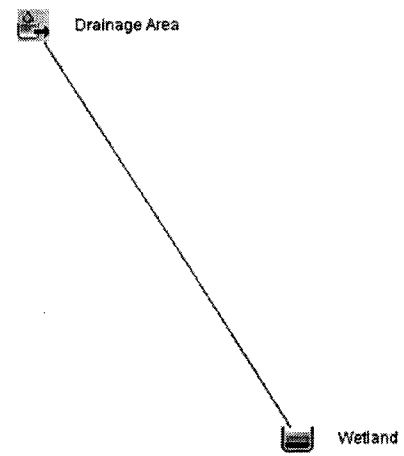
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Initial Abstraction (IN)	0.857
Curve Number:	70
Impervious (%)	1

Basin Model [Basin 1], Current Run [Run 1]



NOTE 10179: Opened basin model "Basin 1" at time 11Mar2009, 13:42:37.
NOTE 10181: Opened control specifications "Control 1" at time 11Mar2009, 13:42:56.
NOTE 10180: Opened meteorologic model "Met 1" at time 11Mar2009, 13:42:56.
NOTE 10184: Began computing simulation run "Run 1" at time 11Mar2009, 13:42:58.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 11Mar2009, 13:42:58.

start | Inbox - Microsoft Out... | HEC-HMS 3.3 [C:\hm... | 1:45 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

Components | Compute | Results

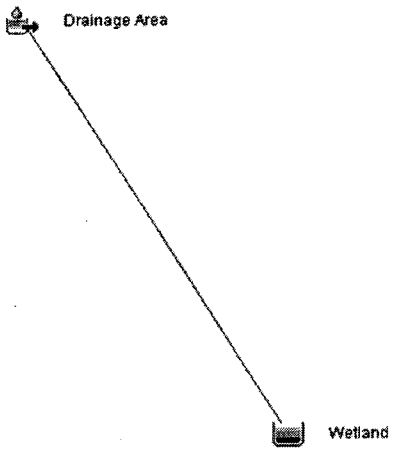
Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Graph Type: Standard

Lag Time (MIN) 33.600000

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

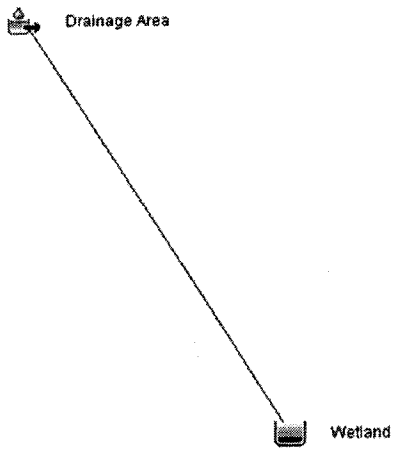
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

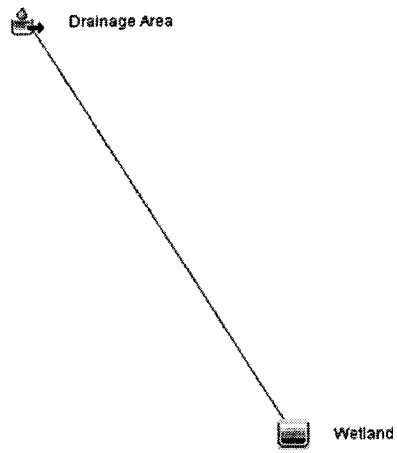
Components | Compute | Results

Reservoir | Options

Basin Name: Basin 1
Element Name: Wetland

Description:	Wetland Storage
Downstream:	-None-
Method:	Specified Release
Storage Method:	Elevation-Area
Elev-Area Function:	Reservoir-1(Basin 1)
Initial Condition:	Elevation
Initial Elevation (FT)	5.0
Discharge Gage:	Gage 1
Max Release (CFS)	
Max Capacity (AC-FT)	

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

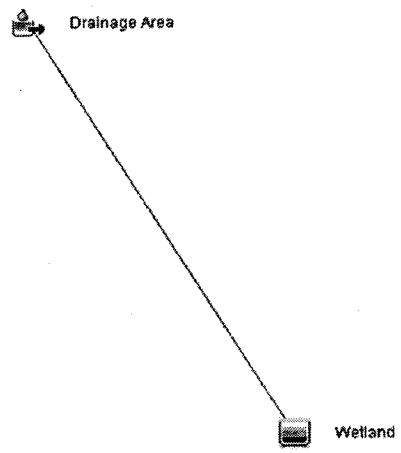
Components | Compute | Results

Reservoir | Options

Basin Name: Basin 1
Element Name: Wetland

Observed Flow: --None--
Observed Stage: --None--
Observed Pool Elevation: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

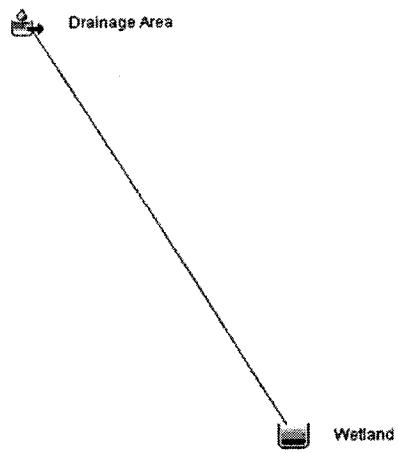
Components | Compute | Results

Meteorology Model | Basins

Name: Met 1

Description:	Antioch, CA (100-yr 24-hr storm)
Precipitation:	SCS Storm
Evapotranspiration:	--None--
Snowmelt:	--None--
Unit System:	U.S. Customary

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:26 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

Components | Compute | Results

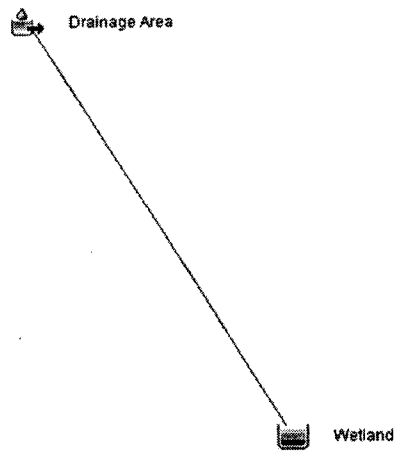
Precipitation

Name: Met 1

Method: Type 1

Depth (IN) 4.0

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:27 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

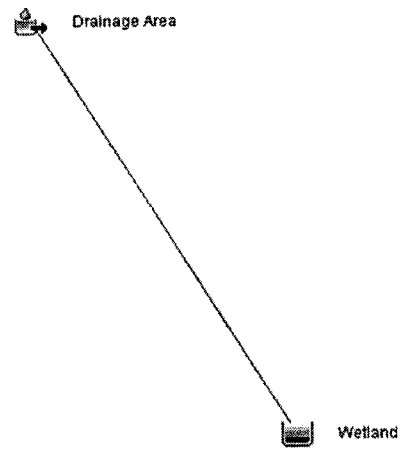
- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
      - Gage 1
  - Paired Data
    - Elevation-Area Functions
      - Reservoir 1 (Basin 1)

Components | Compute | Results

Paired Data | Table | Graph

Elevation (FT)	Area (AC)
5.0	0.40
7.5	0.62
10.0	1.44

Basin Model [Basin 1], Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:29 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

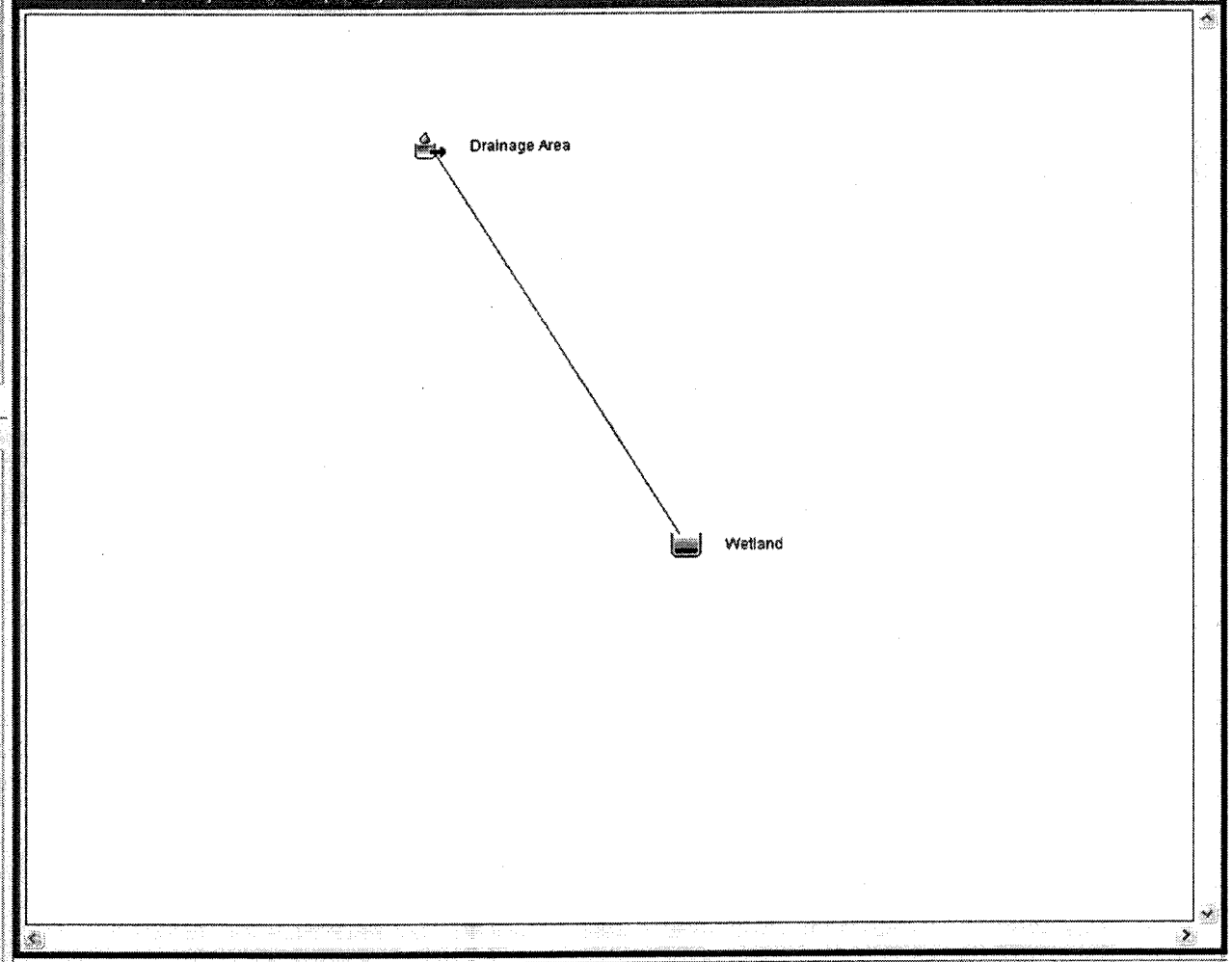
- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
      - Gage 1
        - 10Jan2020, 06:00 - 12Jan2020, 06:00
  - Paired Data
    - Elevation-Area Functions
    - Reservoir-1(Basin 1)

Components | Compute | Results

Time-Series Gage | Time Window | Table | Graph

Time (ddMMMYYYY, HH:mm)	Discharge (CFS)
10Jan2020, 06:00	0.0
10Jan2020, 07:00	0.0
10Jan2020, 08:00	0.0
10Jan2020, 09:00	0.0
10Jan2020, 10:00	0.0
10Jan2020, 11:00	0.0
10Jan2020, 12:00	0.0
10Jan2020, 13:00	0.0
10Jan2020, 14:00	0.0
10Jan2020, 15:00	0.0
10Jan2020, 16:00	0.0
10Jan2020, 17:00	0.0
10Jan2020, 18:00	0.0
10Jan2020, 19:00	0.0
10Jan2020, 20:00	0.0
10Jan2020, 21:00	0.0
10Jan2020, 22:00	0.0
10Jan2020, 23:00	0.0
11Jan2020, 00:00	0.0
11Jan2020, 01:00	0.0
11Jan2020, 02:00	0.0
11Jan2020, 03:00	0.0
11Jan2020, 04:00	0.0
11Jan2020, 05:00	0.0
11Jan2020, 06:00	0.0

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

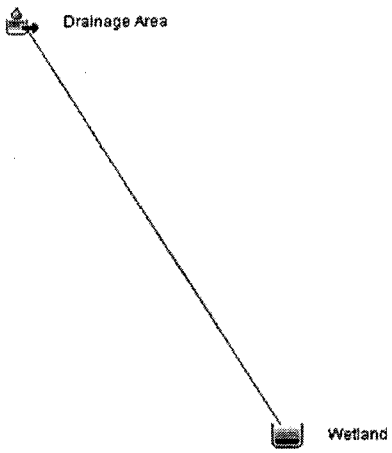
Components | Compute | Results

Control Specifications

Name: Control 1

Description:	Duration
Start Date (ddMMMYYYY)	10Jan2020
Start Time (HH:mm)	06:00
End Date (ddMMMYYYY)	12Jan2020
End Time (HH:mm)	06:00
Time Interval:	6 Minutes

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hms... | untitled - Paint | 2:28 PM

Radback Tenaska Project stormwater Analysis JZ 3/4/09

project # 163994

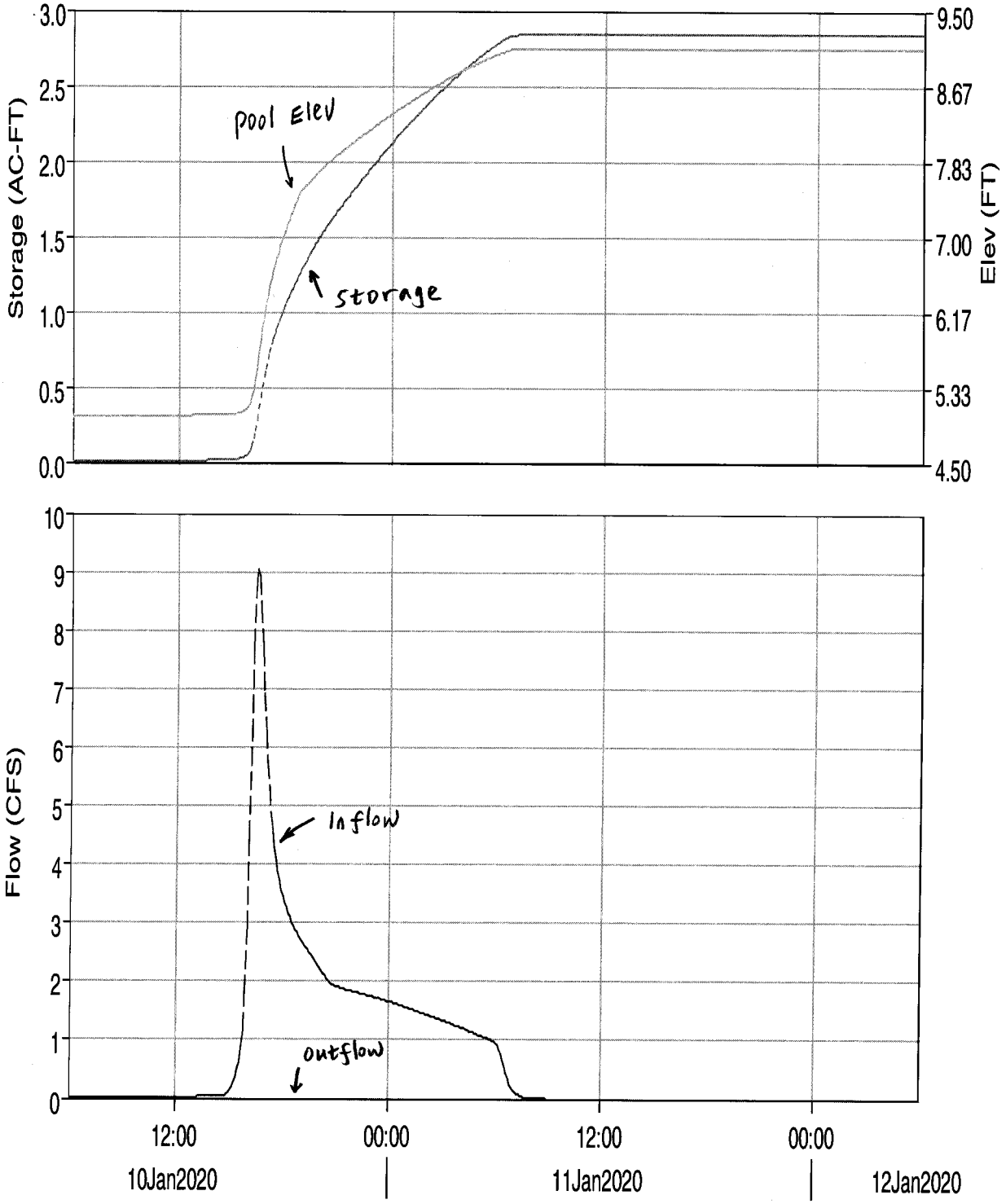
# of pages: 15

52, 5406, 1003

Attachment 2

HEC-HMS Output

Reservoir "Wetland" Results for Run "Run 1"



Run:Run 1 Element:WETLAND Result:Storage

Run:Run 1 Element:WETLAND Result:Pool Elevation

Run:Run 1 Element:WETLAND Result:Outflow

Run:Run 1 Element:WETLAND Result:Combined Inflow

Project: Radback
Simulation Run: Run 1 Reservo

Start of Run: 10Jan2020, 06:00 Basin
End of Run: 12Jan2020, 06:00 M
Compute Time: 11Mar2009, 13:42:58

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	06:00	0.0	0.0	5.0	0.0
10Jan2020	06:06	0.0	0.0	5.0	0.0
10Jan2020	06:12	0.0	0.0	5.0	0.0
10Jan2020	06:18	0.0	0.0	5.0	0.0
10Jan2020	06:24	0.0	0.0	5.0	0.0
10Jan2020	06:30	0.0	0.0	5.0	0.0
10Jan2020	06:36	0.0	0.0	5.0	0.0
10Jan2020	06:42	0.0	0.0	5.0	0.0
10Jan2020	06:48	0.0	0.0	5.0	0.0
10Jan2020	06:54	0.0	0.0	5.0	0.0
10Jan2020	07:00	0.0	0.0	5.0	0.0
10Jan2020	07:06	0.0	0.0	5.0	0.0
10Jan2020	07:12	0.0	0.0	5.0	0.0
10Jan2020	07:18	0.0	0.0	5.0	0.0
10Jan2020	07:24	0.0	0.0	5.0	0.0
10Jan2020	07:30	0.0	0.0	5.0	0.0
10Jan2020	07:36	0.0	0.0	5.0	0.0
10Jan2020	07:42	0.0	0.0	5.0	0.0
10Jan2020	07:48	0.0	0.0	5.0	0.0
10Jan2020	07:54	0.0	0.0	5.0	0.0
10Jan2020	08:00	0.0	0.0	5.0	0.0
10Jan2020	08:06	0.0	0.0	5.0	0.0
10Jan2020	08:12	0.0	0.0	5.0	0.0
10Jan2020	08:18	0.0	0.0	5.0	0.0
10Jan2020	08:24	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	08:30	0.0	0.0	5.0	0.0
10Jan2020	08:36	0.0	0.0	5.0	0.0
10Jan2020	08:42	0.0	0.0	5.0	0.0
10Jan2020	08:48	0.0	0.0	5.0	0.0
10Jan2020	08:54	0.0	0.0	5.0	0.0
10Jan2020	09:00	0.0	0.0	5.0	0.0
10Jan2020	09:06	0.0	0.0	5.0	0.0
10Jan2020	09:12	0.0	0.0	5.0	0.0
10Jan2020	09:18	0.0	0.0	5.0	0.0
10Jan2020	09:24	0.0	0.0	5.0	0.0
10Jan2020	09:30	0.0	0.0	5.0	0.0
10Jan2020	09:36	0.0	0.0	5.0	0.0
10Jan2020	09:42	0.0	0.0	5.0	0.0
10Jan2020	09:48	0.0	0.0	5.0	0.0
10Jan2020	09:54	0.0	0.0	5.0	0.0
10Jan2020	10:00	0.0	0.0	5.0	0.0
10Jan2020	10:06	0.0	0.0	5.0	0.0
10Jan2020	10:12	0.0	0.0	5.0	0.0
10Jan2020	10:18	0.0	0.0	5.0	0.0
10Jan2020	10:24	0.0	0.0	5.0	0.0
10Jan2020	10:30	0.0	0.0	5.0	0.0
10Jan2020	10:36	0.0	0.0	5.0	0.0
10Jan2020	10:42	0.0	0.0	5.0	0.0
10Jan2020	10:48	0.0	0.0	5.0	0.0
10Jan2020	10:54	0.0	0.0	5.0	0.0
10Jan2020	11:00	0.0	0.0	5.0	0.0
10Jan2020	11:06	0.0	0.0	5.0	0.0
10Jan2020	11:12	0.0	0.0	5.0	0.0
10Jan2020	11:18	0.0	0.0	5.0	0.0
10Jan2020	11:24	0.0	0.0	5.0	0.0
10Jan2020	11:30	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	11:36	0.0	0.0	5.0	0.0
10Jan2020	11:42	0.0	0.0	5.0	0.0
10Jan2020	11:48	0.0	0.0	5.0	0.0
10Jan2020	11:54	0.0	0.0	5.0	0.0
10Jan2020	12:00	0.0	0.0	5.0	0.0
10Jan2020	12:06	0.0	0.0	5.0	0.0
10Jan2020	12:12	0.0	0.0	5.0	0.0
10Jan2020	12:18	0.0	0.0	5.0	0.0
10Jan2020	12:24	0.0	0.0	5.0	0.0
10Jan2020	12:30	0.0	0.0	5.0	0.0
10Jan2020	12:36	0.0	0.0	5.0	0.0
10Jan2020	12:42	0.0	0.0	5.0	0.0
10Jan2020	12:48	0.0	0.0	5.0	0.0
10Jan2020	12:54	0.0	0.0	5.0	0.0
10Jan2020	13:00	0.0	0.0	5.0	0.0
10Jan2020	13:06	0.0	0.0	5.0	0.0
10Jan2020	13:12	0.0	0.0	5.0	0.0
10Jan2020	13:18	0.0	0.0	5.0	0.0
10Jan2020	13:24	0.0	0.0	5.0	0.0
10Jan2020	13:30	0.0	0.0	5.0	0.0
10Jan2020	13:36	0.0	0.0	5.0	0.0
10Jan2020	13:42	0.0	0.0	5.0	0.0
10Jan2020	13:48	0.0	0.0	5.0	0.0
10Jan2020	13:54	0.0	0.0	5.0	0.0
10Jan2020	14:00	0.0	0.0	5.0	0.0
10Jan2020	14:06	0.0	0.0	5.0	0.0
10Jan2020	14:12	0.0	0.0	5.0	0.0
10Jan2020	14:18	0.0	0.0	5.0	0.0
10Jan2020	14:24	0.0	0.0	5.0	0.0
10Jan2020	14:30	0.0	0.0	5.0	0.0
10Jan2020	14:36	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	14:42	0.1	0.0	5.0	0.0
10Jan2020	14:48	0.1	0.0	5.0	0.0
10Jan2020	14:54	0.1	0.0	5.0	0.0
10Jan2020	15:00	0.1	0.0	5.0	0.0
10Jan2020	15:06	0.2	0.0	5.0	0.0
10Jan2020	15:12	0.2	0.0	5.0	0.0
10Jan2020	15:18	0.3	0.0	5.0	0.0
10Jan2020	15:24	0.4	0.0	5.1	0.0
10Jan2020	15:30	0.5	0.0	5.1	0.0
10Jan2020	15:36	0.6	0.0	5.1	0.0
10Jan2020	15:42	0.8	0.0	5.1	0.0
10Jan2020	15:48	1.1	0.0	5.1	0.0
10Jan2020	15:54	1.8	0.1	5.1	0.0
10Jan2020	16:00	2.9	0.1	5.2	0.0
10Jan2020	16:06	4.4	0.1	5.2	0.0
10Jan2020	16:12	6.2	0.2	5.3	0.0
10Jan2020	16:18	7.7	0.2	5.4	0.0
10Jan2020	16:24	8.7	0.3	5.6	0.0
10Jan2020	16:30	9.0	0.4	5.7	0.0
10Jan2020	16:36	8.9	0.4	5.8	0.0
10Jan2020	16:42	8.4	0.5	6.0	0.0
10Jan2020	16:48	7.7	0.6	6.1	0.0
10Jan2020	16:54	6.9	0.6	6.2	0.0
10Jan2020	17:00	6.3	0.7	6.3	0.0
10Jan2020	17:06	5.8	0.7	6.4	0.0
10Jan2020	17:12	5.3	0.8	6.5	0.0
10Jan2020	17:18	4.9	0.8	6.6	0.0
10Jan2020	17:24	4.6	0.9	6.7	0.0
10Jan2020	17:30	4.3	0.9	6.8	0.0
10Jan2020	17:36	4.1	0.9	6.8	0.0
10Jan2020	17:42	3.9	1.0	6.9	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	17:48	3.7	1.0	7.0	0.0
10Jan2020	17:54	3.6	1.0	7.0	0.0
10Jan2020	18:00	3.5	1.1	7.1	0.0
10Jan2020	18:06	3.3	1.1	7.1	0.0
10Jan2020	18:12	3.3	1.1	7.2	0.0
10Jan2020	18:18	3.2	1.1	7.2	0.0
10Jan2020	18:24	3.1	1.2	7.3	0.0
10Jan2020	18:30	3.0	1.2	7.3	0.0
10Jan2020	18:36	3.0	1.2	7.4	0.0
10Jan2020	18:42	2.9	1.2	7.4	0.0
10Jan2020	18:48	2.8	1.3	7.5	0.0
10Jan2020	18:54	2.8	1.3	7.5	0.0
10Jan2020	19:00	2.7	1.3	7.5	0.0
10Jan2020	19:06	2.7	1.3	7.6	0.0
10Jan2020	19:12	2.6	1.3	7.6	0.0
10Jan2020	19:18	2.6	1.4	7.6	0.0
10Jan2020	19:24	2.5	1.4	7.6	0.0
10Jan2020	19:30	2.5	1.4	7.6	0.0
10Jan2020	19:36	2.5	1.4	7.7	0.0
10Jan2020	19:42	2.4	1.5	7.7	0.0
10Jan2020	19:48	2.4	1.5	7.7	0.0
10Jan2020	19:54	2.3	1.5	7.7	0.0
10Jan2020	20:00	2.3	1.5	7.7	0.0
10Jan2020	20:06	2.2	1.5	7.8	0.0
10Jan2020	20:12	2.2	1.5	7.8	0.0
10Jan2020	20:18	2.1	1.6	7.8	0.0
10Jan2020	20:24	2.1	1.6	7.8	0.0
10Jan2020	20:30	2.1	1.6	7.8	0.0
10Jan2020	20:36	2.0	1.6	7.8	0.0
10Jan2020	20:42	2.0	1.6	7.9	0.0
10Jan2020	20:48	2.0	1.6	7.9	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	20:54	1.9	1.7	7.9	0.0
10Jan2020	21:00	1.9	1.7	7.9	0.0
10Jan2020	21:06	1.9	1.7	7.9	0.0
10Jan2020	21:12	1.9	1.7	7.9	0.0
10Jan2020	21:18	1.9	1.7	8.0	0.0
10Jan2020	21:24	1.9	1.7	8.0	0.0
10Jan2020	21:30	1.9	1.8	8.0	0.0
10Jan2020	21:36	1.9	1.8	8.0	0.0
10Jan2020	21:42	1.9	1.8	8.0	0.0
10Jan2020	21:48	1.8	1.8	8.0	0.0
10Jan2020	21:54	1.8	1.8	8.1	0.0
10Jan2020	22:00	1.8	1.8	8.1	0.0
10Jan2020	22:06	1.8	1.8	8.1	0.0
10Jan2020	22:12	1.8	1.9	8.1	0.0
10Jan2020	22:18	1.8	1.9	8.1	0.0
10Jan2020	22:24	1.8	1.9	8.1	0.0
10Jan2020	22:30	1.8	1.9	8.1	0.0
10Jan2020	22:36	1.8	1.9	8.2	0.0
10Jan2020	22:42	1.8	1.9	8.2	0.0
10Jan2020	22:48	1.8	2.0	8.2	0.0
10Jan2020	22:54	1.8	2.0	8.2	0.0
10Jan2020	23:00	1.7	2.0	8.2	0.0
10Jan2020	23:06	1.7	2.0	8.2	0.0
10Jan2020	23:12	1.7	2.0	8.2	0.0
10Jan2020	23:18	1.7	2.0	8.3	0.0
10Jan2020	23:24	1.7	2.0	8.3	0.0
10Jan2020	23:30	1.7	2.1	8.3	0.0
10Jan2020	23:36	1.7	2.1	8.3	0.0
10Jan2020	23:42	1.7	2.1	8.3	0.0
10Jan2020	23:48	1.7	2.1	8.3	0.0
10Jan2020	23:54	1.7	2.1	8.3	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	00:00	1.7	2.1	8.4	0.0
11Jan2020	00:06	1.6	2.1	8.4	0.0
11Jan2020	00:12	1.6	2.2	8.4	0.0
11Jan2020	00:18	1.6	2.2	8.4	0.0
11Jan2020	00:24	1.6	2.2	8.4	0.0
11Jan2020	00:30	1.6	2.2	8.4	0.0
11Jan2020	00:36	1.6	2.2	8.4	0.0
11Jan2020	00:42	1.6	2.2	8.5	0.0
11Jan2020	00:48	1.6	2.2	8.5	0.0
11Jan2020	00:54	1.6	2.2	8.5	0.0
11Jan2020	01:00	1.6	2.3	8.5	0.0
11Jan2020	01:06	1.6	2.3	8.5	0.0
11Jan2020	01:12	1.5	2.3	8.5	0.0
11Jan2020	01:18	1.5	2.3	8.5	0.0
11Jan2020	01:24	1.5	2.3	8.5	0.0
11Jan2020	01:30	1.5	2.3	8.6	0.0
11Jan2020	01:36	1.5	2.3	8.6	0.0
11Jan2020	01:42	1.5	2.3	8.6	0.0
11Jan2020	01:48	1.5	2.4	8.6	0.0
11Jan2020	01:54	1.5	2.4	8.6	0.0
11Jan2020	02:00	1.5	2.4	8.6	0.0
11Jan2020	02:06	1.4	2.4	8.6	0.0
11Jan2020	02:12	1.4	2.4	8.6	0.0
11Jan2020	02:18	1.4	2.4	8.6	0.0
11Jan2020	02:24	1.4	2.4	8.7	0.0
11Jan2020	02:30	1.4	2.4	8.7	0.0
11Jan2020	02:36	1.4	2.5	8.7	0.0
11Jan2020	02:42	1.4	2.5	8.7	0.0
11Jan2020	02:48	1.4	2.5	8.7	0.0
11Jan2020	02:54	1.4	2.5	8.7	0.0
11Jan2020	03:00	1.3	2.5	8.7	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	03:06	1.3	2.5	8.7	0.0
11Jan2020	03:12	1.3	2.5	8.8	0.0
11Jan2020	03:18	1.3	2.5	8.8	0.0
11Jan2020	03:24	1.3	2.5	8.8	0.0
11Jan2020	03:30	1.3	2.6	8.8	0.0
11Jan2020	03:36	1.3	2.6	8.8	0.0
11Jan2020	03:42	1.3	2.6	8.8	0.0
11Jan2020	03:48	1.2	2.6	8.8	0.0
11Jan2020	03:54	1.2	2.6	8.8	0.0
11Jan2020	04:00	1.2	2.6	8.8	0.0
11Jan2020	04:06	1.2	2.6	8.8	0.0
11Jan2020	04:12	1.2	2.6	8.9	0.0
11Jan2020	04:18	1.2	2.6	8.9	0.0
11Jan2020	04:24	1.2	2.6	8.9	0.0
11Jan2020	04:30	1.2	2.7	8.9	0.0
11Jan2020	04:36	1.2	2.7	8.9	0.0
11Jan2020	04:42	1.1	2.7	8.9	0.0
11Jan2020	04:48	1.1	2.7	8.9	0.0
11Jan2020	04:54	1.1	2.7	8.9	0.0
11Jan2020	05:00	1.1	2.7	8.9	0.0
11Jan2020	05:06	1.1	2.7	8.9	0.0
11Jan2020	05:12	1.1	2.7	8.9	0.0
11Jan2020	05:18	1.1	2.7	9.0	0.0
11Jan2020	05:24	1.1	2.7	9.0	0.0
11Jan2020	05:30	1.0	2.7	9.0	0.0
11Jan2020	05:36	1.0	2.8	9.0	0.0
11Jan2020	05:42	1.0	2.8	9.0	0.0
11Jan2020	05:48	1.0	2.8	9.0	0.0
11Jan2020	05:54	1.0	2.8	9.0	0.0
11Jan2020	06:00	1.0	2.8	9.0	0.0
11Jan2020	06:06	1.0	2.8	9.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	06:12	0.9	2.8	9.0	0.0
11Jan2020	06:18	0.9	2.8	9.0	0.0
11Jan2020	06:24	0.8	2.8	9.0	0.0
11Jan2020	06:30	0.7	2.8	9.1	0.0
11Jan2020	06:36	0.5	2.8	9.1	0.0
11Jan2020	06:42	0.4	2.8	9.1	0.0
11Jan2020	06:48	0.3	2.8	9.1	0.0
11Jan2020	06:54	0.2	2.8	9.1	0.0
11Jan2020	07:00	0.2	2.8	9.1	0.0
11Jan2020	07:06	0.1	2.8	9.1	0.0
11Jan2020	07:12	0.1	2.8	9.1	0.0
11Jan2020	07:18	0.1	2.8	9.1	0.0
11Jan2020	07:24	0.1	2.8	9.1	0.0
11Jan2020	07:30	0.0	2.8	9.1	0.0
11Jan2020	07:36	0.0	2.8	9.1	0.0
11Jan2020	07:42	0.0	2.8	9.1	0.0
11Jan2020	07:48	0.0	2.8	9.1	0.0
11Jan2020	07:54	0.0	2.8	9.1	0.0
11Jan2020	08:00	0.0	2.8	9.1	0.0
11Jan2020	08:06	0.0	2.8	9.1	0.0
11Jan2020	08:12	0.0	2.8	9.1	0.0
11Jan2020	08:18	0.0	2.8	9.1	0.0
11Jan2020	08:24	0.0	2.8	9.1	0.0
11Jan2020	08:30	0.0	2.8	9.1	0.0
11Jan2020	08:36	0.0	2.8	9.1	0.0
11Jan2020	08:42	0.0	2.8	9.1	0.0
11Jan2020	08:48	0.0	2.8	9.1	0.0
11Jan2020	08:54	0.0	2.8	9.1	0.0
11Jan2020	09:00	0.0	2.8	9.1	0.0
11Jan2020	09:06	0.0	2.8	9.1	0.0
11Jan2020	09:12	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	09:18	0.0	2.8	9.1	0.0
11Jan2020	09:24	0.0	2.8	9.1	0.0
11Jan2020	09:30	0.0	2.8	9.1	0.0
11Jan2020	09:36	0.0	2.8	9.1	0.0
11Jan2020	09:42	0.0	2.8	9.1	0.0
11Jan2020	09:48	0.0	2.8	9.1	0.0
11Jan2020	09:54	0.0	2.8	9.1	0.0
11Jan2020	10:00	0.0	2.8	9.1	0.0
11Jan2020	10:06	0.0	2.8	9.1	0.0
11Jan2020	10:12	0.0	2.8	9.1	0.0
11Jan2020	10:18	0.0	2.8	9.1	0.0
11Jan2020	10:24	0.0	2.8	9.1	0.0
11Jan2020	10:30	0.0	2.8	9.1	0.0
11Jan2020	10:36	0.0	2.8	9.1	0.0
11Jan2020	10:42	0.0	2.8	9.1	0.0
11Jan2020	10:48	0.0	2.8	9.1	0.0
11Jan2020	10:54	0.0	2.8	9.1	0.0
11Jan2020	11:00	0.0	2.8	9.1	0.0
11Jan2020	11:06	0.0	2.8	9.1	0.0
11Jan2020	11:12	0.0	2.8	9.1	0.0
11Jan2020	11:18	0.0	2.8	9.1	0.0
11Jan2020	11:24	0.0	2.8	9.1	0.0
11Jan2020	11:30	0.0	2.8	9.1	0.0
11Jan2020	11:36	0.0	2.8	9.1	0.0
11Jan2020	11:42	0.0	2.8	9.1	0.0
11Jan2020	11:48	0.0	2.8	9.1	0.0
11Jan2020	11:54	0.0	2.8	9.1	0.0
11Jan2020	12:00	0.0	2.8	9.1	0.0
11Jan2020	12:06	0.0	2.8	9.1	0.0
11Jan2020	12:12	0.0	2.8	9.1	0.0
11Jan2020	12:18	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	12:24	0.0	2.8	9.1	0.0
11Jan2020	12:30	0.0	2.8	9.1	0.0
11Jan2020	12:36	0.0	2.8	9.1	0.0
11Jan2020	12:42	0.0	2.8	9.1	0.0
11Jan2020	12:48	0.0	2.8	9.1	0.0
11Jan2020	12:54	0.0	2.8	9.1	0.0
11Jan2020	13:00	0.0	2.8	9.1	0.0
11Jan2020	13:06	0.0	2.8	9.1	0.0
11Jan2020	13:12	0.0	2.8	9.1	0.0
11Jan2020	13:18	0.0	2.8	9.1	0.0
11Jan2020	13:24	0.0	2.8	9.1	0.0
11Jan2020	13:30	0.0	2.8	9.1	0.0
11Jan2020	13:36	0.0	2.8	9.1	0.0
11Jan2020	13:42	0.0	2.8	9.1	0.0
11Jan2020	13:48	0.0	2.8	9.1	0.0
11Jan2020	13:54	0.0	2.8	9.1	0.0
11Jan2020	14:00	0.0	2.8	9.1	0.0
11Jan2020	14:06	0.0	2.8	9.1	0.0
11Jan2020	14:12	0.0	2.8	9.1	0.0
11Jan2020	14:18	0.0	2.8	9.1	0.0
11Jan2020	14:24	0.0	2.8	9.1	0.0
11Jan2020	14:30	0.0	2.8	9.1	0.0
11Jan2020	14:36	0.0	2.8	9.1	0.0
11Jan2020	14:42	0.0	2.8	9.1	0.0
11Jan2020	14:48	0.0	2.8	9.1	0.0
11Jan2020	14:54	0.0	2.8	9.1	0.0
11Jan2020	15:00	0.0	2.8	9.1	0.0
11Jan2020	15:06	0.0	2.8	9.1	0.0
11Jan2020	15:12	0.0	2.8	9.1	0.0
11Jan2020	15:18	0.0	2.8	9.1	0.0
11Jan2020	15:24	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	15:30	0.0	2.8	9.1	0.0
11Jan2020	15:36	0.0	2.8	9.1	0.0
11Jan2020	15:42	0.0	2.8	9.1	0.0
11Jan2020	15:48	0.0	2.8	9.1	0.0
11Jan2020	15:54	0.0	2.8	9.1	0.0
11Jan2020	16:00	0.0	2.8	9.1	0.0
11Jan2020	16:06	0.0	2.8	9.1	0.0
11Jan2020	16:12	0.0	2.8	9.1	0.0
11Jan2020	16:18	0.0	2.8	9.1	0.0
11Jan2020	16:24	0.0	2.8	9.1	0.0
11Jan2020	16:30	0.0	2.8	9.1	0.0
11Jan2020	16:36	0.0	2.8	9.1	0.0
11Jan2020	16:42	0.0	2.8	9.1	0.0
11Jan2020	16:48	0.0	2.8	9.1	0.0
11Jan2020	16:54	0.0	2.8	9.1	0.0
11Jan2020	17:00	0.0	2.8	9.1	0.0
11Jan2020	17:06	0.0	2.8	9.1	0.0
11Jan2020	17:12	0.0	2.8	9.1	0.0
11Jan2020	17:18	0.0	2.8	9.1	0.0
11Jan2020	17:24	0.0	2.8	9.1	0.0
11Jan2020	17:30	0.0	2.8	9.1	0.0
11Jan2020	17:36	0.0	2.8	9.1	0.0
11Jan2020	17:42	0.0	2.8	9.1	0.0
11Jan2020	17:48	0.0	2.8	9.1	0.0
11Jan2020	17:54	0.0	2.8	9.1	0.0
11Jan2020	18:00	0.0	2.8	9.1	0.0
11Jan2020	18:06	0.0	2.8	9.1	0.0
11Jan2020	18:12	0.0	2.8	9.1	0.0
11Jan2020	18:18	0.0	2.8	9.1	0.0
11Jan2020	18:24	0.0	2.8	9.1	0.0
11Jan2020	18:30	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	18:36	0.0	2.8	9.1	0.0
11Jan2020	18:42	0.0	2.8	9.1	0.0
11Jan2020	18:48	0.0	2.8	9.1	0.0
11Jan2020	18:54	0.0	2.8	9.1	0.0
11Jan2020	19:00	0.0	2.8	9.1	0.0
11Jan2020	19:06	0.0	2.8	9.1	0.0
11Jan2020	19:12	0.0	2.8	9.1	0.0
11Jan2020	19:18	0.0	2.8	9.1	0.0
11Jan2020	19:24	0.0	2.8	9.1	0.0
11Jan2020	19:30	0.0	2.8	9.1	0.0
11Jan2020	19:36	0.0	2.8	9.1	0.0
11Jan2020	19:42	0.0	2.8	9.1	0.0
11Jan2020	19:48	0.0	2.8	9.1	0.0
11Jan2020	19:54	0.0	2.8	9.1	0.0
11Jan2020	20:00	0.0	2.8	9.1	0.0
11Jan2020	20:06	0.0	2.8	9.1	0.0
11Jan2020	20:12	0.0	2.8	9.1	0.0
11Jan2020	20:18	0.0	2.8	9.1	0.0
11Jan2020	20:24	0.0	2.8	9.1	0.0
11Jan2020	20:30	0.0	2.8	9.1	0.0
11Jan2020	20:36	0.0	2.8	9.1	0.0
11Jan2020	20:42	0.0	2.8	9.1	0.0
11Jan2020	20:48	0.0	2.8	9.1	0.0
11Jan2020	20:54	0.0	2.8	9.1	0.0
11Jan2020	21:00	0.0	2.8	9.1	0.0
11Jan2020	21:06	0.0	2.8	9.1	0.0
11Jan2020	21:12	0.0	2.8	9.1	0.0
11Jan2020	21:18	0.0	2.8	9.1	0.0
11Jan2020	21:24	0.0	2.8	9.1	0.0
11Jan2020	21:30	0.0	2.8	9.1	0.0
11Jan2020	21:36	0.0	2.8	9.1	0.0

Radback Tenaska project stormwater Analysis JZ 3/4/09

project # 163994 # of pages: 9

52.5406.1003

Attachment 3

Reference 2

select pages

Chapter 2 Estimating Runoff

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull elevation.

Chapter 3 Time of Concentration and Travel Time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[eq. 3-2]}$$

where:

T_c = time of concentration (hr)
m = number of flow segments

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow

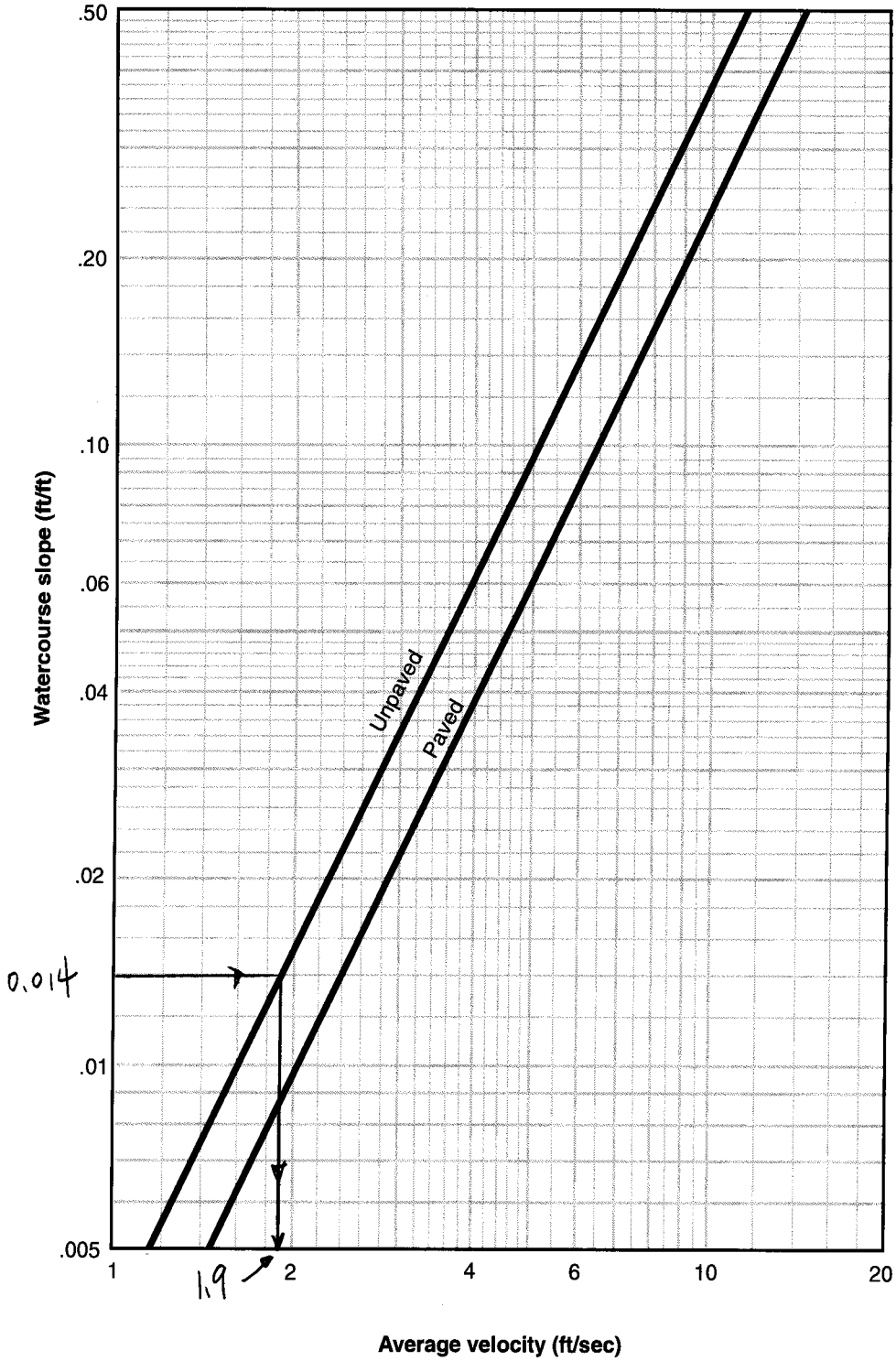
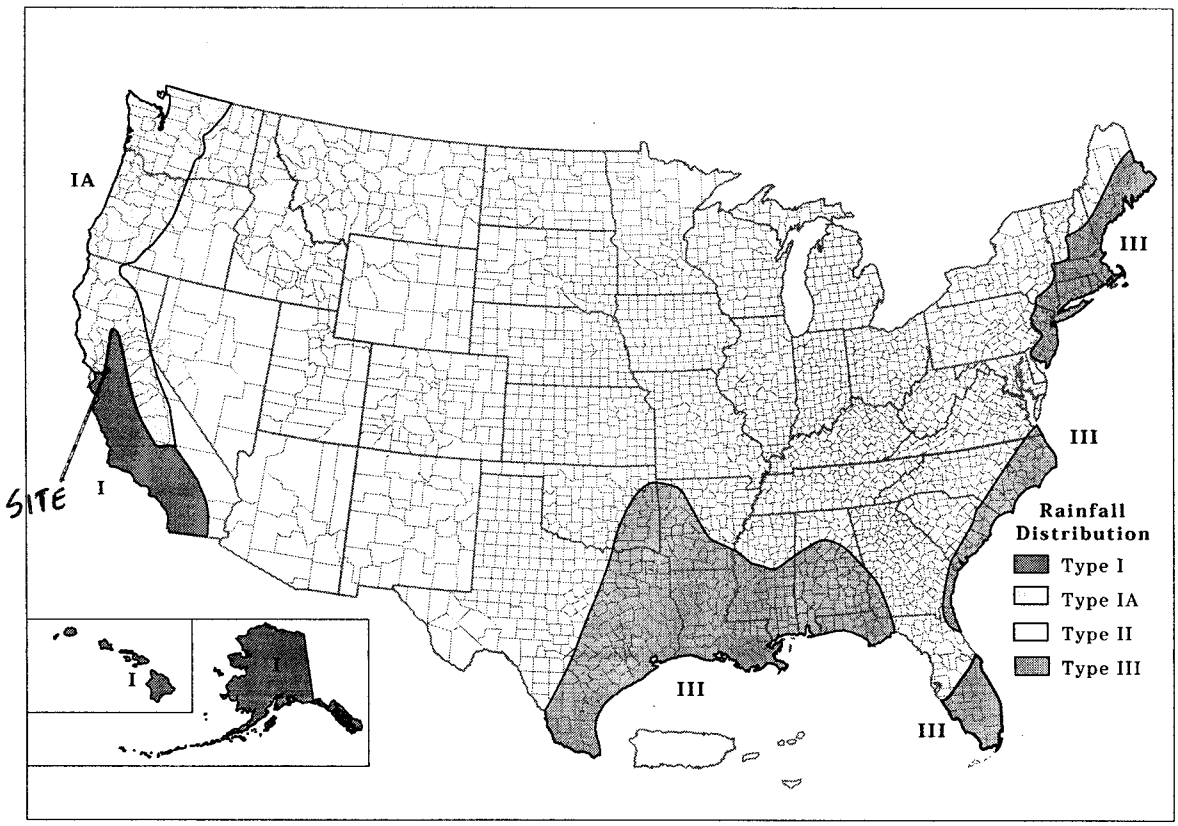


Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Radback Tenaska project Stormwater Analysis JT 3/4/09

project # 163994

# of pages : 5

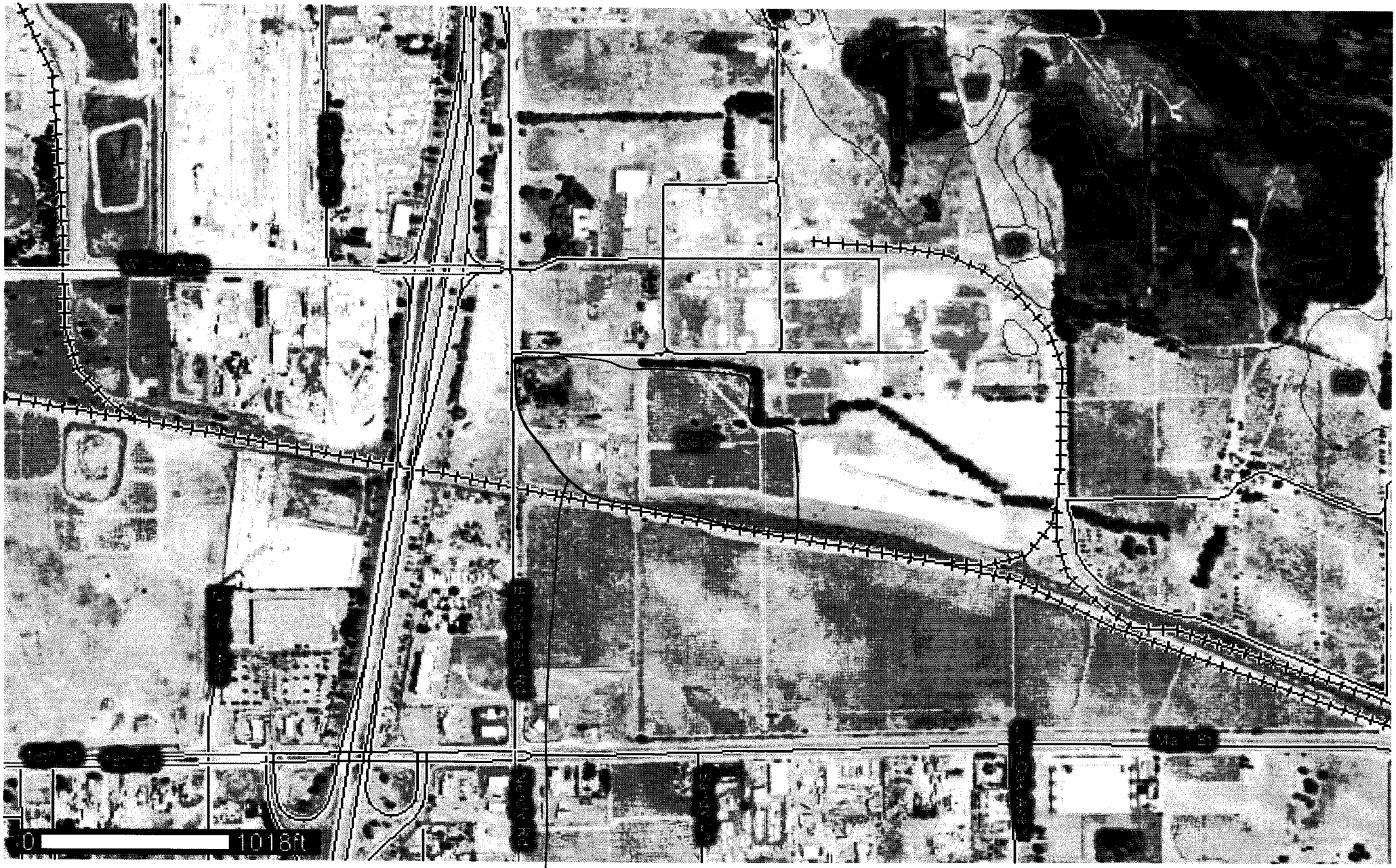
53, 5406, 1003

Attachment 4

Reference 6

Select pages

(printed out from the Online Web soil survey)



Project site

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series.* All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 67

Project Name: Tenaska Contra Costa Generating Station Project No.: 163994

Calculation Title: Soil Erosion Control

Calculation No./File No.: 52.5406.1004

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To design the site's Best Management Practices (BMP) for soil erosion and sediment control.

Unverified Assumptions Requiring Subsequent Verification			
No.	Assumption	Verified By	Date

See Page _____ of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: _____ Version: _____

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval						
Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	P. L. Nelson	3 Apr 2009	Jimmy Zhong	4/3/09	P L Nelson	4/3/09

Purpose

To design the site's Best Management Practices (BMP) for soil erosion and sediment control.

References

1. US Dept of Agriculture, Natural Resources Conservation Services (NRCS), Web Soil Survey.
2. Black & Veatch Drawing:
   - 163994-SS-3101, Rev. A, "Soil Erosion Control Site, Plan Sheet 1"
   - 163994-SS-3102, Rev. A, "Soil Erosion Control Site, Plan Sheet 2"
   - 163994-SS-3150, Rev. A, "Soil Erosion Control Site, Sections and Details"
3. California Stormwater Quality Association, California Stormwater Best Management Practice (BMP) Construction Handbook, January 2003.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)

Drainage area in acres (ac)

Assumptions

Contained in the body of the calculation.

Attachments

1. NRCS Soil Survey
2. Black & Veatch Drawings SS-3101, SS-3102 and SS-3150
3. Reference 2 – Select Pages

Summary

As noted on the drawings and in this calculation, the project site meets the requirements of the California Stormwater Quality Association (CSQA), California Stormwater Best Management Practice (BMP) Construction Handbook.

Site Location

The site is located on the border of Antioch and Oakley California at a former industrial facility. The site previously had no buildings, process equipment or other facilities when the industrial facility was in operation. The main site is currently a vineyard with a row of eucalyptus trees along the north east corner. The site appears to be tilled once or twice a year. Soil is Delhi sand (dune sand) and has a high to very high water transmission rate (Ref 1 and attachment 1). The laydown area was disturbed by industrial facility activities in the form of asphalt paving in the northeast portion. The paved area will be used as-is for temporary storage of materials and equipment. The remainder of the laydown area is currently sparse vegetation to bare soil very similar in nature to the main plant area. ✓

Main Plant Site Design (Dwg SS-3101)

The site drainage design is required to meet Contra Costa Clean Water Program's Stormwater C.3 Guidebook, Stormwater Quality Requirements for Development Applications, Fourth Edition. The vast majority of stormwater runoff will be directed to bioswales for both runoff rate control and water quality improvement. The main plant site will utilize hydraulic mulch, hydroseeding, geotextiles & mats, velocity dissipation devices, silt fence, fiber rolls, storm drain inlet protection and stabilized construction roadway. General details and facts about each BMP are noted in attachment 3. Project specific details are shown in attachment 2 along with plan drawing SS-3101. ✓

Laydown Area Design (Dwg SS-3101)

The laydown area drainage design will meet the same requirements as the main plant site. The stormwater drainage from the asphalt paved area will not be modified. Silt fence wil be placed along the edge to capture any soil from construction traffic deposited on the asphalt. The soil area will be graded to drain to a bioswale down the middle of the laydown area. The bioswale will be pumped as needed to prevent over topping of the bioswale due to a lack of a gravity outlet. BMPs will include hydraulic mulch, hydroseeding, geotextiles & mats, soil binder, silt fence, fiber rolls and stabilized construction roadway. See plan drawing SS-3102 (attachment 2) for further details.

General Construction Sequence

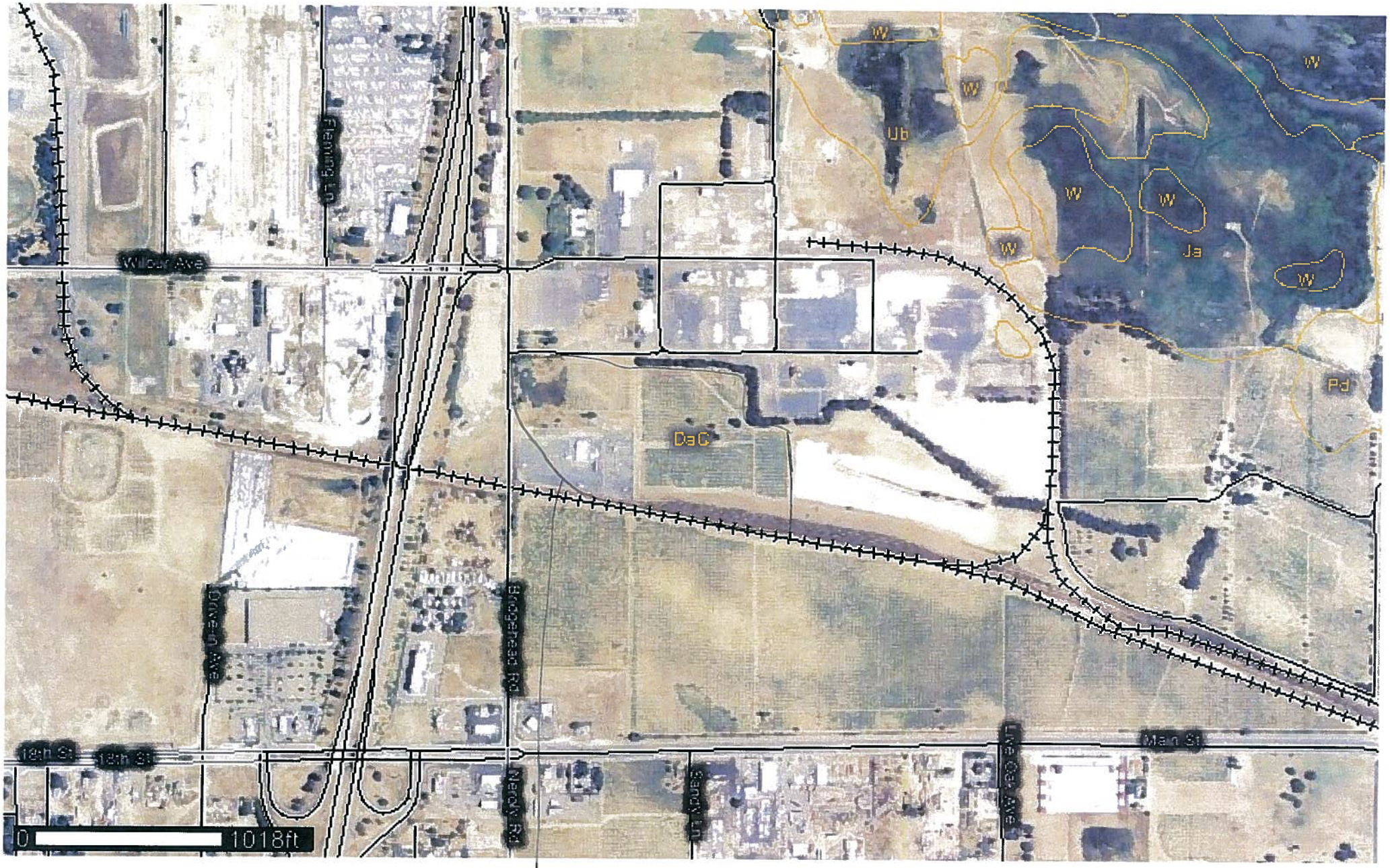
1. Install silt fence and stabilized construction entrances/exits as indicated on the drawings. Construction contractor may temporarily install an additional construction entrance/exit based on the details of the site grading equipment/methods utilized.

2. Install bioswales starting at the lowest elevations and working toward higher elevations. No more soil shall be disturbed than is required to building the facilities lowest in elevation first. Stabilize bioswales and slopes adjacent to conservation easement area as soon as practical in the grading process. Install fiber rolls along top of bioswales at the same time as installing hydroseeding and geotextiles/mats. Fiber rolls may be removed once vegetation obtains 70% coverage within the bioswales. ✓
3. Install storm sewer and catch basin in conjunction with other underground utilities. Place inlet protection on each catch basin and velocity dissipation devices on sewer outlets as each item is installed.
4. Install aggregate roads and maintain construction entrances/exits as required.
5. Install aggregate area surfacing and remaining vegetation/landscaping as project construction permits.

Attachment 1

NRCS Web Soil Survey

4 pages



Project site

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

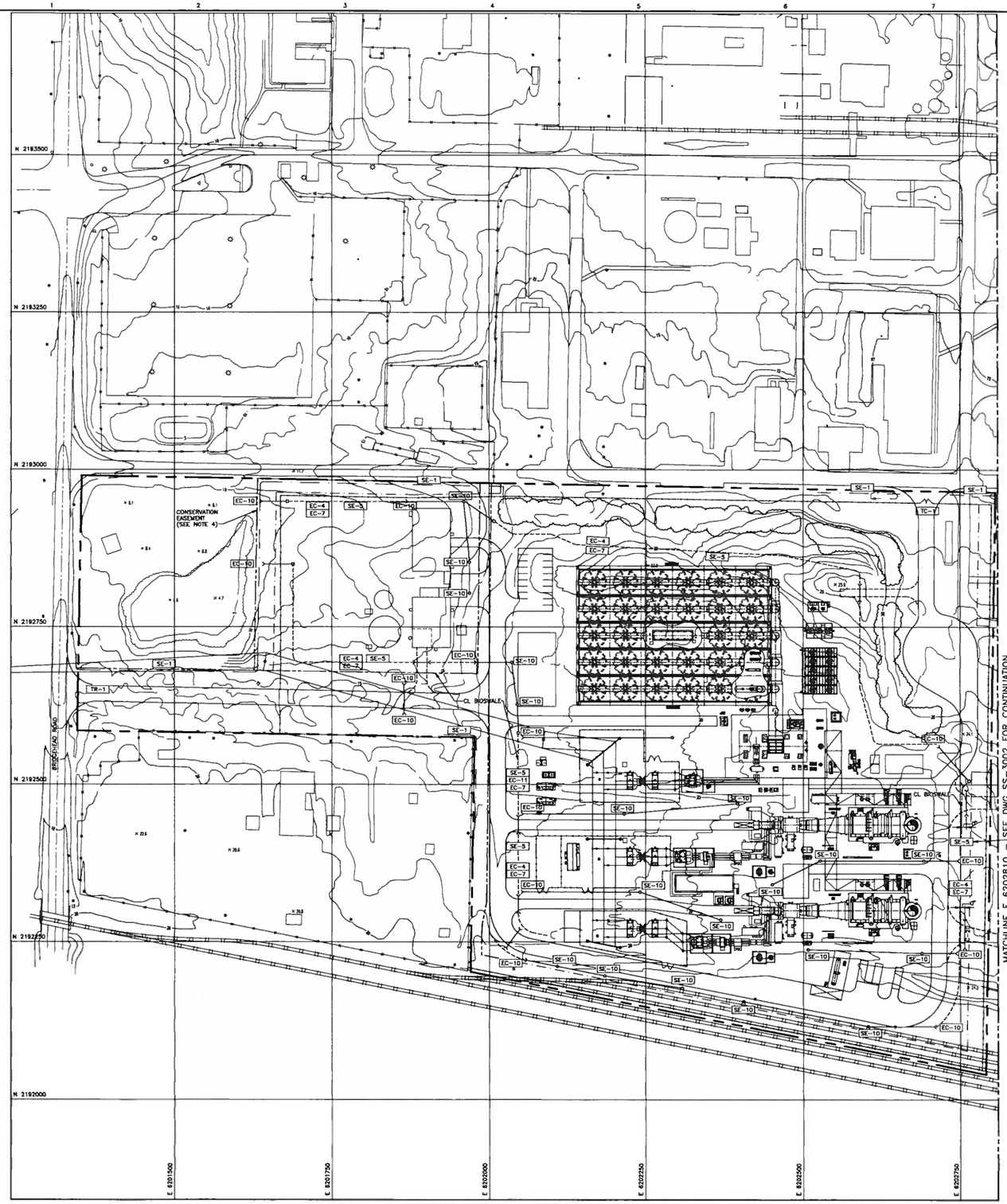
Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Attachment 2

B+V Design Dwgs

3 pages



OPEN
04/01/09

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. SEE DWG SS-3001 FOR GRADING & DRAINAGE PLAN
3. SEE DWG SS-3150 FOR SOIL EROSION CONTROL SECTIONS AND DETAILS.
4. NO CONSTRUCTION ACTIVITY SHALL OCCUR WITHIN CONSERVATION EASEMENT.
5. SE-5 MAY BE REMOVED AFTER BIOSWALE GRASS OBTAINS 70% COVERAGE.
6. SEE DWG SS-3201 FOR SITE SURFACING PLAN. ALL GRASS OR LANDSCAPE AREAS SHALL BE SEEDED AND FERTILIZED EC-4 AND COVERED WITH HYDRAULIC MULCH EC-3

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
A	OPEN		MAB	PLN	PLN	DVN	

SCALE: 1" = 60' (60' 30' 0 60' 120')

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.
SIGNED _____
DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

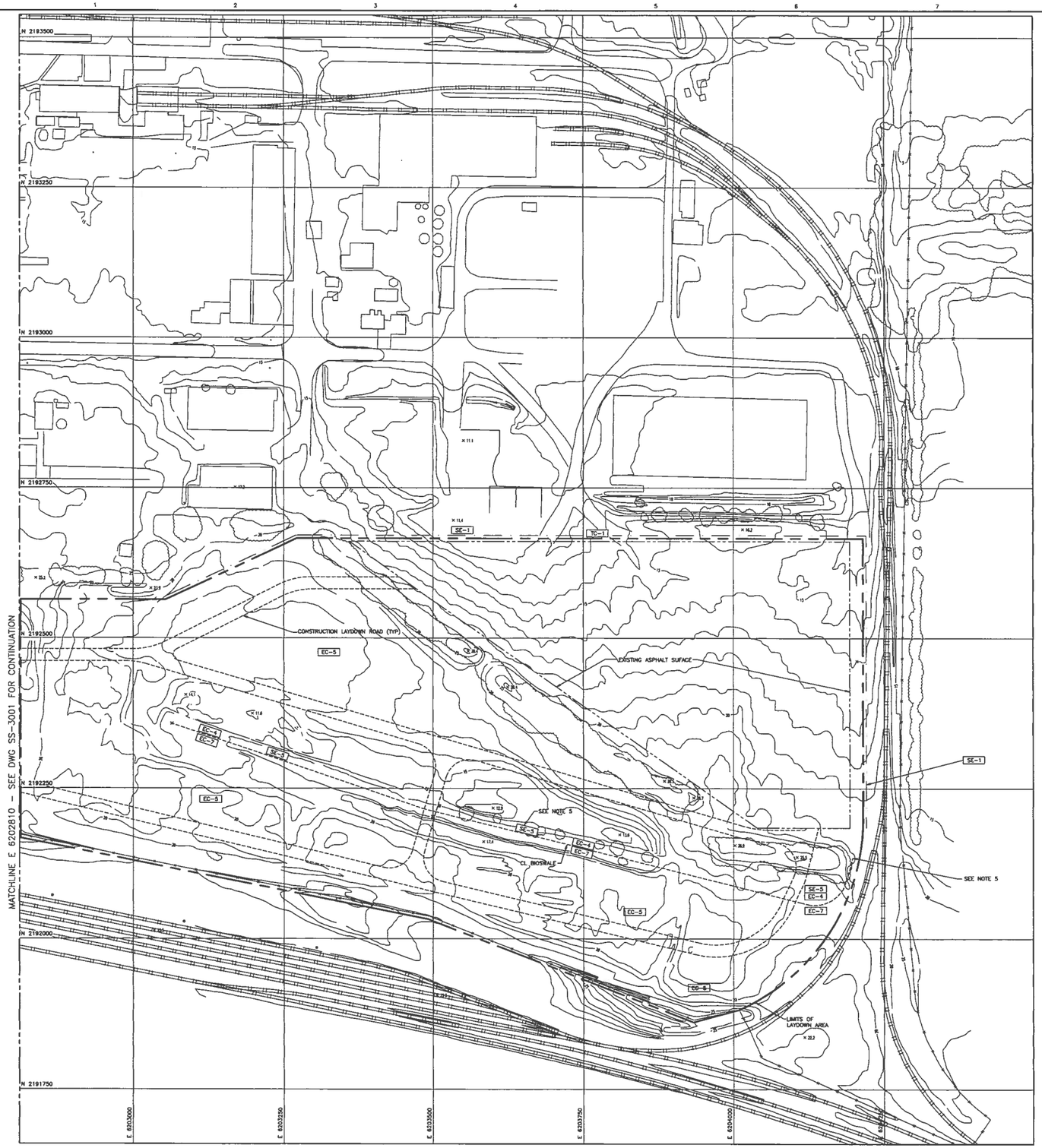
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SOIL EROSION CONTROL – SITE PLAN – SHEET 1

PROJECT DRAWING NUMBER: 163994–SS–3101
REV: A
CODE
AREA

SPU37182
AUG/07/09 E1
AUG/07/09 1=1
ACAD 16.1s (LMS Tech)
1=1
1=48.2



OPEN

04/02/09

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. SEE DWG SS-3002 FOR GRADING & DRAINAGE PLAN
3. SEE DWG SS-3150 FOR SOIL EROSION CONTROL SECTIONS AND DETAILS.
4. SEE DWG SS-3202 FOR SITE SURFACING PLAN.
5. A TEMPORARY 2000 GPM PUMP SHALL BE INSTALLED AND STARTED WHEN WATER LEVEL REACHES EL 16.5. PUMP SHALL DISCHARGE TO NATURAL DRAINAGE EAST OF RAILROAD TRACKS.
6. SE-5 MAY BE REMOVED AFTER BIOSWALE GRASS OBTAINS 70% COVERAGE.
7. SOIL BINDER EC-5 SHOULD BE APPLIED PRIOR TO STORAGE OF MATERIAL OR EQUIPMENT.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	PLN	APP
A	OPEN		NAW				PLN	VW

60' 30' 0 60' 120'
1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

SIGNED _____
DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

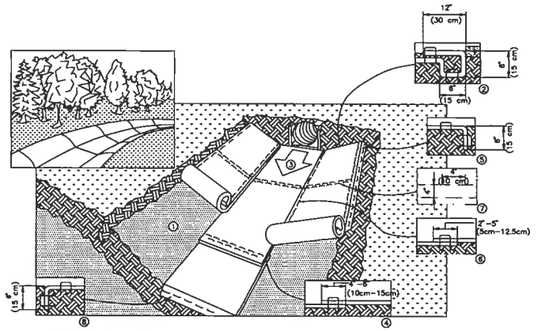
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

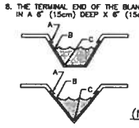
SOIL EROSION CONTROL – SITE PLAN – SHEET 2

PROJECT DRAWING NUMBER: 163994–SS–3102
REV: A
CODE
AREA

ACAD 18.1s (LMS Tech)
SPU37182 E1
A1APLOT7 1=1
04/08/09 14:48:23



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL CENTER BLANKET IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING OPTIONAL DOT SYSTEM™ STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE BLANKETS END OVER END (SHINGLE STYLE) WITH A 4"-6" (10cm-15cm) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10cm) APART AND 4" (10cm) ON CENTER TO SECURE BLANKETS.
5. FULL LENGTH EDGE OF BLANKETS AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT BLANKETS MUST BE OVERLAPPED APPROXIMATELY 2"-5" (5cm-12.5cm) (DEPENDING ON BLANKET TYPE) AND STAPLED. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH ON THE BLANKET BEING OVERLAPPED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (8m-12m) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10cm) APART AND 4" (10cm) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE BLANKETS MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.



CRITICAL POINTS

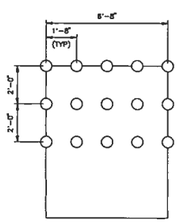
A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTE:
- HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.

** IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 8" (15 cm) MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

EC-7 EROSION BLANKET INSTALLATION (NORTH AMERICAN GREEN SC150BN OR S150 BN)

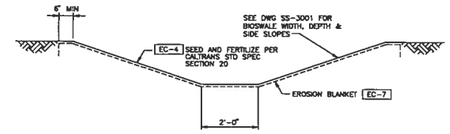
NO SCALE
SEE THIS DWG



NOTE:
USE 3.4 STAPLES PER SQ YD WITH 8", 11 GA WIRE "U" STAPLES.
FOR LOOSE SOILS USE STAPLES 8" AND LONGER.
FOR HARD OR ROCKY SOILS USE 9 GA STAPLES OR HEAVIER.
SECURE BLANKETS TO SOIL BY PLACING A STAPLE/STAKE THROUGH EACH WHITE COLORED CIRCLE.

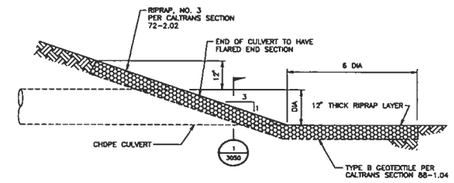
STAPLE PATTERN "D" FOR EROSION BLANKET

NO SCALE
SEE THIS DWG



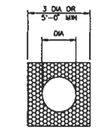
TYPICAL BIOSWALE EROSION PROTECTION

NO SCALE



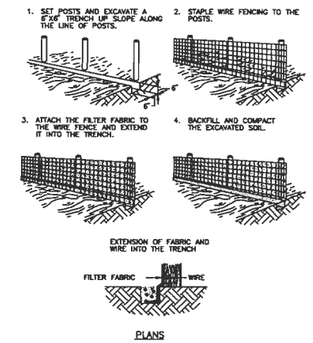
EC-10 TYPICAL STORM DRAIN PIPING INLET/OUTLET PROTECTION

NO SCALE



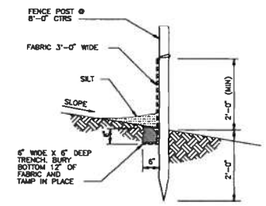
SECTION 1

NO SCALE

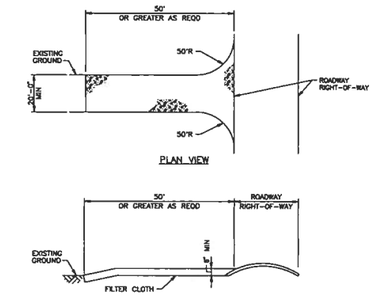


SE-1 SILT FENCE DETAIL

NO SCALE

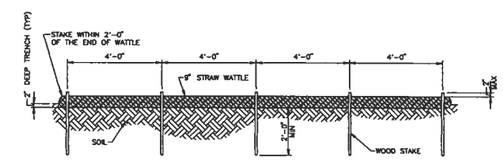


ELEVATION



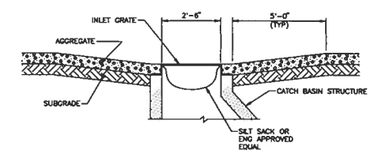
TC-1 TYPICAL STABILIZED CONSTRUCTION ENTRANCE

NO SCALE
SEE NOTE 2



SE-5 STRAW WATTLE DETAIL

NOT TO SCALE



SE-10 TYPICAL CATCH BASIN SEDIMENT FILTER

NOT TO SCALE

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. PROVIDE APPROPRIATE TRANSITION BETWEEN STABILIZED CONSTRUCTION ENTRANCE AND ROADWAY R.O.W.
3. DESIGN CRITERIA FOR STABILIZED CONSTRUCTION ENTRANCE.
   A. STONE SIZE - USE ASTM C-33, SIZE NO 2 OR 3, USE CRUSHED STONE.
   B. THICKNESS - NOT LESS THAN 8 INCHES.
   C. WIDTH - NOT LESS THAN FULL WIDTH OF POINTS OF INGRESS OR EGRESS.
   D. LENGTH - 50 FEET MINIMUM WHERE THE SOILS ARE SANDS OR GRAVEL OR 100 FEET MINIMUM WHERE SOILS ARE CLAYS OR SILTS, EXCEPT WHERE THE TRAVELED LENGTH IS LESS THAN 50 OR 100 FEET RESPECTIVELY. THESE LENGTHS MAY BE INCREASED WHERE FIELD CONDITIONS DICTATE.
   E. FILTER CLOTH - WILL BE PLACED OVER ENTIRE AREA PRIOR TO PLACING OF STONE.
   F. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ON TO PUBLIC RIGHT-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.

NOT TO BE USED FOR CONSTRUCTION

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
A	OPEN	ISSUED FOR	HAN	PLM	PLM	DVR	

60' 30' 0 60' 120'
SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLM DRAWN HAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SOIL EROSION CONTROL - SITE SECTIONS AND DETAILS

PROJECT DRAWING NUMBER 163994-SS-3150 REV A
CODE
AREA

SPU37182 ACAD 16.1s (LMS Tech)
A1A40107 E1
04/09/08 (11:03:28)

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 30

Project Name: Tenaska Project No.: 163994

Calculation Title: Storm Sewer Pipe Design

Calculation No./File No.: 52.5406.1005

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To verify the storm sewer pipes have sufficient capacity to convey the stormwater runoff for the design storm event for proposed Tenaska Contra Costa Generation Project.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page 2 of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: Version:

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	J Zhong Jimmy Zhong	April 15, 2009	P Nelson	4/15/09	P Nelson	4/15/09

Purpose

The design of storm sewer pipes for this project generally consist of two sizes - 12" diameter and 18" diameter. All the sewer pipes will be installed at a minimum of 0.4% slope. The purpose of this calculation is to verify the storm sewer pipes have sufficient capacity to convey the stormwater for a 10-year storm event. The two 18" diameter pipes which discharge directly to the wetland at the most downstream of bioswales will be sized based on a 50-year storm event due to bioswale sizing being based on a 30-year design event.

References

1. Black & Veatch Drawing:
   - 163994-SS-3001, Rev. 0, "Grading & Drainage - Site Plan - Sheet 1"
   - 163994-SS-3201, Rev. A, "Surfacing/Fencing/Roadway - Site Plan - Sheet 1"
   - 163994-SS-3050, Rev. 0, "Site Sections and Details"
   - 163994-SS-1002, Rev. 1, "General Arrangement – Site"
2. Roberson, Cassidy and Chaudhry; Hydraulic Engineering; John Wiley & Sons, Inc.; Second Edition; 1997.
3. US Department of Commerce; Rainfall Intensity-Duration-Frequency Curves; Technical Paper No. 25; December 1955.
4. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
5. Contra Costa Clean Water Program; Stormwater C.3 Guidebook; Stormwater Quality Requirements for Development Applications; Fourth Edition; September 10, 2008.
6. Mays, L. W.; Stormwater Collection Systems Design Handbook; McGraw-Hill; 2001.
7. Black & Veatch Calculation; Stormwater Analysis for Wetland; File No. 52.5406.1003; Same Project; March 2009.
8. Black & Veatch Calculation; IMP Sizing for Plant Area; File No. 52.5406.1002; Same Project; March 2009.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall intensity in inches per hour (inch/hr)

Drainage area in acres (ac)

B&V General Design Criteria

The following design items are based on standard practices used at B&V and engineering experience:

1. Use the Rational Method to determine the peak rate of run-off.

$$Q = CIA \quad \text{(cfs)} \qquad \text{(Ref. 2, Eq. 2-1)}$$

C = runoff coefficient
I = rainfall intensity (inch/hr)
A = drainage area (acres)

2. Per Ref. 4, Page 3-4, 0.1 hour (6 minutes) is the minimum time of concentration (T_c) used in TR-55 for a drainage basin. Per Ref. 6, Table 4.2, standard time of concentrations can be used for small, impervious areas. The recommended time of concentration is 5 minutes for "roof and property drainage", 5 minutes for "road inlet pits", and 10 minutes for "small areas less than 1 acre". Based on the above information, the minimum travel time to a yard catch basin within each drainage basin is set to be 6 minutes (0.1 hour).

3. Assume the project site is graded with slopes of approximately 0.5% for effective drainage of stormwater.

4. Slope storm sewer piping with a diameter of 12-inch and greater at a minimum of 0.4% which is typical for storm sewer design.

5. Design the storm sewer piping such that the full flow velocity through the piping will be greater than 2 ft/s and less than 8 ft/s.

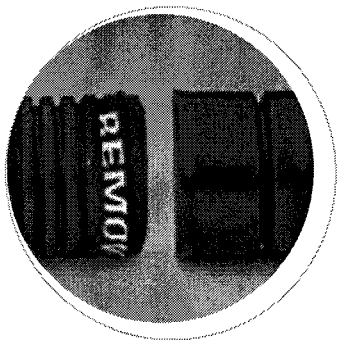
6. Use corrugated high-density polyethylene (CHDPE) pipes for typical storm sewer piping. Use Manning's "n" of 0.011 based on the product specification of HANCOR SURE-LOK® F477 (see Page 4).

Radback Tenaska project 163994
File # 52.5406.1005 page 4 of 30

Hancor®
Technology · Innovation · Solutions™

HANCOR SURE-LOK® WT PIPE SPECIFICATIONS

Diameter: 4" - 10" (100 - 250mm)
Length: 20' (6.1m)
Specifications: AASHTO M252, Type S
Joints: Bell-and-spigot
Gasket: Rubber, meeting ASTM F477



SCOPE

This specification describes 4" - 10" (100 - 250 mm) Hancor Sure-Lok WT pipe for use in non-pressure drainage applications.

PIPE REQUIREMENTS

Sure-Lok WT pipe shall have a smooth interior and annular exterior corrugations.

- 4" - 10" (100 - 250 mm) shall meet AASHTO M252, Type S.
- Manning's "n" value for use in design shall be 0.010 to 0.012. USE n = 0.011

JOINT PERFORMANCE

Pipe shall be joined with the Sure-Lok joint meeting the requirements of AASHTO M252. The joint shall be watertight according to the laboratory requirements of ASTM D3212. Joints shall remain watertight when subjected to a 1.5 degree axial misalignment.

Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477 with the addition that the gaskets shall not have any visible cracking when tested according to ASTM D1149 after 72 hour exposure in 50 PPHM ozone at 104° F (40° C).

Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

FITTINGS

4" - 10" (100 - 250 mm) fittings shall conform to AASHTO M252.

MATERIAL PROPERTIES

Virgin material for pipe and fitting production shall be high density polyethylene meeting ASTM D3350 minimum cell classification 324420C for 4" - 10" (100 - 250 mm) diameters.

INSTALLATION

Installation shall be in accordance with ASTM D2321 and Hancor's published installation guidelines; with the exception that minimum cover in trafficked areas shall be one-foot (0.3 m). Contact your local Hancor representative or visit our website at www.hancor.com for a copy of the latest installation guidelines.

PIPE DIMENSIONS

Nominal Pipe I.D., in. (mm)	4 (100)	6 (150)	8 (200)	10* (250)
Approx. Pipe O.D., in. (mm)	4.7 (119)	6.9 (175)	9.4 (239)	11.9 (303)
Approx. Pitch in. (mm)	0.6 (16)	0.7 (19)	1.0 (26)	13.1 (333)
Approx. Weight lb/ft. (kg/m)	0.33 (0.49)	1.0 (1.5)	1.5 (2.2)	3.0 (4.47)

*Check with sales representative for availability.

OFFICIAL PARTNER
DUCKS UNLIMITED

Hancor is an Official Partner of Ducks Unlimited, the world's leading wetland conservation organization.

All sales of Hancor product are subject to a limited warranty and purchasers are solely responsible for installation and use of Hancor products and determining whether a product is suited for any specific needs. Please consult a full copy of Hancor's Terms and Conditions for Sale for further details.

Direct Contact

Customer Service
888-FOR PIPE (367-7473)
Fax 888-FAX PIPE (329-7473) 24 hours a day

Application Engineering
For technical questions, call
800-2HANCOR (242-6267), ext. 809

Electronic Media

Web Site
For further details on product specifications, visit the Design Aids section of our On-Line Pipeline:
www.hancor.com

Hancor® and Sure-Lok® are registered trademarks of Hancor, Inc.
©2004 Hancor, Inc. 1900-478
#1121/0404

Project Specific Design Criteria

The following design items are specific to the project site:

1. Subdivide the individual drainage basins based on the following runoff categories:
   - Equipment/Roofs
   - Asphalt/Concrete Pavement
   - Gravel Surfacing (dense-graded aggregates)
   - Landscape/Grass
   - Transformer Containment
   - Open Graded Aggregates (ACC Area)

2. Use the following runoff coefficients (C) for the Rational Method (Ref. 5 and Ref. 8):
   - Equipment/Roofs = 1.00
   - Asphalt/Concrete Pavement = 1.00
   - Gravel Surfacing = 0.60
   - Landscape/Grass, Type A Soil = 0.10 (See Ref. 8 for Soil Classification)
   - Transformer Containment = 0.00
   - Open Graded Aggregates = 0.10

3. Use the rainfall intensity curves for Sacramento, California (Ref. 3) to determine the intensity for the project site as this project site is close to and has similar climate conditions as Sacramento, California.

Attachments

1. Black & Veatch Drawings SS-1002, SS-3001, SS-3201 and SS-3050
2. Reference 3 – Select Pages
3. Reference 4 – Select Pages
4. Reference 5 – Select Pages
5. Reference 6 – Select Pages

Summary

The 12" diameter storm sewer pipes were verified to have sufficient capacity to carry the peak runoff for a 10-year storm event. The 18" diameter storm sewer pipes at the end of the bioswales which discharge directly to the wetland (these pipes have the maximum flow rates among 18" diameter pipes) were verified to have sufficient capacity to carry the peak runoff for a 50-year storm event.

General

The design storm sewer pipes for this project generally consist of two sizes - 12" diameter and 18" diameter. All the sewer pipes will be installed at approximately 0.5% slope. The 12" diameter sewer pipes will drain to bioswales constructed near the perimeter of the plant. Two bioswale routes will be constructed to convey stormwater runoff to the wetland, one route along the north boundary of the plant site and the other one along the south boundary. See Drawing SS-3001 (Attachment 1). The bioswales will collect and infiltrate stormwater on site. Drop structures will be installed at the end of each bioswale such that sufficient depth (volume) of stormwater has to be collected in the bioswales before downstream discharge can happen.

18" diameter storm sewer pipes will be installed at the most downstream of bioswales along with drop structures to discharge any overflow to the wetland. The wetland is located on the west side of the conservation easement. 18" diameter pipes acting as culverts will be used to connect adjacent bioswales. See Drawing SS-3001 (Attachment 1).

Pipe Sizing - 12" Diameter

By examining individual drainage basins and their ground cover conditions, the storm sewer pipes C-5, C-6 and C-11 are considered to have the maximum flow rates among 12" diameter sewer pipes. The drainage areas for these three sewer pipes are delineated as shown on Page 10. These three areas will be utilized to verify that the 12" diameter storm sewer pipes have sufficient capacity to carry the peak flow.

Slope of Pipes C-5 and C-6: From SS-3050 (Attachment 1), the inlet invert EL is at 13.1; the outlet invert EL is at 12.9. The pipe is measured to be 52 feet long. Thus the slope = (13.1-12.9)/52 = 0.4%.

Slope of Pipe C-11: From SS-3050 (Attachment 1), the inlet invert EL is at 13.4; the outlet invert EL is at 12.6. The pipe is measured to be 185 feet long. Thus the slope = (13.4-12.6)/185 = 0.4%.

Use 0.4% as the slope of the pipes in the calculations.

(1) Travel Time

The minimum time of concentration (T_c) used in TR-55 is 0.1 hour.
The drainage areas for storm sewer pipes C-5, C-6 and C-11 predominantly consist of equipment, asphalt pavement and aggregate surfacing. These areas are relatively small in size. It is expected that the time of concentration for these areas are very low. Use the minimum time of concentration T_c = 0.1 hr (6 minutes) for all these drainage areas.

(2) Rainfall Intensity

Based on the "Rainfall Intensity – Duration – Frequency" curve for Sacramento, California, the rainfall intensity for a 10-year storm event for 6-minute duration is:

I = 2.9 inch/hr. (see Ref. 3)

(3) Maximum Allowable Flow Rate

The maximum allowable flow rate for a 12" diameter pipe with a 0.4% slope was determined using the FlowMaster 2005 computer program. From the computer output shown on Page 11, the results are as follows:

Maximum allowable flow rate = 2.66 cfs. (full pipe flow)
Flow velocity = 3.39 ft/s, between 2 ft/s and 8 ft/s, OK.

The peak runoff rate by Rational Method is: Q = C x I x A, where: I in inch/hr, A in acres, and Q in cfs.

For I = 2.9 inch/hr and maximum Q = 2.66 cfs, the maximum (C x A) is calculated to be:

$(C \times A)_{\max imum}$ = 2.66 / 2.9 = 0.92 acres.

The $C \times A$ values were calculated for each drainage basin for the storm sewer pipes C-5, C-6 and C-11. See below. All the areas were measured by using AutoCAD.

Drainage Basin for C-5

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Equipment/Roofs	14,071	1.0	14,071
Asphalt Pavement	6,678	1.0	6,678
Gravel Surfacing	22,232	0.6	13,339
Transformer Containment	1,142	0.0	0
Total	--	--	34,088

$\sum(C \times A)$ = 34,088 ft^2 = 0.783 acres < $(C \times A)_{\max imum}$ = 0.92 acres, OK.

Drainage Basin for C-6

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Equipment/Roofs	6,800	1.0	6,800
Asphalt Pavement	2,290	1.0	2,290
Gravel Surfacing	18,317	0.6	10,990
Transformer Containment	2,943	0.0	0
Total	--	--	20,080

$\sum(C \times A)$ = 20,080 ft^2 = 0.461 acres < $(C \times A)_{\max imum}$ = 0.92 acres, OK.

Drainage Basin for C-11

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Equipment/Roofs	5,862	1.0	5,862
Asphalt Pavement	4,138	1.0	4,138
Gravel Surfacing	19,291	0.6	11,575
Transformer Containment	1,874	0.0	0
Total	--	--	21,575

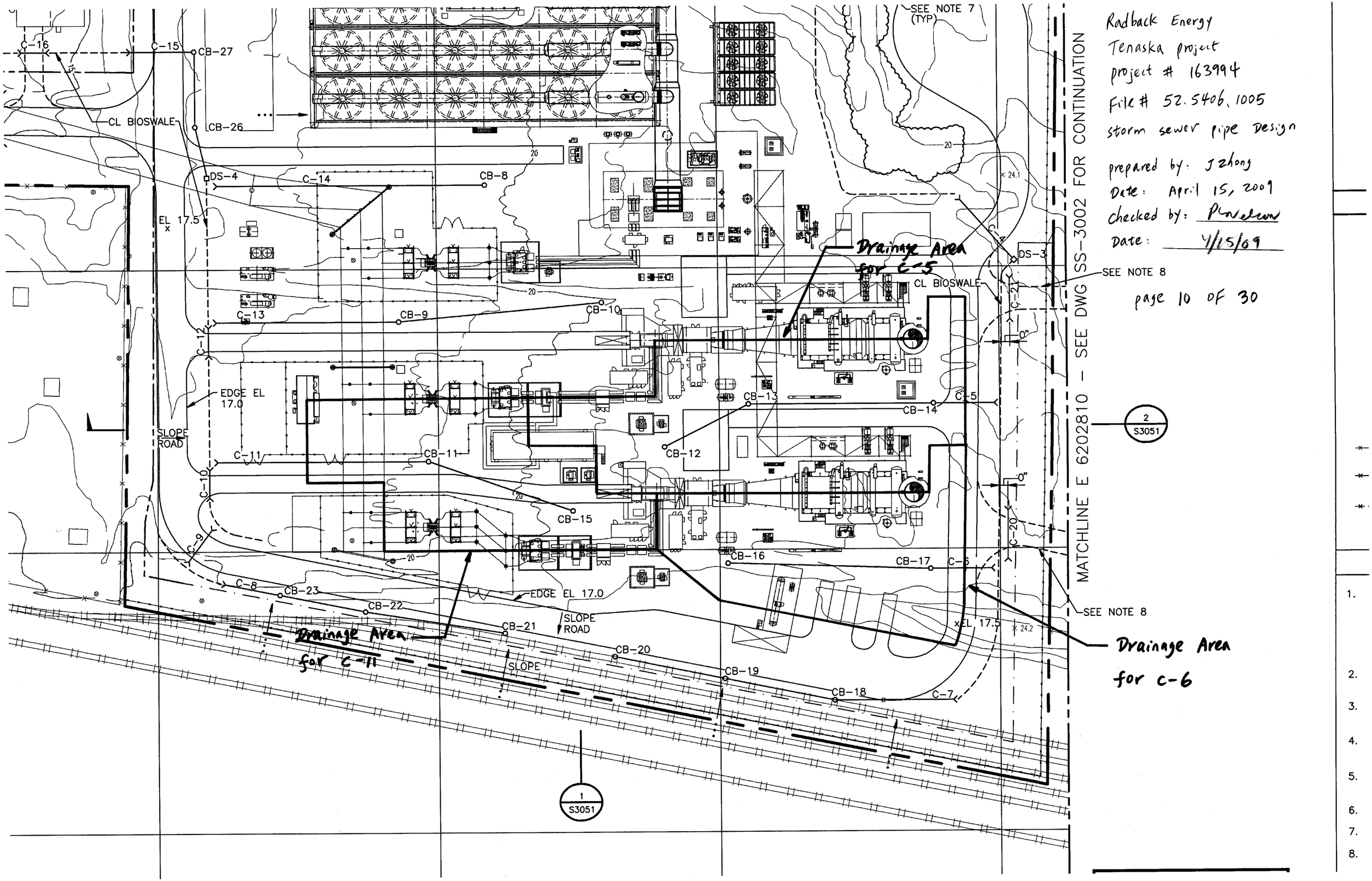
$$\sum(C \times A) = 21{,}575\ ft^2 = 0.495\ acres < (C \times A)_{max\ imum} = 0.92\ acres,\ OK.$$

Conclusion: The 12" diameter storm sewer pipes have sufficient capacity to carry the flows.

Radback Energy
Tenaska project
project # 163994
File # 52.5406.1005
storm sewer pipe Design

prepared by: J zhong
Date: April 15, 2009
checked by: Plavelow
Date: 4/15/09

page 10 OF 30



Radback Tenaska project
project # 163994
File # 52.5406.1005

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.011	
Channel Slope	0.00400	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	2.66	ft^3/s

Results

Discharge	2.66	ft^3/s
Normal Depth	1.00	ft
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Top Width	0.00	ft
Critical Depth	0.70	ft
Percent Full	100.0	%
Critical Slope	0.00572	ft/ft
Velocity	3.39	ft/s
Velocity Head	0.18	ft
Specific Energy	1.18	ft
Froude Number	0.00	
Maximum Discharge	2.86	ft^3/s
Discharge Full	2.66	ft^3/s
Slope Full	0.00400	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Pipe Sizing - 18" Diameter

18" diameter storm sewer pipes (C-1 and C-19) will be installed at the most downstream of bioswales along with drop structures to discharge any overflow to the wetland. There are two bioswale routes to convey stormwater runoff to the wetland. The first route is along the north boundary of the plant site while the second route is along the south boundary. The drainage areas for the first route and second route are delineated as shown on Page 15.

Slope of Pipe C-1: From SS-3050 (Attachment 1), the inlet invert EL is at 8.2; the outlet invert EL is at 8.0. The pipe is measured to be 38 feet long. Thus the slope = (8.2-8.0)/38 = 0.5%.

Slope of Pipe C-19: From SS-3050 (Attachment 1), the inlet invert EL is at 8.7; the outlet invert EL is at 8.4. The pipe is measured to be 45 feet long. Thus the slope = (8.7-8.4)/45 = 0.7%.

Use 0.5% as the slope of the pipes in the calculations to be conservative.

(1) Travel Time

Per calculation "Stormwater Analysis for Wetland" for the same project (Ref. 7), the time of concentration for this project site is 0.93 hour (56 minutes) for pre-development condition. For post-development condition, IMPs (bioswales) will be installed to retain and infiltrate stormwater on site. The Stormwater C.3 Guidebook (Ref. 5) indicates that post-project runoff does not exceed pre-project runoff rates or durations if the IMPs are sized based on the C.3 Guidebook. Based on this, it is estimated that the post-development time of concentration will not exceed the pre-development time of concentration. Therefore, use the time of concentration T_c = 56 minutes for both bioswale routes.

(2) Rainfall Intensity

Based on the "Rainfall Intensity – Duration – Frequency" curve for Sacramento, California, the rainfall intensity for a 50-year storm event for 56-minute duration is:

I = 1.2 inch/hr. (see Ref. 3)

(3) Maximum Allowable Flow Rate

The maximum allowable flow rate for an 18" diameter pipe with a 0.5% slope was determined using the FlowMaster 2005 computer program. From the computer output on Page 16, the results are as follows:

Maximum allowable flow rate = 8.78 cfs. (full pipe flow)
Flow velocity = 4.97 ft/s, between 2 ft/s and 8 ft/s, OK.

The peak runoff rate by Rational Method is: Q = C x I x A, where: I in inch/hr, A in acres, and Q in cfs.

For I = 1.2 inch/hr and maximum Q = 8.78 cfs, the maximum (C x A) is calculated to be:
$(C \times A)_{\max imum}$ = 8.78 / 1.2 = 7.32 acres.

The $C \times A$ values were calculated for each drainage area of the two bioswale routes. See below. All the areas were measured by using AutoCAD.

Drainage Area for North Bioswale Route

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Equipment/Roofs	61,323	1.0	61,323
Asphalt Pavement	67,199	1.0	67,199
Gravel Surfacing	100,200	0.6	60,120
Open Graded Aggregates (ACC Area)	68,200	0.1	6,820
Landscape, Group A Soil	230,466	0.1	23,047
Transformer Containment	4,491	0.0	0
Total	--	--	218,509

$\sum(C \times A)$ = 218,509 ft^2 = 5.02 acres < $(C \times A)_{\max imum}$ = 7.32 acres, OK.

Drainage Area for South Bioswale Route

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Equipment/Roofs	35,298	1.0	35,298
Asphalt Pavement	59,167	1.0	59,167
Gravel Surfacing	295,933	0.6	177,560

	Area, A (ft^2)	Runoff Coefficient, C	C X A (ft^2)
Landscape, Group A Soil	113,387	0.1	11,339
Transformer Containment	5,479	0.0	0
Total	--	--	283,364

$$\sum(C \times A) = 283{,}364 \text{ ft}^2 = 6.51 \text{ acres} < (C \times A)_{\max imum} = 7.32 \text{ acres, OK.}$$

The combined peak flow rate of pipes C-1 and C-19 is:

$$\sum(C \times A) \text{ x I} = (5.02 + 6.51) \text{ x } 1.2 = 13.8 \text{ cfs.}$$

The peak flow rate from Ref. 7 was estimated at 9.0 cfs. Rational Method used in this calculation is known to over-estimate flow rate, especially for ~~large~~ larger areas (normal limit is 20 acres).

Conclusion: The 18" diameter storm sewer pipes have sufficient capacity to carry the flows.

North Route

South Route

CONSERVATION EASEMENT

UNDERDRAIN TERMINATION (SEE NOTE 9)

SLOPE TO MATCH BRIGEHEAD ROAD

CL BIOSWALE

SEE NOTE 7 (TYP)

SEE NOTE 8

MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION

N 2193000

N 2192750

N 2192500

N 2192250

N 2192000

Radback Tenaska project

project # 163994 File # 52.5406.1005

storm sewer pipe Design

prepared by: J zhong

Date: April 8, 2009

checked by: Pkw

Date: 4/15/09

page 15 OF 30

OPEN

ABBREVIATION

APPROX	–	APPR
ASPH	–	ASPH
AVG	–	AVER
BND	–	BEND
BLDG	–	BUILD
B/MH	–	BOTT
BOC	–	BOTT
BOD	–	BOTT
BOP	–	BOTT
BU	–	BELL-
C	–	CULV
CB	–	CATC
CD	–	CABL
CHDPE	–	CORR DENS
CL	–	CENT
CLR	–	CLEA
CMH	–	CHEM
CND	–	COND
CONC	–	CONC
CO	–	CLEA
CS	–	CARB
CW	–	CIRC
DB	–	DUCT
DBC	–	DIREC
DET	–	DETA
DIA	–	DIAME
DIP	–	DUCT
DWG	–	DRAW
DWP	–	DOUB
EC	–	ELECT
ECC	–	ECCE
EF	–	EACH
EHH	–	ELECT
EL	–	ELEVA
EMH	–	ELECT
EW	–	EACH
FC	–	FIELD
FDN	–	FOUN
FF	–	FLAT
FRP	–	FIBER
GR	–	GRAD
HDM	–	HOT
HDPE	–	HIGH
HP	–	HIGH
HYD	–	HYDR
ID	–	INSID
INV	–	INVER
JBX	–	JUNC
L	–	LENG
LP	–	LOW

LEGI

N

C

S
D

1 S3000

326.5

F

BM-1

S

E

N

T

TR-1

E

NOTES A

1. COORDINATES ARE BASE NGVD 29 DATUM. BENC THE FLAGPOLE AT THE DATUM ELEVATION, ADD PHOTOGRAPH DATED JU ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS INDICATE FINISH GRADE
3. ALL CUT AND FILL SLO NOTED OTHERWISE.
4. SEE DWG SS-3050 FO STRUCTURE CHARTS.
5. TOP OF CONCRETE ELE EL 18.0. FINISH GRADE
6. CL OF ALL PAVED ROA
7. TREES TO REMAIN. GRA
8. TEMPORARY ROAD FRO CONSTRUCTION.
9. UNDERDRAIN CONTINUO EASEMENT. UTILIZE UNP

Radback Tenaska project
project # 163994
File # 52.5406.1005

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.011	
Channel Slope	0.00500	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	8.78	ft³/s

Results

Discharge	8.78	ft³/s
Normal Depth	1.50	ft
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.15	ft
Percent Full	100.0	%
Critical Slope	0.00575	ft/ft
Velocity	4.97	ft/s
Velocity Head	0.38	ft
Specific Energy	1.88	ft
Froude Number	0.00	
Maximum Discharge	9.44	ft³/s
Discharge Full	8.78	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

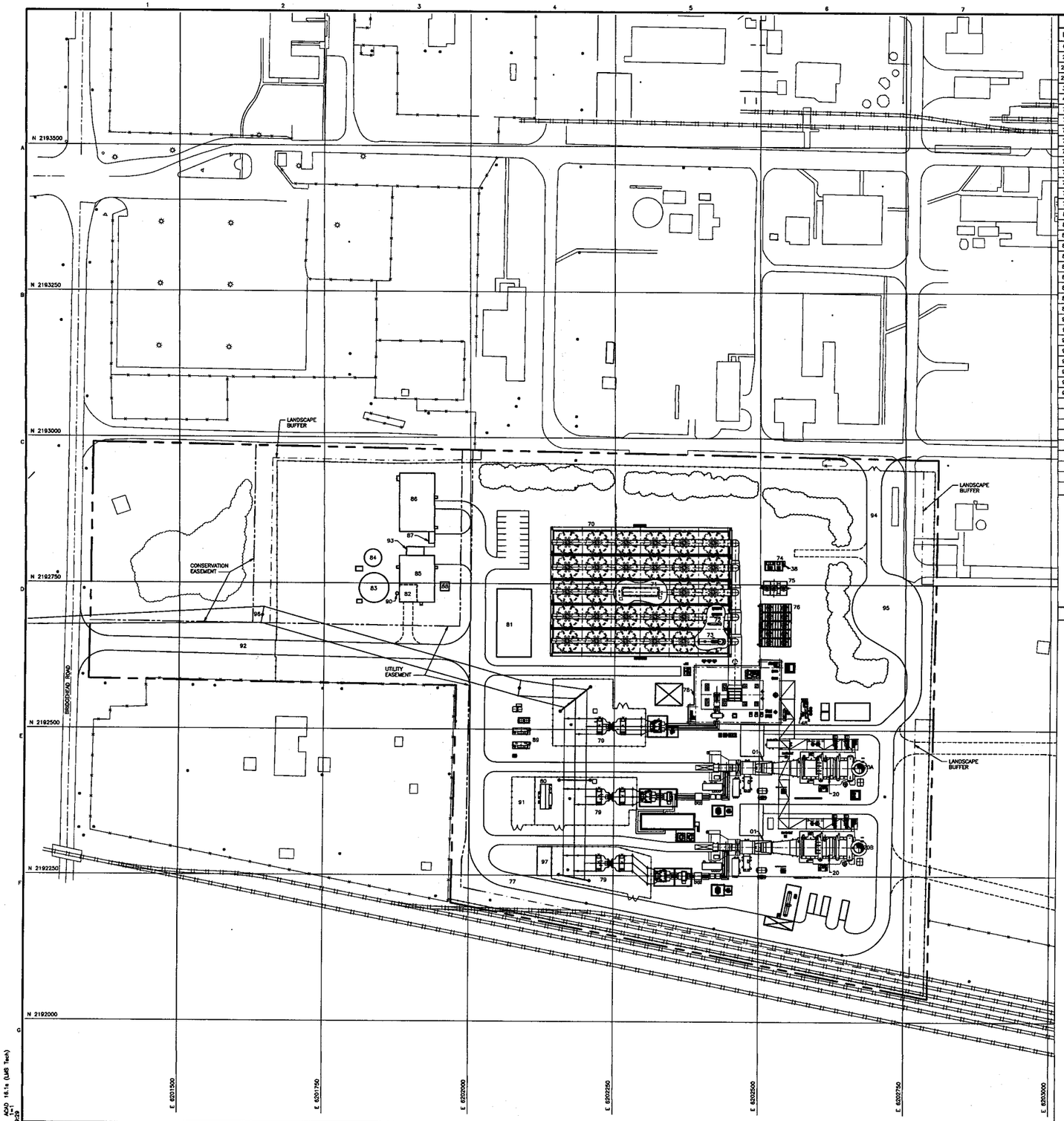
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%

Attachment 1

Black & Veatch Dwgs SS-1002, SS-3001, SS-3201 and SS-3050

DWG40999 08-APR-2009 10:05:34



FACILITIES LEGEND

ID	FACILITY	STRUCTURE HEIGHT	TIEDOWN LOCATION NORTH	TIEDOWN LOCATION EAST	REMARKS
01	COMBUSTION TURBINE	70'	–	–	–
20	HEAT RECOVERY STEAM GENERATOR (HRSG)	103'	–	–	–
20A	HRSG EXHAUST STACK A	155'	2192436.00	6202665.00	CL EXHAUST STACK
20B	HRSG EXHAUST STACK B	155'	2192300.00	6202665.00	CL EXHAUST STACK
38	SAFETY SHOWER EYEWASH STATION	–	–	–	–
48	AUXILIARY BOILER	50'	2192527.61	6202572.26	CL EXHAUST STACK
70	AIR COOLED CONDENSER (ACC)	124'	–	–	–
71	ACC ELECTRICAL ENCLOSURE	14'	–	–	–
72	CONDENSER AIR EXTRACTION SKIDS	6'	–	–	–
73	ACC CONDENSATE COLLECTION TANK	28'	–	–	–
74	WET SURFACE AIR COOLER CHEMICAL FEED SKIDS	8'	–	–	–
75	WET SURFACE AIR COOLER	23'	2192744.67	6202523.00	CL COOLER
76	CLOSED CYCLE COOLING WATER HEAT EXCHANGER	19'	–	–	–
77	LOOP ROAD	–	–	–	–
78	STEAM TURBINE FOUNDATION	–	–	–	–
79	SWITCHYARD	18' & 45'	–	–	–
80	SWITCHYARD CONTROL ENCLOSURE	12'	–	–	–
81	CONTROL & ADMIN BUILDING	14'	–	–	–
82	FIRE WATER PUMP ROOM	20'	–	–	–
83	FIRE/SERVICE WATER STORAGE TANK	32'	–	–	–
84	DEMIN WATER STORAGE TANK	24'	–	–	–
85	WATER TREATMENT BUILDING	20'	–	–	–
86	WAREHOUSE/MAINTENANCE BUILDING	16'	–	–	–
87	LUBRICANT STORAGE SHED	10'	–	–	–
88	WASTE WATER LIFT STATION (IF REQUIRED)	–	–	–	–
89	GAS COMPRESSORS & GAS CONDITIONING	13'	–	–	–
90	DIESEL FIRE PUMP EXHAUST	16'	2192732.52	6201874.72	CL EXHAUST STACK
91	GAS METERING STATION	–	–	–	–
92	ACCESS ROAD	–	–	–	–
93	LEASED MIX BED EXCHANGER CONCRETE SLAB	–	–	–	–
94	EMERGENCY ACCESS ROAD	–	–	–	–
95	CUL DA SAC (TURNAROUND)	–	–	–	–
96	230KV POWER POLE	105'	–	–	–
97	OUTAGE MAINTENANCE TRAILERS AREA	–	–	–	–

NOTES

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. SEE PLANT ARRANGEMENT DRAWING SM-2001, FOR LEGEND OF MAIN POWER BLOCK.
3. PROPERTY AND EASEMENT BOUNDARY INFORMATION IS BASED UPON DRAWING EXHIBIT D, BY RONALD GREENWELL & ASSOCIATES, INC. REVISION DATED 05/FEB/09.

GENERAL LEGEND

- NEW FENCE
- EXISTING FENCE
- PROPERTY BOUNDRY (SEE NOTE 3)
- EASEMENT BOUNDARY (SEE NOTE 3)
- LANDSCAPE BUFFER

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRWD	DES	CHK	PDE	APP
1	30/MAR/09	ISSUED PER ECN-N-S-0001	NAW	PLN		PLN	DWN
0	13/MAR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DWN

60' 30' 0 60' 120'
SCALE: 1" =60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION

ENGINEER PLN DRAWN NAW
CHECKED DATE

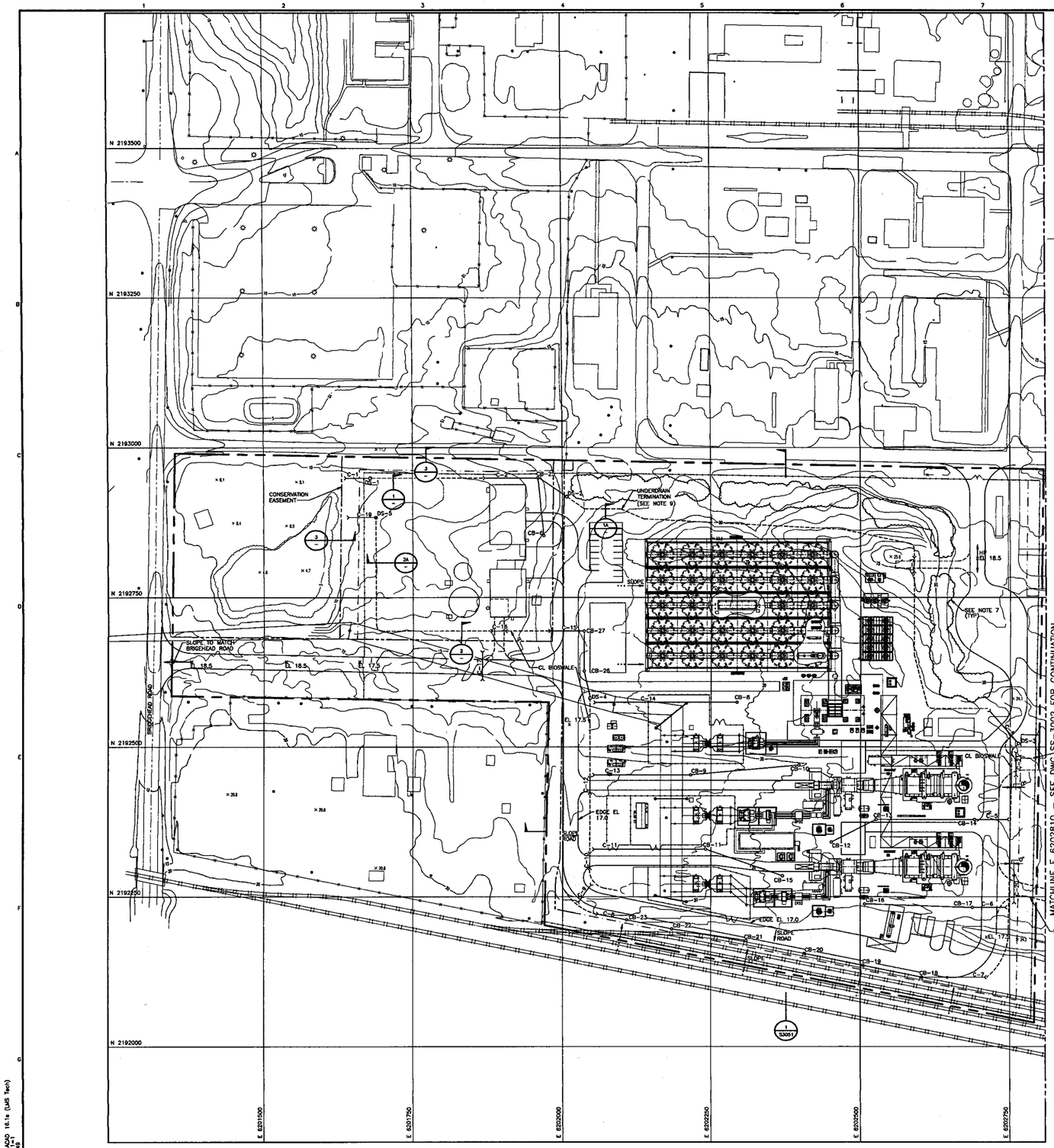
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

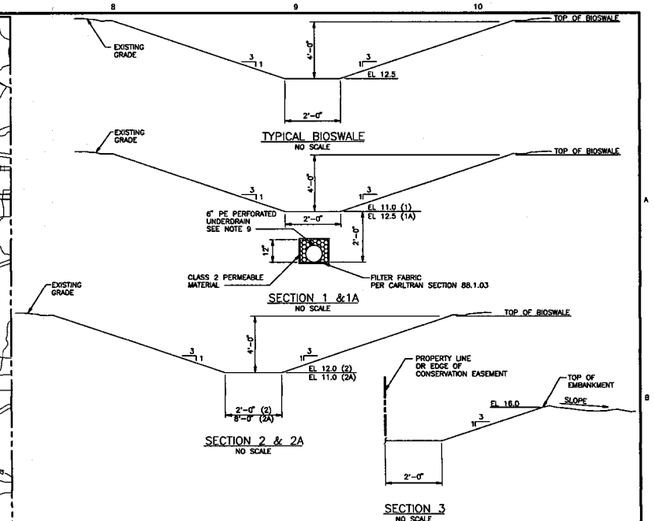
GENERAL ARRANGEMENT SITE

PROJECT DRAWING NUMBER 163994-SS-1002 REV 1
CODE
AREA

ACAD 16.1s (LMS Tech)
WEBLGA11
A1-ARCH-PT
03/30/09 15:00:29

DWG40999 15-APR-2009 09:14:44





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	=	APPROXIMATE	LTR	=	LATER
ASPH	=	ASPHALT	MAX	=	MAXIMUM
AVG	=	AVERAGE	MH	=	MANHOLE
BND	=	BEND	MIN	=	MINIMUM
BLDG	=	BUILDING	MJ	=	MECHANICAL JOINT
BJMH	=	BOTTOM OF MANHOLE ELEVATION	MSL	=	MEAN SEA LEVEL
BOC	=	BOTTOM OF CONDUIT ELEVATION	NO.	=	NUMBER
BOD	=	BOTTOM OF DUCTBANK ELEVATION	NTS	=	NOT TO SCALE
BOP	=	BOTTOM OF PIPE ELEVATION	OD	=	OUTSIDE DIAMETER
BU	=	BELL-UP	OWS	=	OIL WATER SEPARATOR
C	=	CULVERT	OWMH	=	OILYWASTE MANHOLE
CB	=	CATCH BASIN	PC	=	POINT OF CURVATURE
CD	=	CABLE DUCT	PE	=	PLAIN END
CHDPE	=	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	=	POINT OF INTERSECTION
			PLCS	=	PLACES
CL	=	CENTERLINE	PM	=	PLANT MANHOLE
CLR	=	CLEAR	POT	=	POINT OF TANGENT
CMH	=	CHEMICAL MANHOLE	PT	=	PIPE TERMINATION
CND	=	CONDUIT	PVC	=	POLYVINYL CHLORIDE PIPE
CONC	=	CONCRETE	QTY	=	QUANTITY
CO	=	CLEAN OUT	R	=	RADIUS
CS	=	CARBON STEEL	RCP	=	REINFORCED CONCRETE PIPE
CW	=	CIRCULATING WATER	RD	=	ROOF DRAIN
DB	=	DUCTBANK	RDV	=	REVISION
DBC	=	DIRECT BURIED CABLE	RGS	=	RIGID GALVANIZED STEEL
DET	=	DETAIL	RR	=	RAILROAD
DIA	=	DIAMETER	SECT	=	SECTION
DIP	=	DUCTILE IRON PIPE	SIM	=	SIMILAR
DWG	=	DRAWING	SLS	=	SANITARY LIFT STATION
DWP	=	DOUBLE WALL PIPE	SMH	=	SANITARY MANHOLE
EC	=	ELECTRICAL CONDUIT	STMH	=	STORM MANHOLE
ECC	=	ECCENTRIC	STRL	=	STRUCTURAL
EF	=	EACH FACE	T/C	=	TOP OF CONCRETE ELEVATION
EHH	=	ELECTRICAL HANDHOLE	T/G	=	TOP OF GRADE ELEVATION
EL	=	ELEVATION	THH	=	TELEPHONE SERVICE HANDHOLE
EMH	=	ELECTRICAL MANHOLE	T/MH	=	TOP OF MANHOLE ELEVATION
EW	=	EACH WAY	T/P	=	TOP OF PAVEMENT ELEVATION
FC	=	FIELD CHECK	TP	=	MECH PIPE TERMINAL POINT
FDN	=	FOUNDATION	TYP	=	TYPICAL
FF	=	FLAT FACE	UG	=	UNDERGROUND LIGHTING CONDUIT
FRP	=	FIBERGLASS REINFORCED PIPE	UNO	=	UNLESS NOTED OTHERWISE
GR	=	GRADE	VERT	=	VERTICAL
HDM	=	HOT DRAIN MANHOLE	WGT	=	WEIGHT
HDPE	=	HIGH DENSITY POLYETHYLENE PIPE	WTR	=	WATER
HP	=	HIGH POINT	W/	=	WITH
HYD	=	HYDRANT	W/O	=	WITHOUT
ID	=	INSIDE DIAMETER	WP	=	WORK POINT
INV	=	INVERT	XFMR	=	TRANSFORMER
JBX	=	JUNCTION BOX			
L	=	LENGTH			
LP	=	LOW POINT			

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

- NEW CULVERT
- CL BIOSWALE
- SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER (1 / S3000)
- FINISHED SPOT ELEVATIONS (× 326.5)
- SURVEY MONUMENT/CONTROL POINT (BM-1)
- EXISTING FENCE
- NEW SECURITY FENCE
- TEMPORARY CONSTRUCTION FENCE
- EROSION CONTROL METHOD (TR-1)
- NEW SLIDE GATE
- NEW SWING GATE
- EXISTING POWER POLE
- NEW CATCH BASIN (CB-101)
- NEW DROP STRUCTURE
- PROPERTY LINE
- BOUNDARY LINE
- EXISTING CONTOURS (126)
- GRADE TO DRAIN (DIRECTION OF ARROW)

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE. ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN AND DROP STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.
9. UNDERDRAIN CONTINUOUS UNDER BIOSWALE FROM UNDERDRAIN TERMINATION TO CONSERVATION EASEMENT. UTILIZE UNPERFORATED PIPE BETWEEN DS-2 TO C-2 OUTLET AND DS-1 TO C-1 OUTLET.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____ DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN DRAWN NAW CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

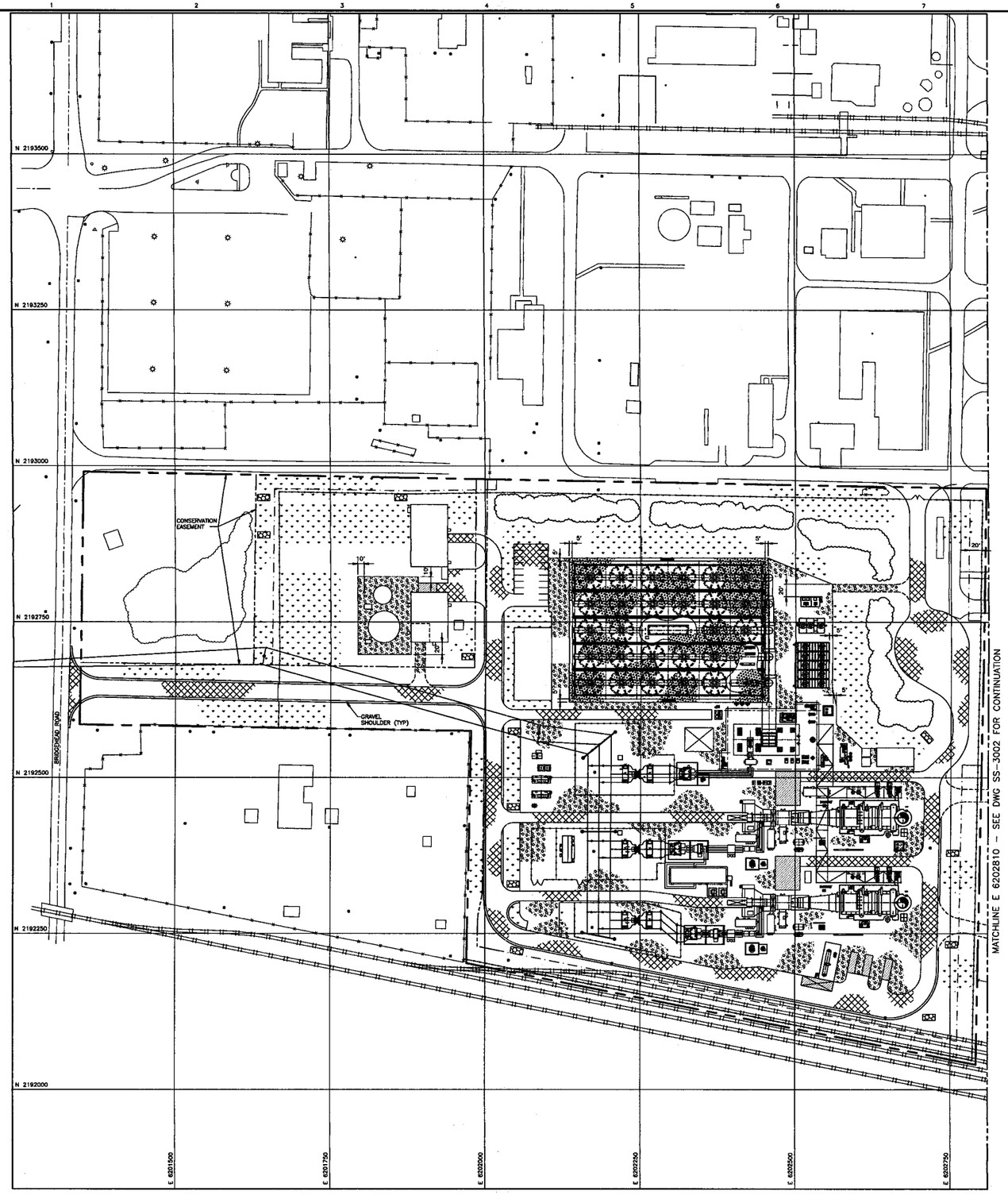
GRADING AND DRAINAGE – SITE PLAN – SHEET 1

PROJECT DRAWING NUMBER: 163994-SS-3001 REV: 0

CODE AREA

SPU37182 ACAD 16.1s (LMS Tech) A4P/TOSH 08:06:46 1=1

DWG40999 08-APR-2009 10:05:50



SITE SURFACING LEGEND

- ASPHALT SURFACING
- AGGREGATE SURFACING
- CONCRETE
- GRASS
- OPEN GRADED STONE SURFACING
- RIPRAP
- EXISTING FACILITY
- NEW FACILITY
- NATURAL SOIL

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	PLN	APP
A	27/MAR/09	ISSUED FOR CLIENT REVIEW	NAW				PLN	VW

SCALE: 1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____
DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN DRAWN NAW
CHECKED DATE

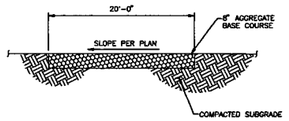
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SURFACING/FENCING/ROADWAY – SITE PLAN – SHEET 1

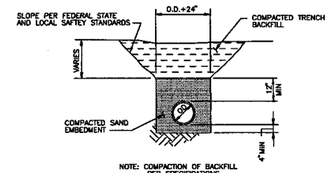
PROJECT DRAWING NUMBER: 163994–SS–3201
REV: A
CODE
AREA

WEB15411 ACAD 18.1s (LMS Tech)
A1PS/079 E1=40.35 1=1
A0PS/079 Plot Date: 07-Apr-2009

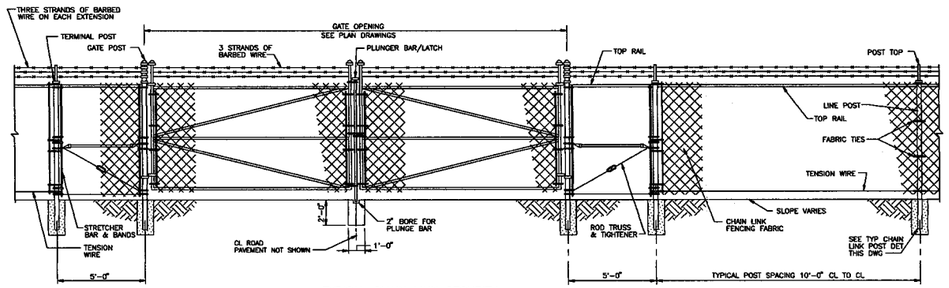
DWG40999 15-APR-2009 07:52:10



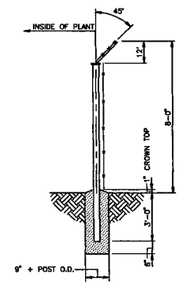
TYPICAL CONSTRUCTION LAYDOWN ROAD
NO SCALE



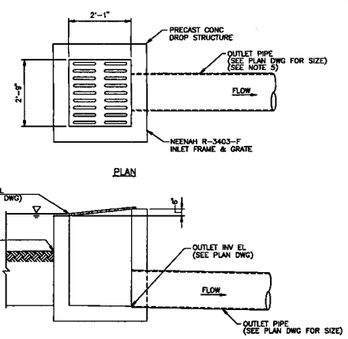
TYPICAL PIPE EMBEDMENT
NO SCALE



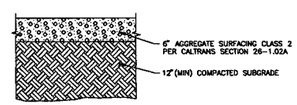
TYPICAL CHAIN LINK SECURITY FENCE AND GATE DETAIL
NO SCALE



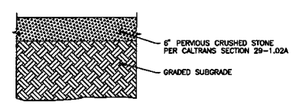
TYPICAL SECURITY FENCE POST DETAIL
NO SCALE



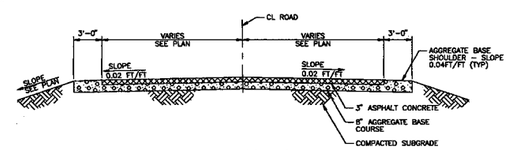
TYPICAL BIOSWALE DROP STRUCTURE DETAIL
NO SCALE



TYPICAL AGGREGATE SURFACING SECTION
NO SCALE

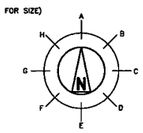


TYPICAL PERVIOUS CRUSHED STONE SURFACING SECTION
NO SCALE



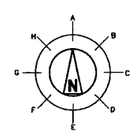
TYPICAL PAVED ROAD
NO SCALE
SEE DWG SS-3201

CULVERT TABLE						
CULVERT NO.	INLET INV ELEVATION	OUTLET INV ELEVATION	LENGTH	PIPE DIAMETER	PIPE MATERIAL	REMARKS
C-1	8.2	8.0	–	18"	–	
C-2	11.8	11.5	–	18"	–	
C-3	13.0	13.0	–	18"	–	
C-4	13.2	13.0	–	18"	–	
C-5	13.1	12.9	–	12"	–	
C-6	13.1	12.9	–	12"	–	
C-7	13.3	13.0	–	12"	–	
C-8	13.2	13.0	–	12"	–	
C-9	13.0	13.0	–	12"	–	
C-10	13.0	13.0	–	15"	–	
C-11	13.4	12.6	–	12"	–	
C-12	13.0	13.0	–	18"	–	
C-13	13.4	12.6	–	12"	–	
C-14	13.5	12.5	–	12"	–	
C-15	12.8	12.5	–	18"	–	
C-16	12.5	12.5	–	18"	–	
C-17	14.7	14.4	–	12"	–	
C-19	8.7	8.4	–	18"	–	
C-20	–	–	–	18"	–	
C-21	–	–	–	18"	–	



CATCH BASIN TABLE																						
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																		REMARKS
				A		B		C		D		E		F		G		H				
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA			
CB-6	–	–	16.0	–	–	13.2	12"	–	–	–	–	13.2	12"	–	–	–	–	–	–			
CB-7	NOT USED																					
CB-8	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.5	12"			
CB-9	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-10	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–			
CB-11	–	–	17.0	–	–	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–			
CB-12	–	–	17.0	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	–	–			
CB-13	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	–	–			
CB-14	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–			
CB-15	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"			
CB-16	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–			
CB-17	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–			
CB-18	–	–	16.5	–	–	13.2	12"	–	–	–	–	–	–	–	–	13.2	12"	–	–			
CB-19	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-20	–	–	16.5	–	–	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–			
CB-21	–	–	16.5	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	–	–			
CB-22	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–			
CB-23	–	–	16.5	–	–	–	–	13.2	12"	–	–	–	–	–	–	13.2	12"	–	–			
CB-24	NOT USED																					
CB-25	–	–	15.0	–	–	–	–	–	–	11.8	18"	12.3	12"	–	–	11.8	18"	–	–			
CB-26	–	–	16.0	13.2	18"	–	–	–	–	–	–	13.2	18"	–	–	–	–	–	–			
CB-27	–	–	16.5	–	–	–	–	–	–	–	–	12.8	18"	–	–	12.8	18"	–	–			

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST



DROP STRUCTURE (DS) TABLE																						
STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																		REMARKS
				A		B		C		D		E		F		G		H				
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA			
DS-1	–	–	13.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12.1	18"			
DS-2	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	11.8	18"	–	–			
DS-3	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.2	18"			
DS-4	–	–	15.5	13.5	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
DS-5	–	–	14.5	8.7	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–			

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST

NOTES

1. FILTER FABRIC SHALL BE UV-STABILIZED NONWOVEN GEOTEXTILE HAVING A MINIMUM WEIGHT OF 135 g/M^2 PER CALTRANS SS 88-1.03.
2. SEE DWG SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

60' 30' 0 60' 120'
SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SITE
SECTIONS AND DETAILS

PROJECT DRAWING NUMBER REV
163994-SS-3050 0
CODE
AREA

SPU3J7152 ACAD 16.1s (LMS Tech)
A1APU0/0 EL
01/01/09 08:17:35 1=1

Radback Energy
Tenaska Contra Costa Generation
Project # 163994 File # 52.5406.1005

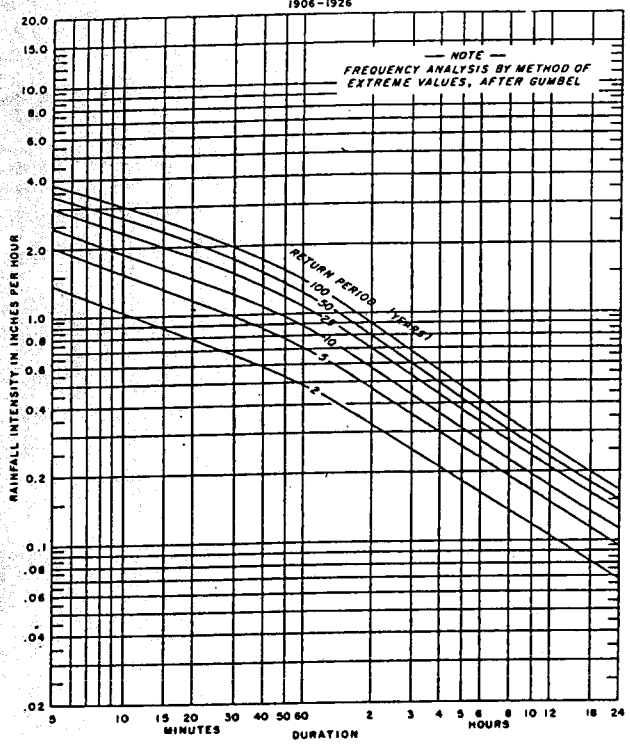
Prepared by: J Zhong
Date: April 8, 2009
# of Pages: 2

Attachment 2

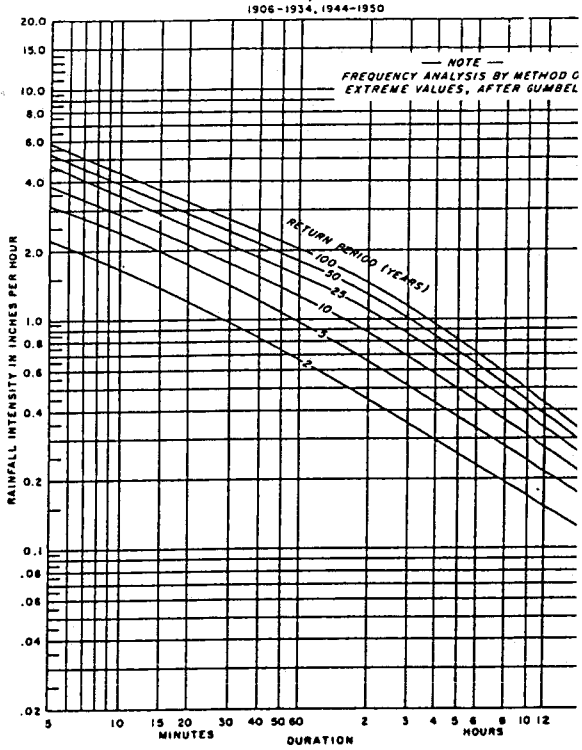
Reference 3 – Select Pages

RAINFALL INTENSITY– DURATION–FREQUENCY CURVES

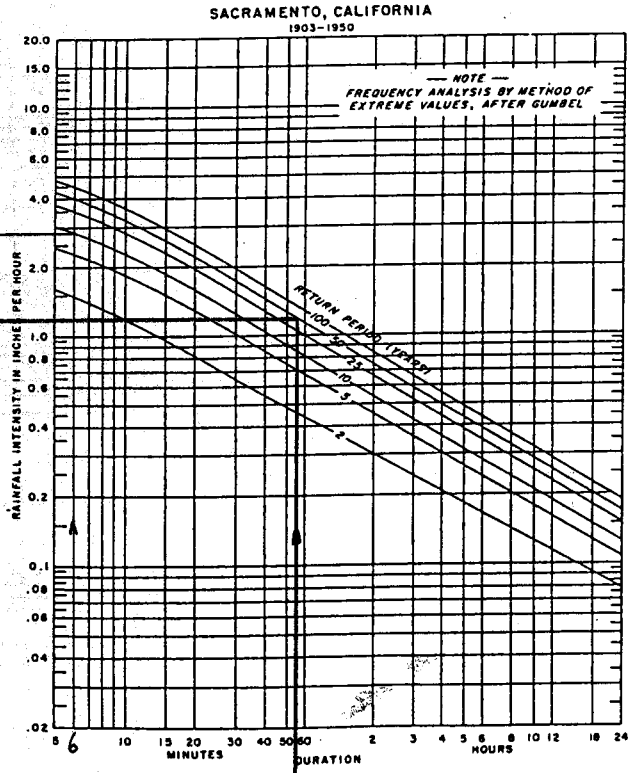
PT. REYES, CALIFORNIA
1906–1926



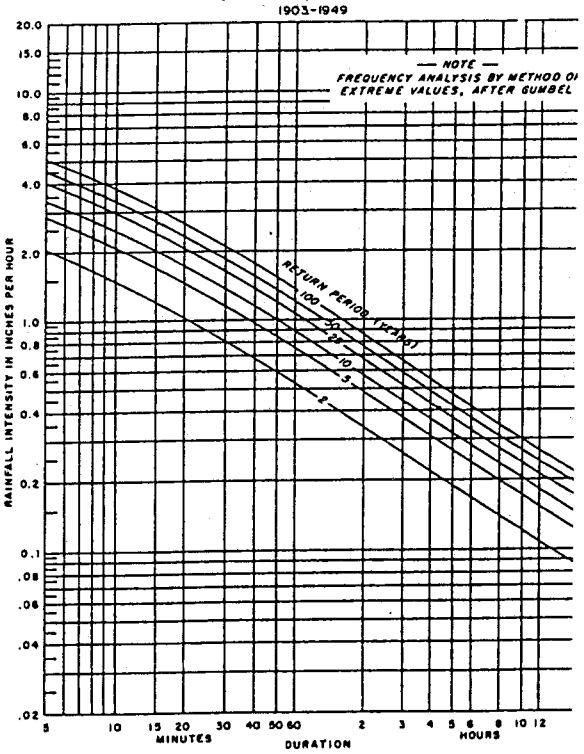
RED BLUFF, CALIFORNIA
1906–1934, 1944–1950



SACRAMENTO, CALIFORNIA
1903–1950



SAN DIEGO, CALIFORNIA
1903–1949



Radback Energy
Tenaska Contra Costa Generation
Project # 163994 File # 52.5406.1005

Prepared by: J Zhong
Date: April 8, 2009
# of Pages: 2

Attachment 3

Reference 4 – Select Pages

Manning's equation is:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{[eq. 3-4]}$$

where:

V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/p_w
a = cross sectional flow area (ft^2)
p_w = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow.

Manning's n values for open channel flow can be obtained from standard textbooks such as Chow (1959) or Linsley et al. (1982). After average velocity is computed using equation 3-4, T_t for the channel segment can be estimated using equation 3-1.

Reservoirs or lakes

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.

Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.

- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate T_c. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.

- The minimum T_c used in TR-55 is 0.1 hour.

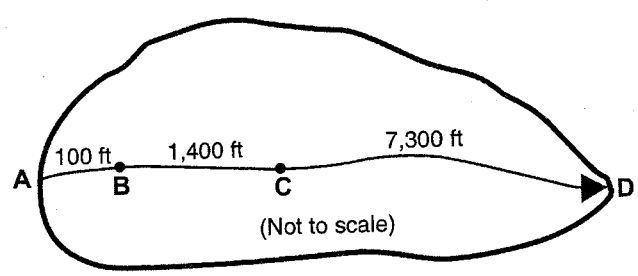
- A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

Example 3-1

The sketch below shows a watershed in Dyer County, northwestern Tennessee. The problem is to compute T_c at the outlet of the watershed (point D). The 2-year 24-hour rainfall depth is 3.6 inches. All three types of flow occur from the hydraulically most distant point (A) to the point of interest (D). To compute T_c, first determine T_t for each segment from the following information:

Segment AB: Sheet flow; dense grass; slope (s) = 0.01 ft/ft; and length (L) = 100 ft. Segment BC: Shallow concentrated flow; unpaved; s = 0.01 ft/ft; and L = 1,400 ft. Segment CD: Channel flow; Manning's n = .05; flow area (a) = 27 ft^2; wetted perimeter (p_w) = 28.2 ft; s = 0.005 ft/ft; and L = 7,300 ft.

See figure 3-2 for the computations made on worksheet 3.



Attachment 4

Reference 5 – Select Pages

(Runoff factor) x (tributary area) ≤ 2 x (self-retaining area) *Equation 4-1*

For treatment-only sites, and

(Runoff factor) x (tributary area) ≤ 1 x (self-retaining area) *Equation 4-2*

for sites subject to flow-control requirements. Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

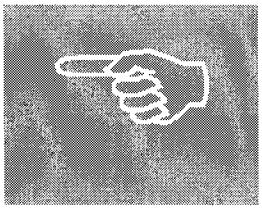


TABLE 4-2. Runoff factors to be used when sizing IMPs.

Surface	Treatment and Flow Control	Treatment only
Roofs	1.0	1.0
Concrete or Asphalt	1.0	1.0
Pervious Concrete	0.1	0.1
Porous Asphalt	0.1	0.1
Grouted Unit Pavers	1.0	1.0
Solid Unit Pavers	0.5	0.2
Crushed Aggregate	0.1	0.1
Turfblock	0.1	0.1
Landscape, Group A Soil	0.1	0.1
Landscape, Group B Soil	0.3	0.1
Landscape, Group C Soil	0.5	0.1
Landscape, Group D Soil	0.7	0.1

Areas draining to IMPs are used to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

The CCCWP has developed sizing factors (ratios of IMP area to impervious DMA area). For each IMP design, factors are provided for:

1. the intensity-duration-frequency method, with a hydrograph corresponding to a 50-year storm,
2. the 85th percentile rainfall intensity times two, and
3. 0.2 inches per hour.

An analysis conducted for the CCCWP determined all three methods yielded similar results. The 0.2 inches per hour rainfall intensity is used for sizing flow-based treatment facilities in Contra Costa County. This intensity corresponds to a storm depth of approximately 0.6 inches.

The CCCWP used the 0.2 inches per hour criterion to develop a **consistent countywide sizing factor** for bioretention facilities when used for stormwater treatment only (i.e., not for flow control). The factor is based on maintaining a minimum percolation rate of 5 inches per hour through an engineered soil mix. The sizing factor is the ratio of the design intensity of rainfall on tributary impervious surfaces (0.2 inches/hour) to the design percolation rate in the facility (5 inches/hour), or **0.04** (dimensionless).

► FLOW-CONTROL (HYDROGRAPH MODIFICATION MANAGEMENT)

The NPDES permit specifies for applicable projects:

> ...estimated post-project runoff peaks and durations do not exceed estimated pre-project peaks and durations if increased stormwater runoff peaks or durations could cause erosion or other significant effects on beneficial uses.

Applicants may select among **four options** for compliance. See Table 1-2. The first three options demonstrate runoff will not exceed pre-project durations by showing there will be no net increase in impervious area, by using Integrated Management Practice designs and sizing factors developed by the Program, or by constructing a site-specific hydrologic model. The fourth option is to demonstrate that, even though runoff will increase, it will not cause erosion or other significant effects on beneficial uses. This may be done by showing downstream channels are not susceptible to erosion (Option 4a) or that a restoration project will mitigate any impacts from increased flows (Options 4b and 4c).

Details on compliance requirements are in Appendix C. Technical background is in the Hydrograph Modification Management Plan, which is available on the Program's website.

Radback Energy
Tenaska Contra Costa Generation
Project # 163994 File # 52.5406.1005

Prepared by: J Zhong
Date: April 8, 2009
# of Pages: 2

Attachment 5

Reference 6 – Select Pages

TABLE 4.2 Time of Concentration for Small, Impervious Areas

Location	Standard t_c (minutes)
Roof and property drainage	5
Road inlet pits	5
Small areas <1 acre	10

Rather than attempting more detailed analysis, for areas up to one acre, values in Table 4.2 (taken from Urban Storm Water Management Manual for Malaysia, 2000) can be used.

To obtain an estimate of the time of concentration for the basin, the component values should be added. However, the addition must be done only for those components of flow in series along the principal path of flow from the hydraulically most remote point to the design point. Do not add travel time in intermediate tributaries. In the case of residential areas, consider only the interconnected impervious area.

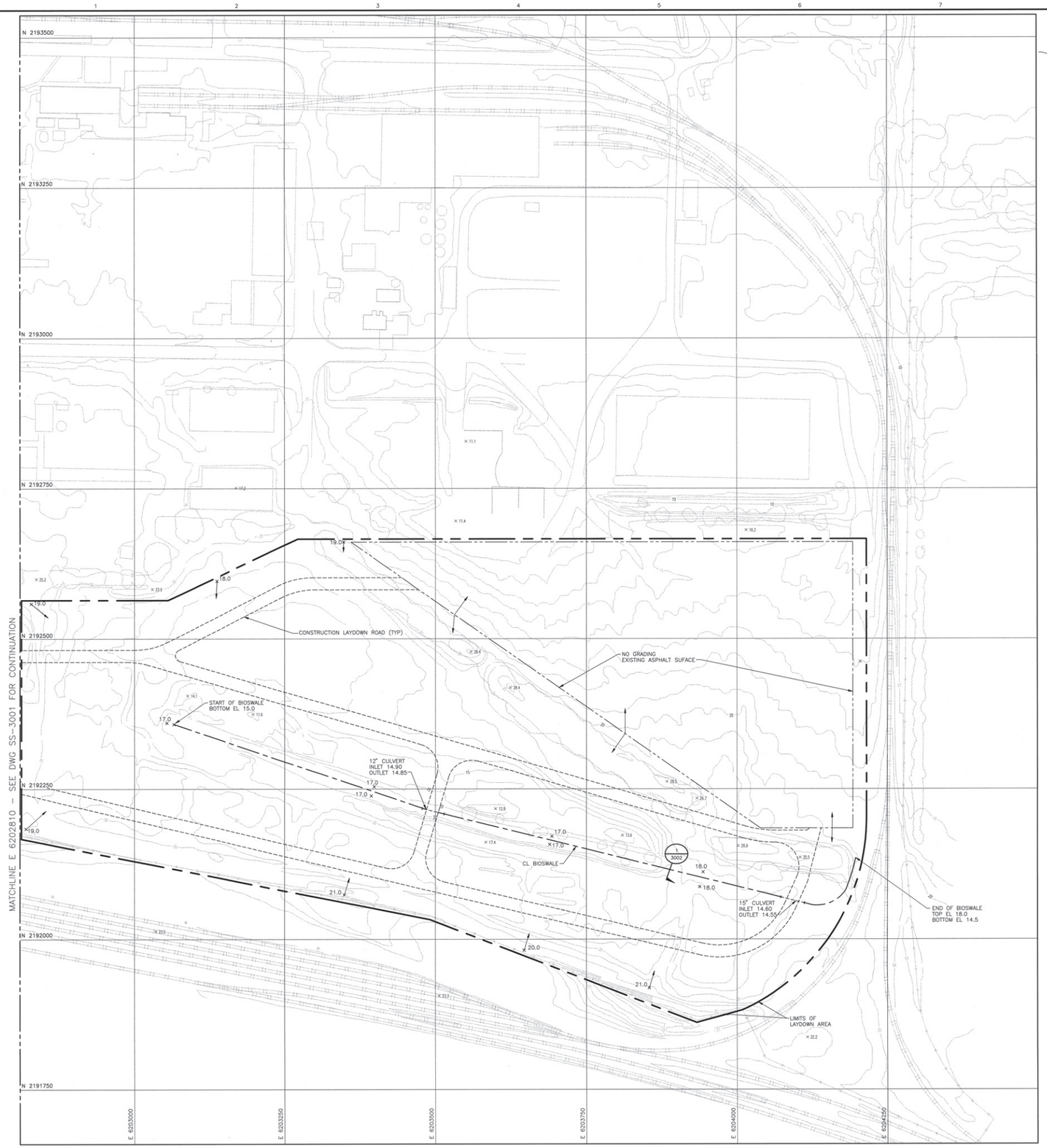
In the selection of a time of concentration for any individual component, the engineer should probably use two or three of the methods with which he or she is familiar and for which the necessary independent variables and parameters exist or can be economically determined. The procedure that gives a reasonable value and is conservative (shorter times will result in higher peak flow rates) with respect to the design objective should be the value that is selected.

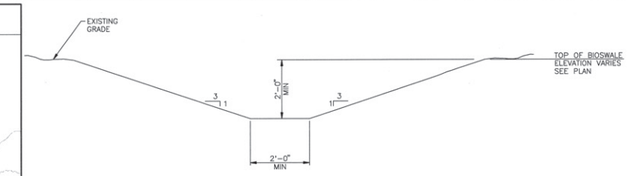
Remember, the equations are based on average velocities, not point velocities. Therefore, in many, if not most cases, you can walk faster than water flows. For overland flow and for concentrated flow in swales or natural channels, velocities will normally be less than 5 ft/sec or 6 ft/sec, and in larger, lined channels and closed conduits, they will usually be less than 10 ft/sec to 12 ft/sec.

Typically, rainfall intensities are determined from *Intensity-Duration-Frequency curves* (*IDF curves*) or *Depth-Duration-Frequency curves* (*DDF curves*). These are plots of rainfall intensity (or depth) versus duration of event rainfall. Usually, there are several curves on a single graph, one for each of several different rainfall frequencies (e.g. the 10-year event, the 25-year event, the 50-year event and the 100-year event). Figure 4.1 is a set of IDF curves for Rolla, MO.

Often, one or both of these graphs (or a tabular form thereof) are supplied by the local governmental authority under whose auspices the work is being done. First, the time of concentration is determined. Then, in the case of the IDF curve, the graph is entered with time of concentration and the rainfall intensity or depth is read at the intersection of the time coordinate and the corresponding design frequency. In the case of DDF data, the design depth is divided by the time of concentration so as to obtain the desired rainfall intensity, I.

In the absence of preexisting IDF or DDF curves, the engineer must develop the information that is required. In the best of all worlds, an engineer should develop IDF or DDF curves from local or nearby rainfall data. However, for all practical purposes, the necessary rainfall data are seldom available, and if they are available, the cost of developing the rainfall frequency relations is seldom justifiable in terms of any design project where the Rational method is applicable (e.g. drainage design for a subdivision, an industrial park, a shopping center, etc.). In this case, IDF or DDF curves can be developed from rainfall data contained in published rainfall frequency atlases (e.g. Hershfield, 1961; Miller et al., 1973; Frederick et al., 1977; Huff and Angel, 1992). For a given frequency, rainfall depths are interpolated from isohyets in the atlas at the published durations. Each rainfall depth is divided by the corresponding duration to obtain an average rainfall intensity for that particular duration. The computed intensities for the given frequency are then plotted on either logarithmic or on semilogarithmic coordinates (time on the logarithmic scale in both cases). Use of loga-





SECTION 1
TYPICAL BIOSWALE
NO SCALE

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. ALL TREES WITHIN LAYDOWN AREA SHALL BE REMOVED.

NOT TO BE USED
FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DWW

60' 30' 0 60' 120'
1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

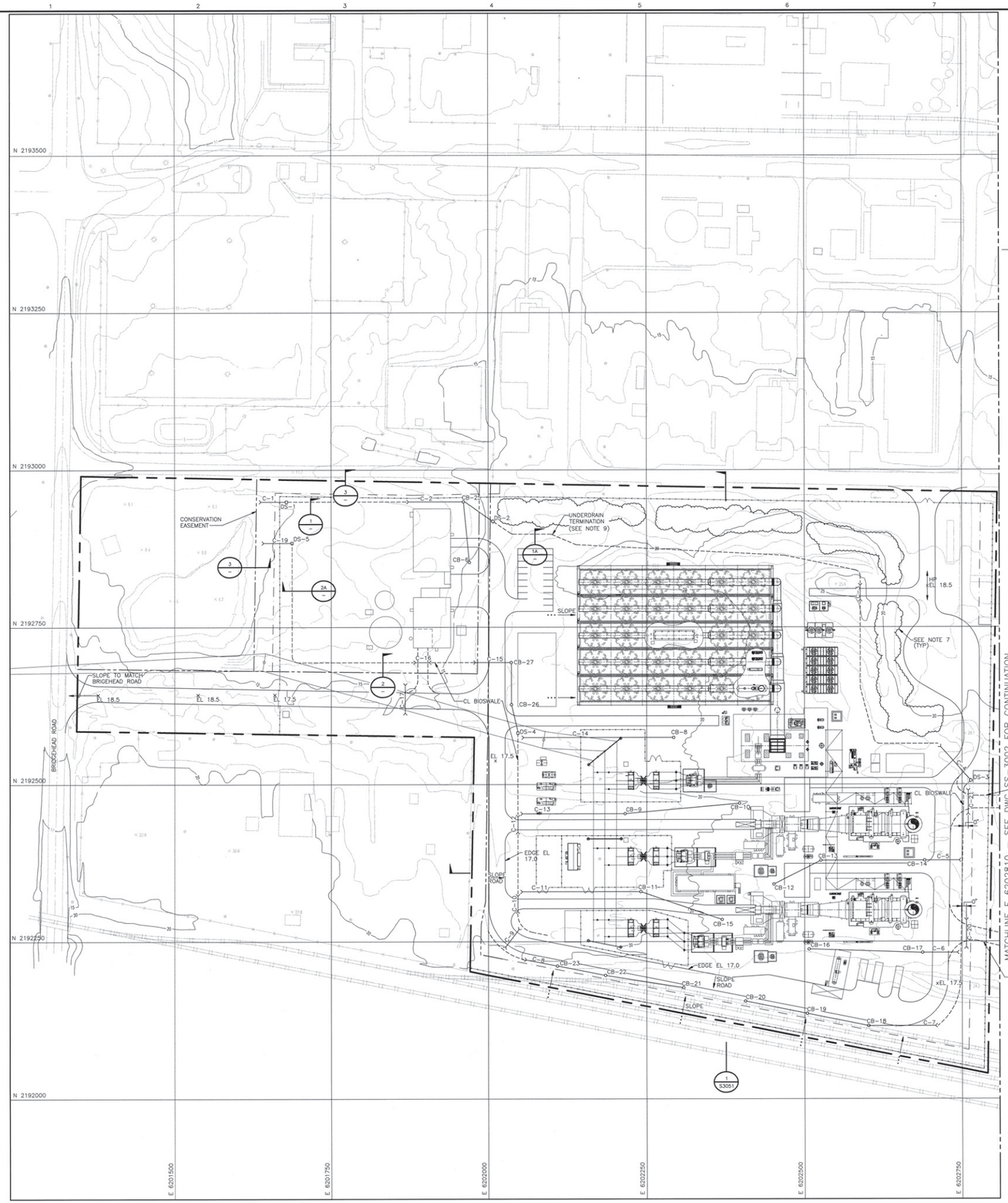
BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

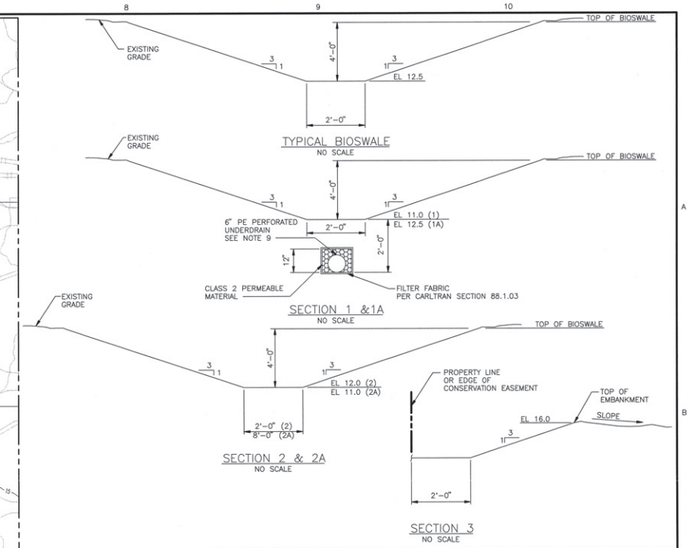
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GRADING AND DRAINAGE – SITE
PLAN – SHEET 2

PROJECT DRAWING NUMBER 163994–SS–3002
REV 0
CODE
AREA

SPU37162
A1APU07
ACAD 16.1s (LMS Tech)
Fri, 10/15/2010 - 8:15am





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	–	APPROXIMATE	LTR	–	LATER
ASPH	–	ASPHALT	MAX	–	MAXIMUM
AVG	–	AVERAGE	MH	–	MANHOLE
BND	–	BEND	MIN	–	MINIMUM
BLDG	–	BUILDING	MJ	–	MECHANICAL JOINT
B/MH	–	BOTTOM OF MANHOLE ELEVATION	MSL	–	MEAN SEA LEVEL
BOC	–	BOTTOM OF CONDUIT ELEVATION	NO.	–	NUMBER
BOD	–	BOTTOM OF DUCTBANK ELEVATION	NTS	–	NOT TO SCALE
BOP	–	BOTTOM OF PIPE ELEVATION	OD	–	OUTSIDE DIAMETER
BU	–	BELL-UP	OWS	–	OIL WATER SEPARATOR
C	–	CULVERT	OWMH	–	OILYWASTE MANHOLE
CB	–	CATCH BASIN	PC	–	POINT OF CURVATURE
CD	–	CABLE DUCT	PE	–	PLAIN END
CHDPE	–	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	–	POINT OF INTERSECTION
			PLCS	–	PLACES
CL	–	CENTERLINE	PM	–	PLANT MANHOLE
CLR	–	CLEAR	POT	–	POINT OF TANGENT
CMH	–	CHEMICAL MANHOLE	PT	–	PIPE TERMINATION
CND	–	CONDUIT	PVC	–	POLYVINYL CHLORIDE PIPE
CONC	–	CONCRETE	QTY	–	QUANITY
CO	–	CLEAN OUT	R	–	RADIUS
CS	–	CARBON STEEL	RCP	–	REINFORCED CONCRETE PIPE
CW	–	CIRCULATING WATER	RD	–	ROOF DRAIN
DB	–	DUCTBANK	REV	–	REVISION
DBC	–	DIRECT BURIED CABLE	RGS	–	RIGID GALVANIZED STEEL
DET	–	DETAIL	RR	–	RAILROAD
DIA	–	DIAMETER	SECT	–	SECTION
DIP	–	DUCTILE IRON PIPE	SIM	–	SIMILAR
DWG	–	DRAWING	SLS	–	SANITARY LIFT STATION
DWP	–	DOUBLE WALL PIPE	SMH	–	SANITARY MANHOLE
EC	–	ELECTRICAL CONDUIT	STMH	–	STORM MANHOLE
ECC	–	ECCENTRIC	STRL	–	STRUCTURAL
EF	–	EACH FACE	T/C	–	TOP OF CONCRETE ELEVATION
EHH	–	ELECTRICAL HANDHOLE	T/G	–	TOP OF GRADE ELEVATION
EL	–	ELEVATION	THH	–	TELEPHONE SERVICE HANDHOLE
EMH	–	ELECTRICAL MANHOLE	T/MH	–	TOP OF MANHOLE ELEVATION
EW	–	EACH WAY	T/P	–	TOP OF PAVEMENT ELEVATION
FC	–	FIELD CHECK	TP	–	MECH PIPE TERMINAL POINT
FDN	–	FOUNDATION	TYP	–	TYPICAL
FF	–	FLAT FACE	UGL	–	UNDERGROUND LIGHTING CONDUIT
FRP	–	FIBERGLASS REINFORCED PIPE	UNO	–	UNLESS NOTED OTHERWISE
GR	–	GRADE	VERT	–	VERTICAL
HDM	–	HOT DRAIN MANHOLE	WGT	–	WEIGHT
HDPE	–	HIGH DENSITY POLYETHYLENE PIPE	WTR	–	WATER
HP	–	HIGH POINT	W/	–	WITH
HYD	–	HYDRANT	W/O	–	WITHOUT
ID	–	INSIDE DIAMETER	WP	–	WORK POINT
INV	–	INVERT	XFMR	–	TRANSFORMER
JBX	–	JUNCTION BOX			
L	–	LENGTH			
LP	–	LOW POINT			

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

	NEW CULVERT		NEW SLIDE GATE
	CL BIOSWALE		NEW SWING GATE
1 / S3000	SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER		EXISTING POWER POLE
× 326.5	FINISHED SPOT ELEVATIONS	CB-101	NEW CATCH BASIN
			NEW DROP STRUCTURE
BM-1	SURVEY MONUMENT/CONTROL POINT		PROPERTY LINE
	EXISTING FENCE		BOUNDARY LINE
	NEW SECURITY FENCE	126	EXISTING CONTOURS
	TEMPORARY CONSTRUCTION FENCE		GRADE TO DRAIN (DIRECTION OF ARROW)
TR-1	EROSION CONTROL METHOD		

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCSB3, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN AND DROP STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.
9. UNDERDRAIN CONTINUOUS UNDER BIOSWALE FROM UNDERDRAIN TERMINATION TO CONSERVATION EASEMENT. UTILIZE UNIPERFORATED PIPE BETWEEN DS-2 TO C-2 OUTLET AND DS-1 TO C-1 OUTLET.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN	PLN	DVM	

SCALE: 1"=60' (60' 30' 0 60' 120')

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.
SIGNED
DATE REG NO.

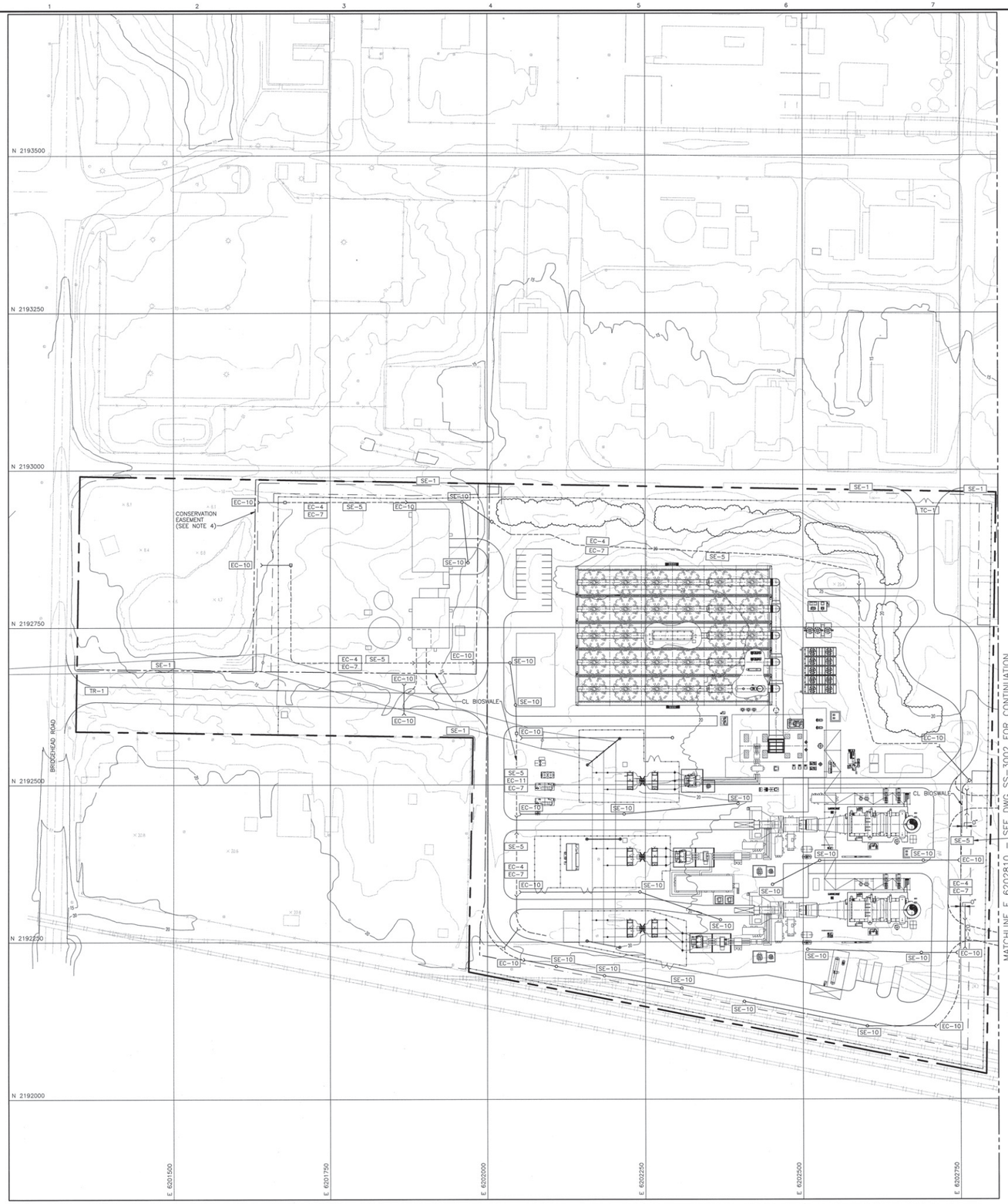
BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GRADING AND DRAINAGE – SITE PLAN – SHEET 1

PROJECT DRAWING NUMBER 163994–SS–3001 REV 0
CODE
AREA

SPL37162 ACAD 16.1s (LMS Tech)
A1APL077 E1 1=1
Rev 15/09/09 13:57:19



NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.
2. SEE DWG SS-3001 FOR GRADING & DRAINAGE PLAN
3. SEE DWG SS-3150 FOR SOIL EROSION CONTROL SECTIONS AND DETAILS.
4. NO CONSTRUCTION ACTIVITY SHALL OCCUR WITHIN CONSERVATION EASEMENT.
5. SE-5 MAY BE REMOVED AFTER BIOSWALE GRASS OBTAINS 70% COVERAGE.
6. SEE DWG SS-3201 FOR SITE SURFACING PLAN. ALL GRASS OR LANDSCAPE AREAS SHALL BE SEEDED AND FERTILIZED EC-4 AND COVERED WITH HYDRAULIC MULCH EC-3

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1"=60' (60' 30' 0 60' 120')

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____

DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN | DRAWN NAW | CHECKED | DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SOIL EROSION CONTROL – SITE PLAN – SHEET 1

PROJECT / DRAWING NUMBER: 163994–SS–3101 | REV: 0

CODE | AREA

SPU37162 ACAD 16.1s (LMS Tech)
A1APU07 E:\36.dwg 1=1
A1APU07 E:\36.dwg 1=1

Appendix E
Preliminary Stormwater Management Design

BLACK & VEATCH

MEMORANDUM

Radback Energy
Oakley Generating Station (Tenaska)
Summary of Stormwater Modifications

B&V Project 163994
B&V File 14.0100
22 September 2010

To: Jim McLucas

From: Paul Nelson & Craig Kantola
PLN CAK

Philip Williams & Associates (PWA), consultant for the California Energy Commission (CEC), provided comments related to the proposed stormwater management system for the Oakley Generating Station project. The stormwater management system reviewed by PWA consisted of a network of bioswales designed in accordance with the recommendations and procedures outlined in the Contra Costa Clean Water Program's (CCCWP) Stormwater C.3 Guidebook.. Flood control is proposed within the existing wetland area and a proposed detention basin in the northwest corner of the site. This memo summarizes the overall proposed stormwater management concept and also documents adjustments to the stormwater model in response to PWA comments.

Flood Control for the project will still be provided within the existing wetland area and the proposed detention basin, which was expanded per PWA comments. The volume provided within these areas is sufficient to store the combined 100-year and 10-year runoff volumes without discharging stormwater off-site. PWA requested that the hydrologic modeling be updated to more clearly demonstrate the impact of directly connected impervious areas (DCIA) on the project site.

Wetland Hydrology is of importance to ensure that the existing wetland will be provided with a consistent source of stormwater runoff. The revised design includes the use of low-flow orifices placed within the bioswale and detention basin outlet structures to allow runoff from small storm events to reach the wetland area. The sizing of these orifices is discussed in the response to the PWA comments listed below.

Water Quality Treatment will be provided to stormwater runoff within the proposed bioswales and detention basin prior to discharging into the existing wetland area. Bioswale 1-2 was determined to be sufficiently sized in the previous PWA review and has not been revised. Bioswale 3 has been removed to allow expansion of the detention basin. Bioswales 4 and 5 were determined by PWA to be improperly sized. The stormwater plan for the site has been revised to result in two facilities for water quality treatment – Bioswale 1-2 (which has not been revised) and the detention basin (which provides treatment for the areas previously included within Bioswales 3, 4 and 5). Bioswale and basin sizing are based on CCCWP C.3 Guidebook. Calculations for each are included in B&V calculation 52.5406.1008 and are discussed in greater detail below.

Response to PWA Comments

<u>Wetland Hydrology – #1</u>
The proposed design has been revised to include low-flow orifices within the bioswale and pond outlet structures to allow passage of water through the system during smaller, frequent storm events. This change was made to address the concern that the wetland quality could suffer from a lack of runoff during smaller rain events where runoff was retained and infiltrated within the bioswales in the prior design approach. A result of adding the low-flow orifices is that in most rainfall events generating runoff, there will be more water directed into the wetland system than if the runoff was retained in the bioswales to infiltrate into the ground.

The bioswale low-flow orifice sizing is based on passing the water quality flow rate (defined as the flow generated by a rainfall intensity of 0.2 inches per hour) with one foot of head above the orifices. The pond orifice sizing is based on draining the water quality volume (WQV) from the

pond in approximately 24 hours. This approach allows stormwater runoff to be treated within the bioswale and pond areas without diminishing the wetland hydrology. See pages 24 to 27 of B&V calculation 52.5406.1007 for further details on the bioswale orifice sizing and pages 9a to 9b of B&V calculation 52.5406.1008 for further details on the pond orifice sizing.

Wetland Hydrology – #2
This comment was an observation, no changes to the analysis were requested in Comment #2. However the pond configuration was modified based on other PWA comments and the 0.33 ac-ft volume noted has been reduced. See response to PWA Water Quality Treatment Comment #5.

Wetland Hydrology – #3
The existing and proposed runoff models have been updated to reflect additional impervious areas within the PG&E yard as requested. As noted, this results in additional runoff from the PG&E site that crosses the project site and enters the wetland area. See pages 5 and 11 of B&V calculation 52.5406.1003 and pages 5a and 15a of B&V calculation 52.5406.1006 for further details.

Wetland Hydrology – #4
The existing and proposed runoff models have been updated to account for impervious areas that could be considered 'directly connected'. Previously all impervious areas were factored into the runoff curve number (CN) for each drainage area. The updated models have separated out a portion of the impervious area to reflect 'directly connected' conditions. It was estimated that generally 25 percent of the impervious areas within the power block site will be located near enough to the storm sewer system inlets to be considered directly connected. The result of this change was a slight increase in the runoff volume produced for each storm event, when compared to the previously submitted model and calculations. See pages 11 to 17 of B&V calculation 52.5406.1006 for further details.

Note that all of the storm sewers in the power block area are routed through bioswales and/or the detention pond prior to discharge into the wetland and are not directly connected to the wetland area. This offers an opportunity for runoff from all impervious surfaces to infiltrate into the ground before reaching the wetland.

Water Quality Treatment – #1 & #2
PWA suggested that the bioswale cross-sections be revised to a greater width in order to meet a 1-foot maximum treatment depth criterion. Due to space limitations and the desire to preserve existing woodlands, widening the bioswales is not preferred. As noted in the PWA letter, Bioswale 1-2 is sufficiently sized for its drainage area. The detention basin has been expanded to provide water quality treatment for the remaining areas. See response to Comment #5 below.

Water Quality Treatment – #2
The low-flow orifice design limits the capture and infiltration of runoff in the bioswales by allowing the water quality flow rate (the flow rate generated by a rainfall intensity of 0.2 in/hr) to pass with one foot of hydraulic head. See pages 24 to 27 of B&V Calculation 52.5406.1007 for further details.

Water Quality Treatment – #3
Gravel check dams will be installed within the bioswales to limit erosion and transport of soil mix within the bioswales during higher flow rates.

Water Quality Treatment – #4
B&V Calculation 52.5406.1008 has been revised to reflect the changes proposed for meeting water quality treatment criteria. Bioswale 1-2 sufficiently sized for its drainage area and did not require revision. Bioswale 3 has been removed and the detention pond expanded to capture runoff in that area. Bioswale 4 has not been revised. However, since the treatment depth is greater than one foot, the detention basin was designed to provide treatment for this area prior to discharge to the wetland. Bioswale 5 has been shortened and the detention pond expanded to capture and treat runoff from that area prior to discharge into the wetland. Bioswales 4 and 5 will provide additional treatment, particularly during construction, to limit sedimentation from construction activities from reaching the wetland.

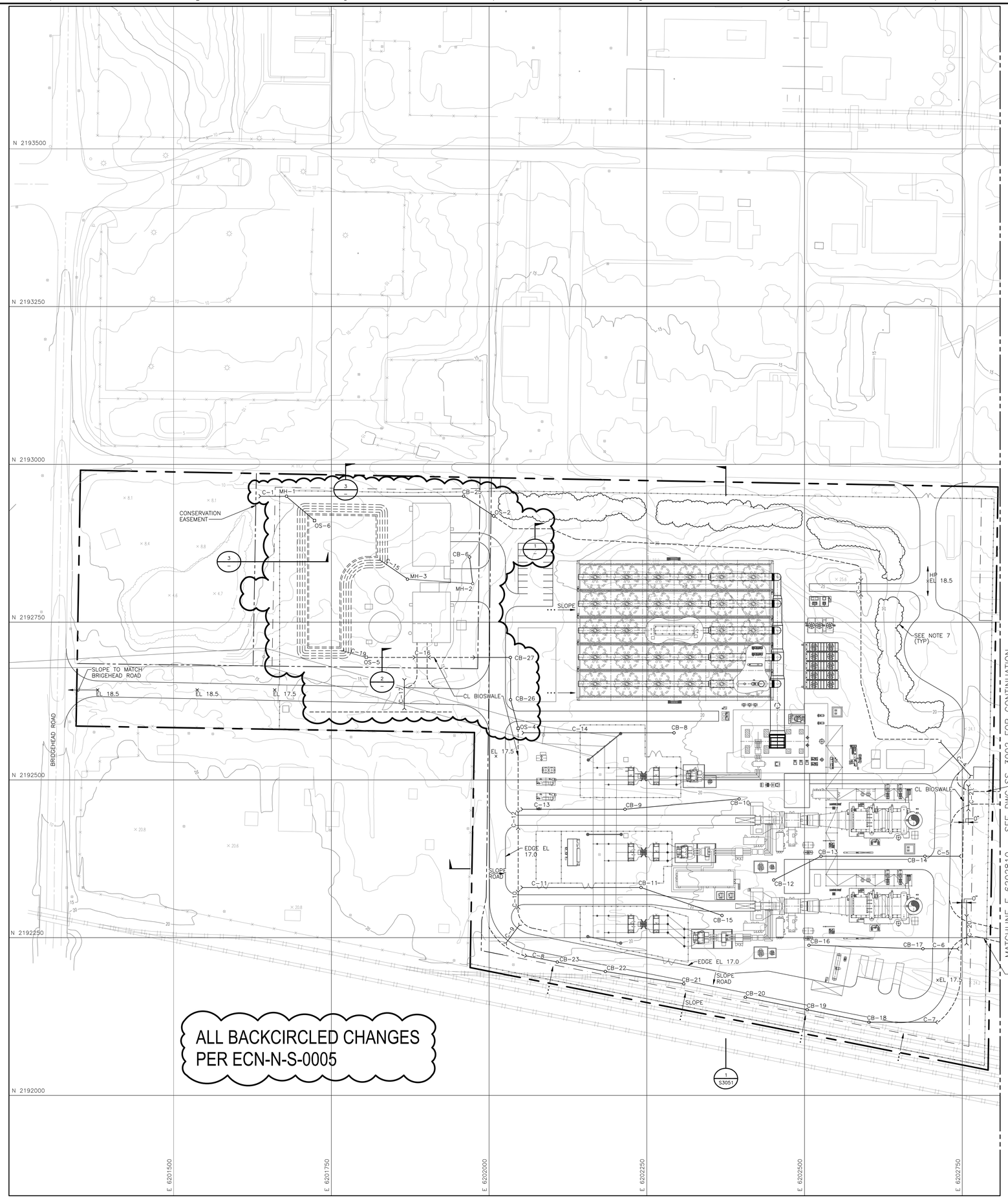
Water Quality Treatment – #5
PWA suggested the pond berm be lowered by two feet, down to elevation 13.0, which is one foot above the computed high water level in the pond. In addition, PWA suggested the pond footprint be expanded to provide additional volume and treatment capacity for the WQV captured by undersized Bioswales 4 and 5.

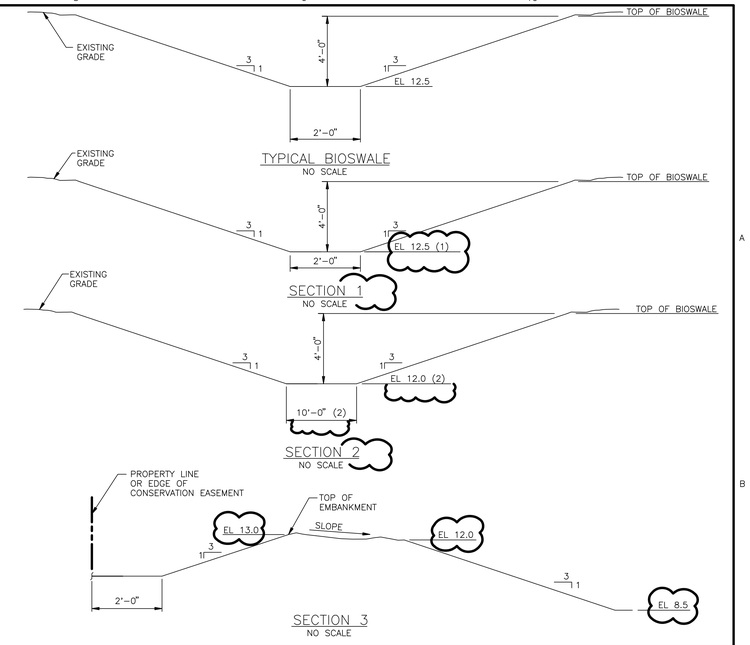
The C.3 Guidebook offers a method to determine basin sizing required for 80% capture within the basin. The C.3 chart 'Unit Basin Storage Size for 80% Capture' is used and is based on the annual precipitation depth and directly connected impervious area within the drainage area.

B&V Calculation 52.5406.1008 pages 9a to 9c provide detailed calculations for the water quality treatment storage volume for the pond using the C.3 chart. The mean annual precipitation for the site is estimated at 12.5 inches, per Contra Costa County Department of Public Works Drawing B-166. The directly connected impervious area (DCIA) coverage is estimated at 50%, which includes paved and roof surfaces (accounted at 100% DCIA) and gravel surfaces (accounted at 50%). These values correspond to a 'Unit Basin Storage Size for 80% Capture' value of 0.025 feet from the chart. When multiplied by the area draining to the pond (12.02 acres), the resulting WQV = 0.30 ac-ft. This volume is detained in the pond at elevation 9.34 which is below the pond overflow elevation of 12.0. The water is released to the wetland via low flow orifices as noted below.

Water Quality Treatment – #6
As discussed in the telephone conversation with PWA on September 2, 2010, the WQV should drain from the pond within 24-48 hours. It was suggested that the pond should drain closer to 24 hours to maintain hydration of the existing wetland area. Low-flow orifices within the pond are provided to meet this criterion. B&V Calculation 52.5406.1008 page 9b demonstrates the time to dewater the WQV from the pond.

Given the high permeability of the Delhi Sand soils found in the area, any water below the low-flow orifices is expected to infiltrate in a short period of time. With three inches of depth below the orifices and permeability rate of 5.95 to 19.98 in/hr for Delhi Sand, any water below the orifices would infiltrate swiftly, minimizing the potential for mosquito production.





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	–	APPROXIMATE	LTR	–	LATER
ASPH	–	ASPHALT	MAX	–	MAXIMUM
AVG	–	AVERAGE	MH	–	MANHOLE
BND	–	BEND	MIN	–	MINIMUM
BLDG	–	BUILDING	MJ	–	MECHANICAL JOINT
B/MH	–	BOTTOM OF MANHOLE ELEVATION	MSL	–	MEAN SEA LEVEL
BOC	–	BOTTOM OF CONDUIT ELEVATION	NO.	–	NUMBER
BOD	–	BOTTOM OF DUCTBANK ELEVATION	NTS	–	NOT TO SCALE
BOP	–	BOTTOM OF PIPE ELEVATION	OD	–	OUTSIDE DIAMETER
BU	–	BELL-UP	OWS	–	OIL WATER SEPARATOR
C	–	CULVERT	OWMH	–	OILYWASTE MANHOLE
CB	–	CATCH BASIN	PC	–	POINT OF CURVATURE
CD	–	CABLE DUCT	PE	–	PLAIN END
CHDPE	–	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	–	POINT OF INTERSECTION
			PLCS	–	PLACES
CL	–	CENTERLINE	PM	–	PLANT MANHOLE
CLR	–	CLEAR	POT	–	POINT OF TANGENT
CMH	–	CHEMICAL MANHOLE	PT	–	PIPE TERMINATION
CND	–	CONDUIT	PVC	–	POLYVINYL CHLORIDE PIPE
CONC	–	CONCRETE	QTY	–	QUANITY
CO	–	CLEAN OUT	R	–	RADIUS
CS	–	CARBON STEEL	RCP	–	REINFORCED CONCRETE PIPE
CW	–	CIRCULATING WATER	RD	–	ROOF DRAIN
DB	–	DUCTBANK	REV	–	REVISION
DBC	–	DIRECT BURIED CABLE	RGS	–	RIGID GALVANIZED STEEL
DET	–	DETAIL	RR	–	RAILROAD
DIA	–	DIAMETER	SECT	–	SECTION
DIP	–	DUCTILE IRON PIPE	SIM	–	SIMILAR
DWG	–	DRAWING	SLS	–	SANITARY LIFT STATION
DWP	–	DOUBLE WALL PIPE	SMH	–	SANITARY MANHOLE
EC	–	ELECTRICAL CONDUIT	STMH	–	STORM MANHOLE
ECC	–	ECCENTRIC	STRL	–	STRUCTURAL
EF	–	EACH FACE	T/C	–	TOP OF CONCRETE ELEVATION
EHH	–	ELECTRICAL HANDHOLE	T/G	–	TOP OF GRADE ELEVATION
EL	–	ELEVATION	THH	–	TELEPHONE SERVICE HANDHOLE
EMH	–	ELECTRICAL MANHOLE	T/MH	–	TOP OF MANHOLE ELEVATION
EW	–	EACH WAY	T/P	–	TOP OF PAVEMENT ELEVATION
FC	–	FIELD CHECK	TP	–	MECH PIPE TERMINAL POINT
FDN	–	FOUNDATION	TYP	–	TYPICAL
FF	–	FLAT FACE	UGL	–	UNDERGROUND LIGHTING CONDUIT
FRP	–	FIBERGLASS REINFORCED PIPE	UNO	–	UNLESS NOTED OTHERWISE
GR	–	GRADE	VERT	–	VERTICAL
HDM	–	HOT DRAIN MANHOLE	WGT	–	WEIGHT
HDPE	–	HIGH DENSITY POLYETHYLENE PIPE	WTR	–	WATER
HP	–	HIGH POINT	W/	–	WITH
HYD	–	HYDRANT	W/O	–	WITHOUT
ID	–	INSIDE DIAMETER	WP	–	WORK POINT
INV	–	INVERT	XFMR	–	TRANSFORMER
JBX	–	JUNCTION BOX			
L	–	LENGTH			
LP	–	LOW POINT			

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

	NEW CULVERT		NEW SLIDE GATE
	CL BIOSWALE		NEW SWING GATE
1 / S3000	SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER		EXISTING POWER POLE
× 326.5	FINISHED SPOT ELEVATIONS	CB-101	NEW CATCH BASIN
			NEW DROP STRUCTURE
BM-1	SURVEY MONUMENT/CONTROL POINT		PROPERTY LINE
	EXISTING FENCE		BOUNDARY LINE
	NEW SECURITY FENCE	126	EXISTING CONTOURS
	TEMPORARY CONSTRUCTION FENCE		GRADE TO DRAIN (DIRECTION OF ARROW)
TR-1	EROSION CONTROL METHOD		

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN, DROP AND OUTLET STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
3	22/SEP/10	ISSUED FOR PERMITTING	ARB	CAK		PLN	DVW
1	18/JUN/10	ISSUED FOR PERMITTING	RJS	CAK		PLN	DVW
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1"=60' (60' 30' 0 60' 120')

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____

DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN | DRAWN NAW | CHECKED | DATE

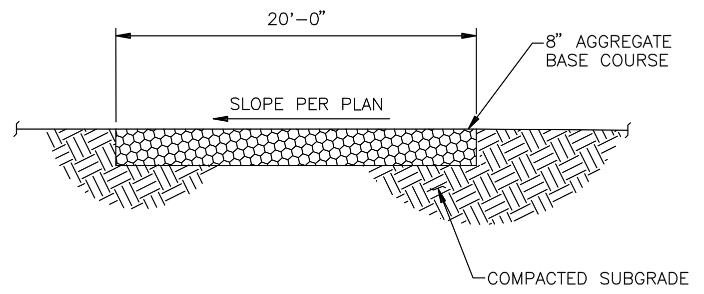
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GRADING AND DRAINAGE – SITE PLAN – SHEET 1

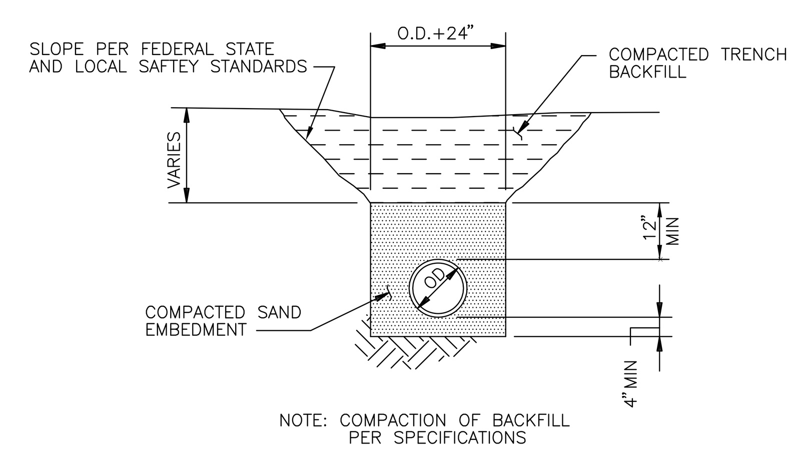
PROJECT / DRAWING NUMBER: 163994–SS–3001 | REV: 2

CODE | AREA

BE13057G
A1/01-27 E1
09/22/10 15:50:45
ACAD 16.1s (LMS Tech)

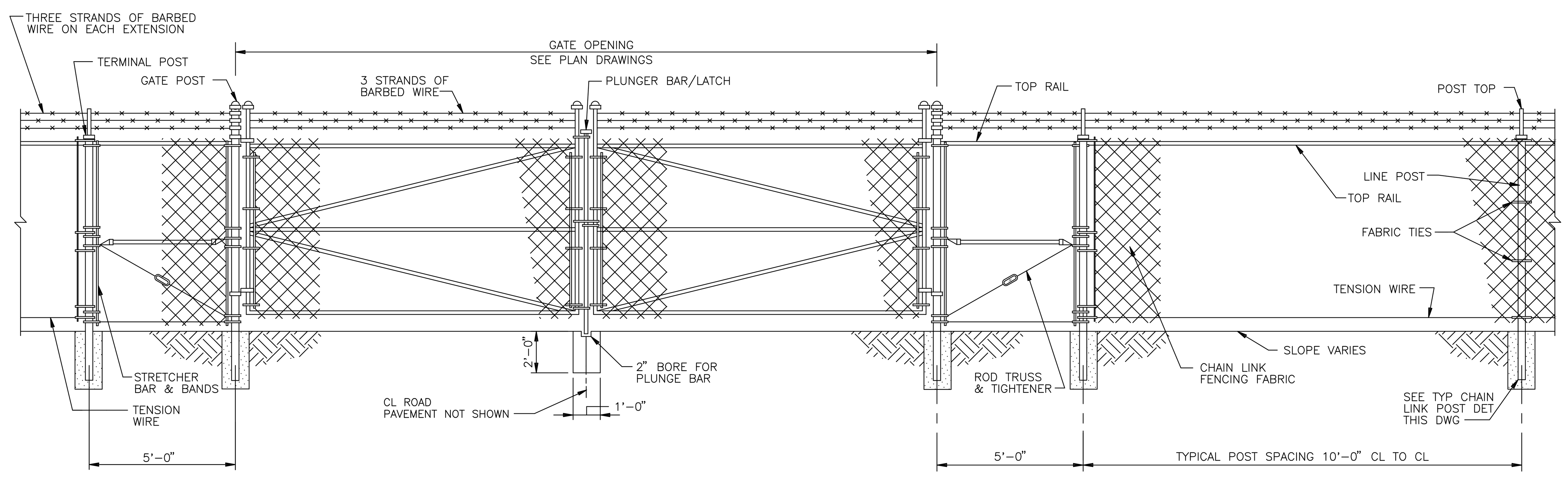


TYPICAL CONSTRUCTION LAYDOWN ROAD
NO SCALE

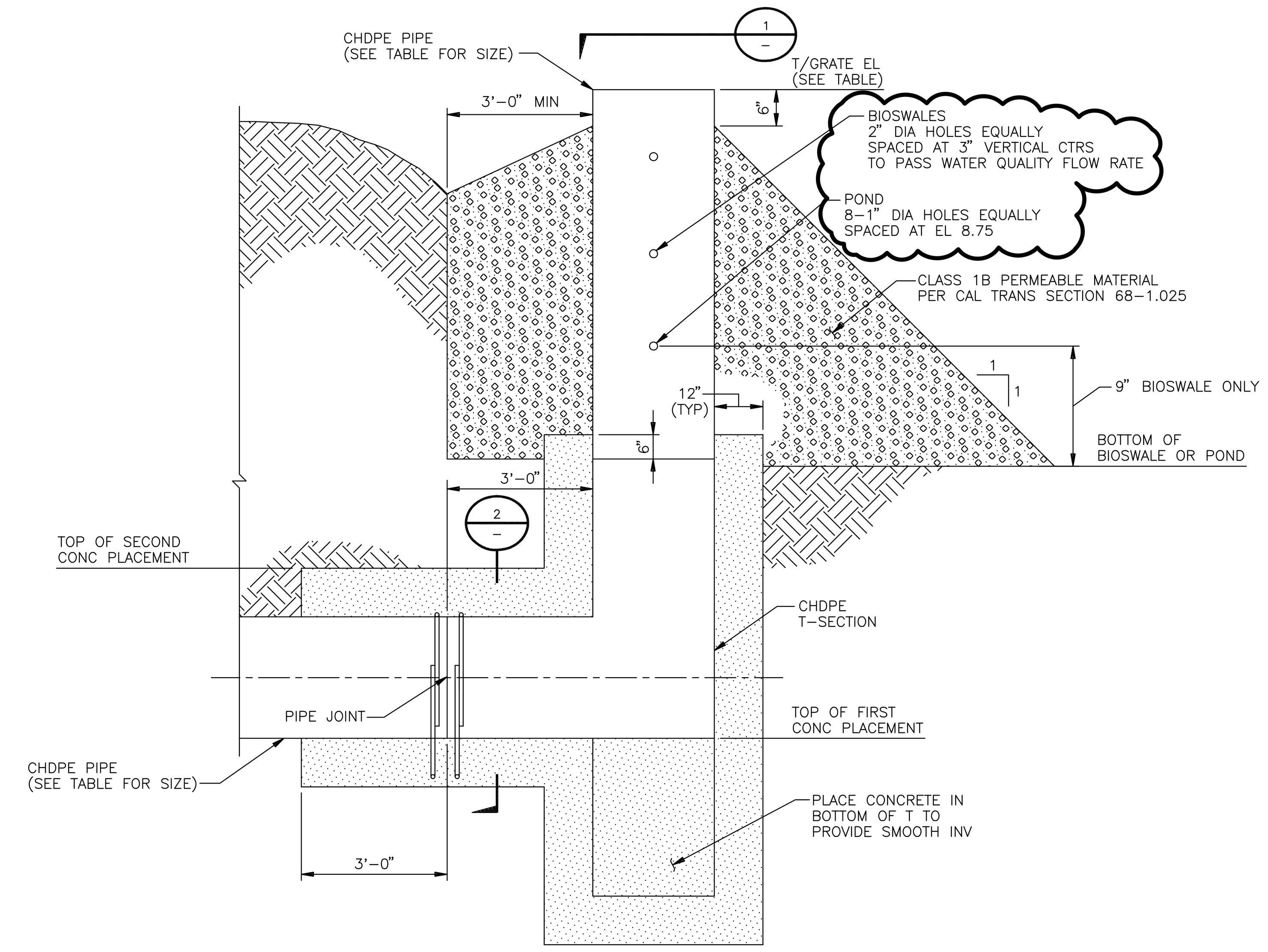


NOTE: COMPACTION OF BACKFILL PER SPECIFICATIONS

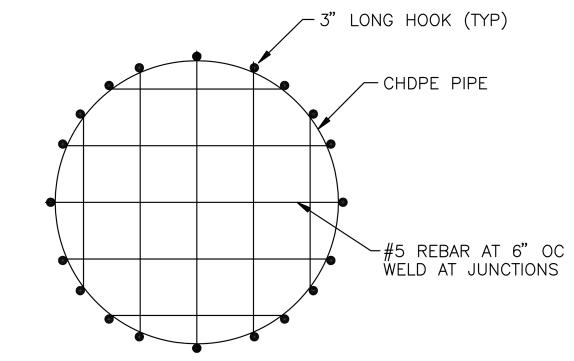
TYPICAL PIPE EMBEDMENT
NO SCALE



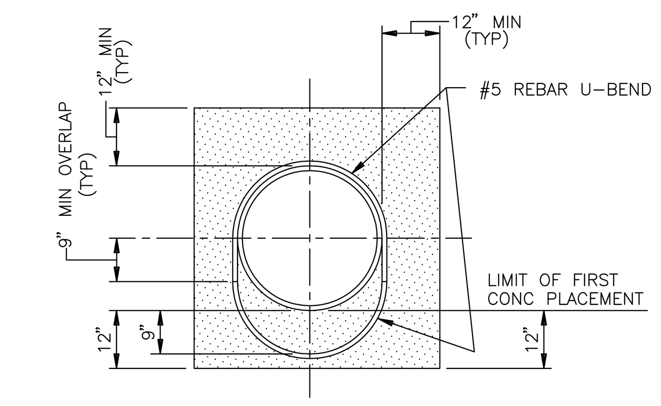
TYPICAL CHAIN LINK SECURITY FENCE AND GATE DETAIL
NO SCALE



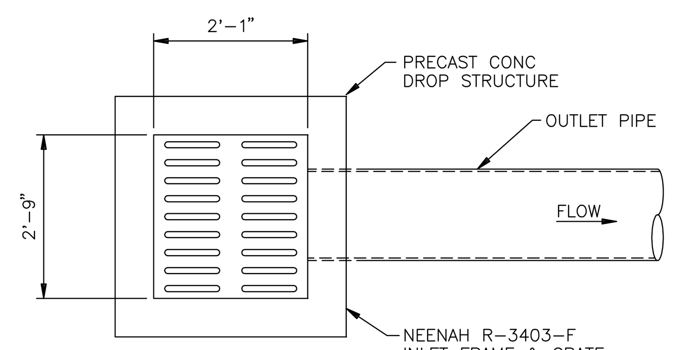
TYPICAL OUTLET STRUCTURE DETAIL
NO SCALE



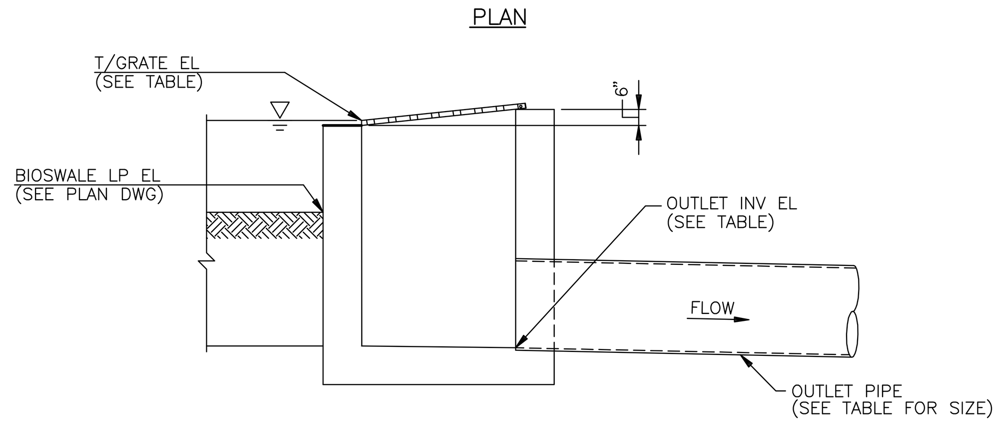
SECTION 1
NO SCALE



SECTION 2
NO SCALE

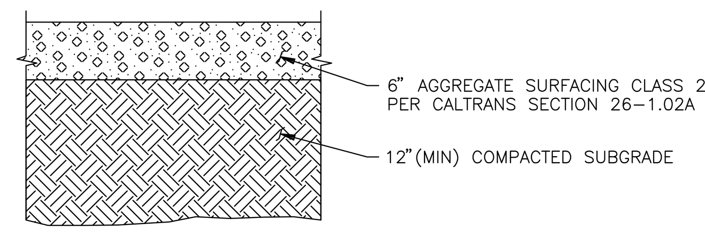


PLAN

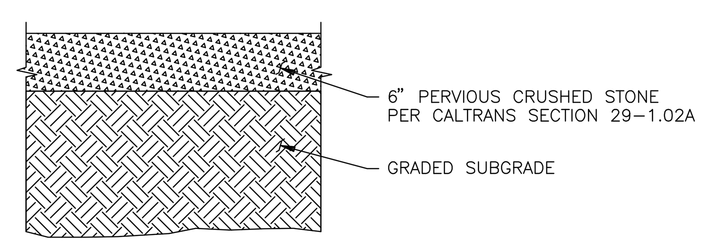


SECTION

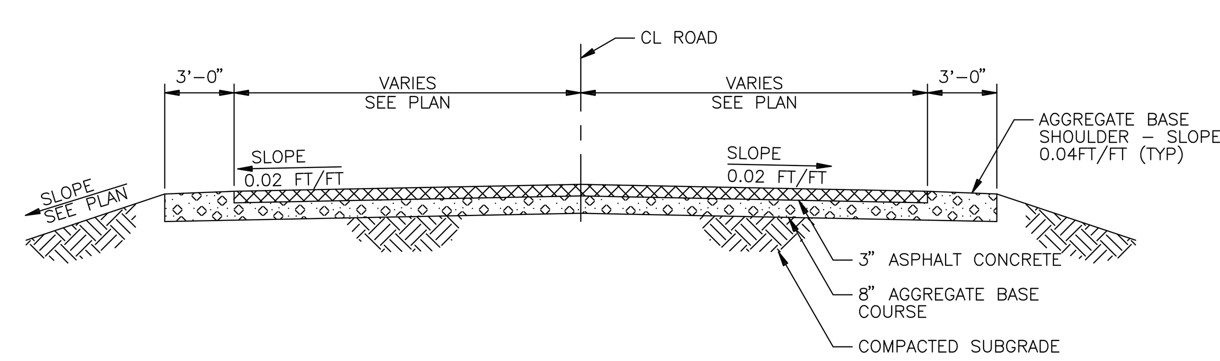
TYPICAL BIOSWALE DROP STRUCTURE DETAIL
NO SCALE



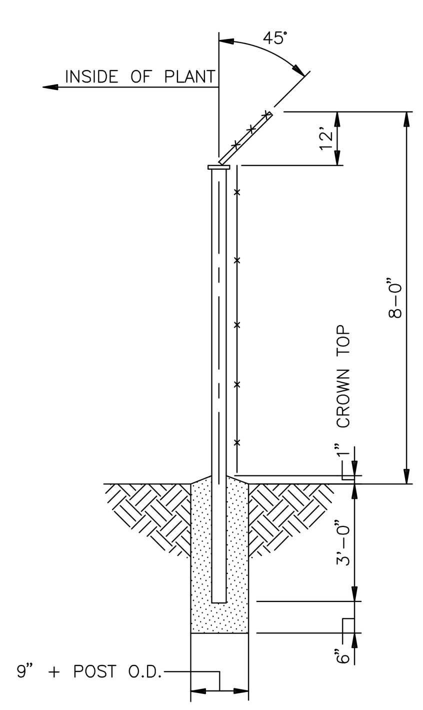
TYPICAL AGGREGATE SURFACING SECTION
NO SCALE



TYPICAL PERVIOUS CRUSHED STONE SURFACING SECTION
NO SCALE



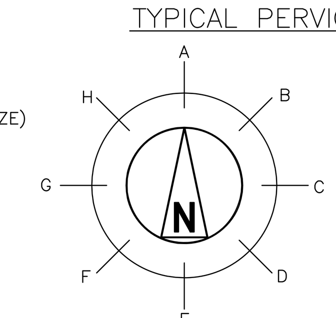
TYPICAL PAVED ROAD
NO SCALE
SEE DWG SS-3201



TYPICAL SECURITY FENCE POST DETAIL
NO SCALE

CULVERT TABLE

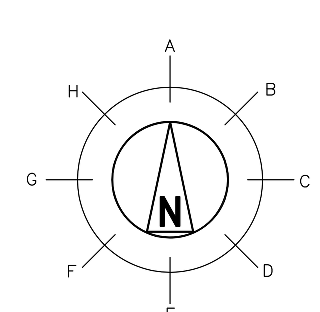
CULVERT NO.	INLET INV ELEVATION	OUTLET INV ELEVATION	LENGTH	PIPE DIAMETER	PIPE MATERIAL	REMARKS
C-1	8.2	8.0	–	24"	–	
C-2						NOT USED
C-3	13.0	13.0	–	18"	–	
C-4	13.2	13.0	–	18"	–	
C-5	13.1	12.9	–	12"	–	
C-6	13.1	12.9	–	12"	–	
C-7	13.3	13.0	–	12"	–	
C-8	13.2	13.0	–	12"	–	
C-9	13.0	13.0	–	12"	–	
C-10	13.0	13.0	–	15"	–	
C-11	13.4	12.6	–	12"	–	
C-12	13.0	13.0	–	18"	–	
C-13	13.4	12.6	–	12"	–	
C-14	13.5	12.5	–	12"	–	
C-15	10.3	10.0	–	18"	–	
C-16	12.5	12.5	–	18"	–	
C-17	14.7	14.4	–	12"	–	
C-18	12.8	12.5	–	18"	–	
C-19	10.5	10.0	–	18"	–	
C-20	13.0	13.0	–	18"	–	
C-21	13.0	13.0	–	18"	–	



CATCH BASIN AND MAN HOLE TABLE

STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
				A		B		C		D		E		F		G		H		
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
CB-6	–	–	16.0	–	–	–	–	–	–	–	–	12.3	18"	–	–	–	–	–	–	
CB-7	NOT USED																			
CB-8	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.5	12"	
CB-9	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-10	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–	
CB-11	–	–	17.0	–	–	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	
CB-12	–	–	17.0	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	–	–	
CB-13	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	–	–	
CB-14	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–	
CB-15	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	
CB-16	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–	
CB-17	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–	
CB-18	–	–	16.5	–	–	13.2	12"	–	–	–	–	–	–	–	–	13.2	12"	–	–	
CB-19	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-20	–	–	16.5	–	–	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	
CB-21	–	–	16.5	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	–	–	
CB-22	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-23	–	–	16.5	–	–	–	–	13.2	12"	–	–	–	–	–	–	13.2	12"	–	–	
CB-24	NOT USED																			
CB-25	–	–	15.0	–	–	–	–	–	–	11.6	18"	–	–	–	–	11.8	18"	–	–	
CB-26	–	–	16.0	13.2	18"	–	–	–	–	–	–	13.2	18"	–	–	–	–	–	–	
CB-27	–	–	16.5	–	–	–	–	–	–	–	–	12.8	18"	–	–	12.8	18"	–	–	
MH-1	–	–	13.0	–	–	–	–	8.2	24"	8.7	18"	–	–	–	–	8.2	24"	–	–	
MH-2	–	–	17.0	11.2	18"	–	–	–	–	–	–	–	–	–	–	11.0	18"	–	–	
MH-3	–	–	16.5	–	–	–	–	10.3	18"	–	–	–	–	–	–	–	–	10.3	18"	

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST



DROP (DS) AND OUTLET (OS) STRUCTURE TABLE

STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
				A		B		C		D		E		F		G		H		
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
DS-1	NOT USED	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
OS-2	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11.8	18"	
OS-3	NOT USED																			
OS-4	–	–	15.5	13.5	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
OS-5	–	–	14.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10.5	18"	
OS-6	–	–	14.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.5	24"	

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST

ALL BACKCIRCLED CHANGES PER ECN-N-S-0005

NOTES

1. FILTER FABRIC SHALL BE UV-STABILIZED NONWOVEN GEOTEXTILE HAVING A MINIMUM WEIGHT OF 135 g/M^2 PER CALTRANS SS 88-1.03.
2. SEE DWG SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
2	22/SEP/10	ISSUED FOR PERMITTING	ARB	CAK		PLN	DVW
1	18/JUN/10	ISSUED FOR PERMITTING	RJS	CAK		PLN	DVW
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

60' 30' 0 60' 120'
SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

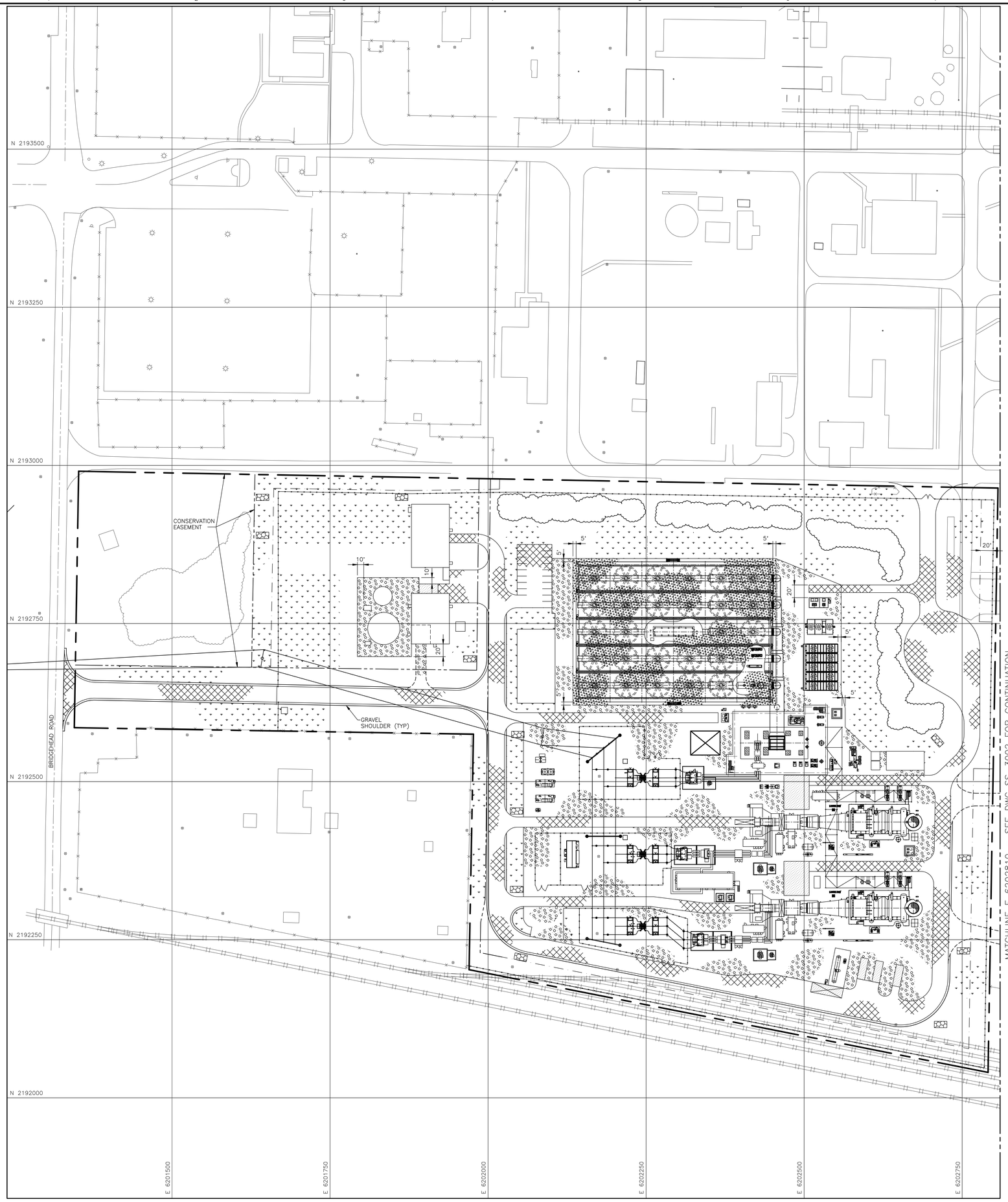
BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SITE
SECTIONS AND DETAILS

PROJECT DRAWING NUMBER 163994-SS-3050 REV 2
CODE
AREA

BEL30576 E1 ACAD 16.1s (LMS Tech)
A1APL017 1=1
09/22/10 15:52:09



SITE SURFACING LEGEND

- ASPHALT SURFACING
- AGGREGATE SURFACING
- CONCRETE
- GRASS
- OPEN GRADED STONE SURFACING
- RIPRAP
- EXISTING FACILITY
- NEW FACILITY
- NATURAL SOIL

NOTES

1. SEE DRAWING SS–3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

N

60' 30' 0 60' 120'
SCALE: 1"=60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____
DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN | DRAWN NAW
CHECKED | DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SURFACING/FENCING/ROADWAY – SITE PLAN – SHEET 1

PROJECT DRAWING NUMBER: 163994–SS–3201
REV: 0
CODE
AREA

SPU3716Z ACAD 16.1s (LMS Tech)
A-1907 E1 1=1
04/15/09 14:11:39

BLACK & VEATCH

Calculation Record

Client Name: Radback Energy Page 1 of 53

Project Name: Tenaska Project No.: 163994

Calculation Title: Stormwater Analysis for Wetland

Calculation No./File No.: 52. 5406. 1003

Calculation Is: (check all that apply) ☐ Preliminary ☒ Final ☐ Nuclear Safety-Related

Objective To determine if the existing wetland at the Tenaska project site can retain the runoff of a 100-yr 24-hr storm without overflowing to other properties. The analysis is performed for pre-construction ground conditions at the site.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page 2 of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: HEC-HMS Version: 3.3

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	J Zhong Jimmy Zhong	March 5, 2009	[illegible]	6 MAR 09	[illegible]	6 MAR 09
1	J Zhong Jimmy Zhong	21 APR 09	[illegible]	21 APR 09	[illegible]	21 APR 09
2	C Kantola [illegible]	8 Jun 10	[illegible]	10 JUN 10	[illegible]	10 JUN 10
3	C Kantola [illegible]	9 Sept 10	[illegible]	16 Sept 10	[illegible]	16 Sept 10

Purpose

To determine if the existing wetland at the Tenaska project site can retain the runoff of a 100-year 24-hour storm without overflowing to other properties. The analysis is performed for pre-construction ground conditions at the project site. The existing wetland has no outlet structure.

References

1. Black & Veatch Drawings:
   - 163994-SS-3001, Rev. A, "Grading & Drainage - Site"
   - 163994-SS-3002, Rev. A, "Grading & Drainage - Site"
2. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
3. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, User's Manual, Version 3.3; September 2008.
4. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, Technical Reference Manual; March 2000.
5. US Department of Commerce; Technical Paper No. 40; Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years; May 1961.
6. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
7. Mays, L. W.; Stormwater Collection Systems Design Handbook, McGraw-Hill; 2001.
8. Black & Veatch Calculation, "IMP Sizing for Plant Area", File No. 52.5406.1002 Rev 0, Same project, March 2009 (Rev 1)
9. Contra Costa County Public Works Department; Mean Seasonal Isohyets (Dwg B-166) Precipitation Duration-Frequency-Depth Curves (100-YR) (Dwg B-159); 1977 (Rev 2)

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)
Drainage area in acres (ac)

Attachments

1. HEC-HMS Input
2. HEC-HMS Output
3. Reference 2 – Select Pages
4. Reference 6 – Select Pages

Summary

8.9 (Rev 2) PLN 6/10/10

Based on the HEC-HMS analysis, the maximum water elevation in the wetland is determined to be EL ~~9.1~~ feet. The lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis with current ground cover conditions, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm. ~~Since the project site will be developed based on Contra Costa County's Stormwater C.3 Guidebook, the post development runoff will be no greater than pre-development runoff.~~

Rev 1

VOID Rev 2 PLN 6/10/10
See Calculation 52.5406.1006 & .1007 for further information on post-development.

SUPERSEDED 9/7/10 CAK

SEE PAGE 3a

Summary

Based on the HEC-HMS analysis, the maximum water elevation in the wetland is determined to be EL 9.0 feet. The lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis with current ground cover conditions, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm.

See calculations 52.5406.1006 and .1007 for further information on post-development.

Hydrology Modeling – HEC-HMS

There is one drainage area that will drain to the wetland. See Page 5 for the boundary delineation of this area. This drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

The stormwater runoff to the wetland for a 100-year 24-hour storm event was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

Section 1.0 Determine the Time of Concentration

Time of concentration (T_c) can be calculated as:

$$T_c = T_{sheet} + T_{shallow} + T_{channel} \quad \text{(Ref. 4, Eq. 6-11)}$$

Where:

T_{sheet} = travel time in sheet flow;
$T_{shallow}$ = travel time in shallow concentrated flow;
$T_{channel}$ = travel time in open channels.

There is no open channel flow on this site. Thus $T_{channel} = 0$.

The flow path from the hydraulically most distant point of this drainage area to the wetland is identified as shown on Page 5.

The total flow length is measured to 1490 feet.

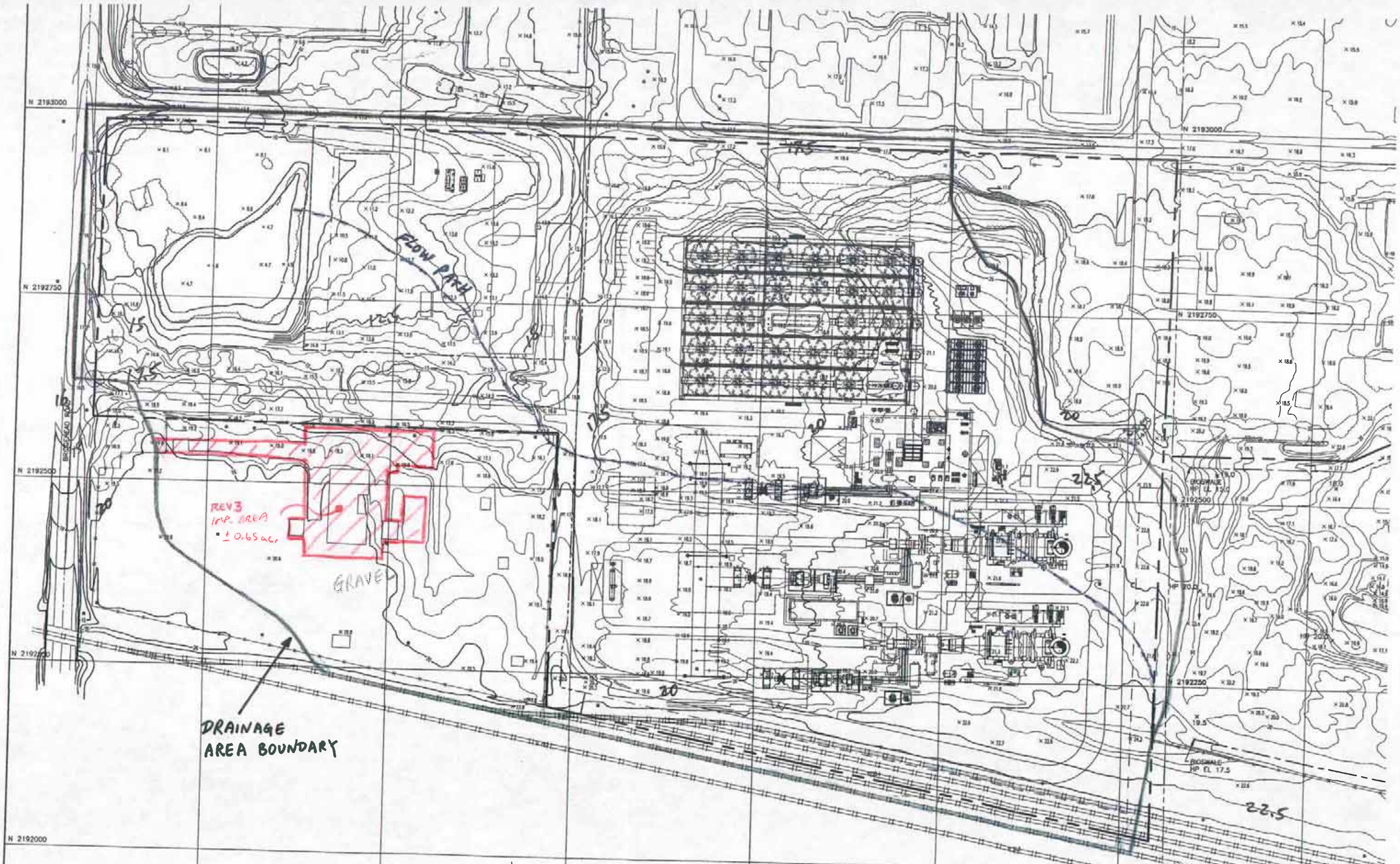
(1) Sheet Flow

Sheet flow travel time can be calculated as:

$$T_{sheet} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad \text{(Ref. 2, Eq. 3-3)}$$

Where:

n = roughness coefficient;
L = flow length (ft);
P_2 = 2-year, 24-hour rainfall (in);
s = land slope (ft/ft).



Radback Tenaska project
project # 163994
57.5436.1003

stormwater Analysis
page 5 of 53

prepared by: J zhong
Date 3/4/09
checked by: PLN
Date: 3/6/09

REV 3 CAK
DATE 9/9/10
CK BY: PLN
DATE: 9/16/10

NOTE: THIS PAGE IS A PORTION OF B&V
Drawing 163994-SS-3001 Rev A.

ACAD 16.1s (LMS Tech)
1=1
E1
09.17.10

0.06 (Rev. 2) PLN 6/10/10 < (Rev 2)

Roughness coefficient n = 0.~~17~~ for "cultivated soils, residue cover ~~≤~~20%". (Ref. 2, Table 3-1)

Existing conditions have sparse ground coverage based on aerial photos | Rev 2

Per Ref. 2, "After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow". Use sheet flow length L = 300 feet.

1.6 (Rev 2) PLN 6/10/10 9 (Rev 2)

2-year, 24-hour rainfall P_2 = ~~2~~ inch for this site per Ref. ~~5~~ (see Page 8).

The land slope for the first 300 feet = (24.2-21.5)/300 = 0.009 ft/ft. (Refer to Page 5)

0.06 (Rev 2) 0.37 (Rev 2)

Thus, $T_{sheet} = \dfrac{0.007 \times (0.\cancel{17} \times 300)^{0.8}}{\cancel{2}^{0.5} \times 0.009^{0.4}}$ = 0.~~76~~ hour.

1.6 (Rev 2) PLN 6/10/10

(2) Shallow Concentrated Flow

The flow length for shallow concentrated flow L = 1490-300 = 1190 feet.

The average watercourse slope = (21.5-5) / 1190 = 0.014 ft/ft. (Refer to Page 5)

Based on a slope of 0.014 ft/ft, from Ref. 2, Figure 3-1, the average velocity (V) for "unpaved" surface is found to be:

V = 1.9 ft/sec.

Thus the travel time for shallow concentrated flow is calculated to be:

$$T_{shallow} = \frac{L}{3600 \times V} = \frac{1190}{3600 \times 1.9} = 0.17 \text{ hour.}$$

In summary, the time of concentration is calculated to be:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$

= ~~0.76~~ + 0.17 + 0

(Rev 2) 0.37

= 0.~~93~~ hour.

0.54 hr (Rev. 2) PLN 6/10/10

Per Ref. 4, "For ungaged watersheds, the SCS suggests that the UH (unit hydrograph) lag time may be related to the time of concentration, T_c, as: $T_{lag} = 0.6\ T_c$". See Page 7.

The SCS UH lag time (T_{lag}) is an input parameter into the HEC-HMS computer program. Thus

T_{lag} = 0.6 x 0.~~93~~ = 0.~~56~~ hour = 3~~3~~.6 minutes.

0.54 = 0.324 hr = 19.4 min (Rev. 2)

PLN 6/10/10

Radback Tenaska project project # 163394 52.5406.1003 stormwater Analysis page 7 of 53

UH can be found from the dimensionless form, which is included in HEC-HMS, by multiplication.

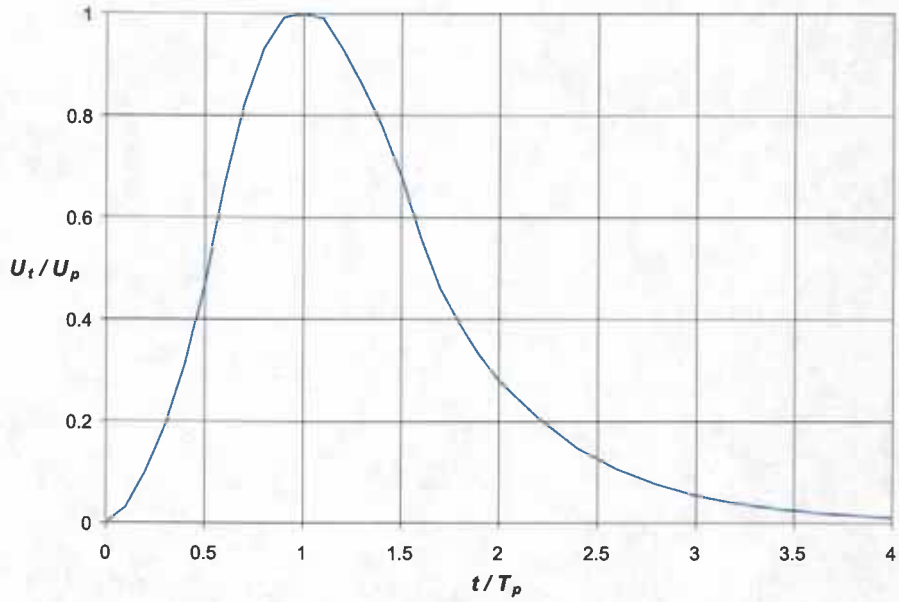


Figure 6-2. SCS unit hydrograph

Estimating the SCS UH Model Parameters

The SCS UH lag can be estimated via calibration, using procedures described in Chapter 9, for gaged headwater subwatersheds.

For ungaged watersheds, the SCS suggests that the UH lag time may be related to time of concentration, t_c, as:

$$t_{lag} = 0.6\, t_c \qquad (6\text{-}10)$$

Time of concentration is a quasi-physically based parameter that can be estimated as

$$t_c = t_{sheet} + t_{shallow} + t_{channel} \qquad (6\text{-}11)$$

where t_{sheet} = sum of travel time in sheet flow segments over the watershed land surface; $t_{shallow}$ = sum of travel time in shallow flow segments, down streets, in gutters, or in shallow rills and rivulets; and $t_{channel}$ = sum of travel time in channel segments.

NOTE: THIS PAGE IS FROM REF. 4.

Identify open channels where cross section information is available. Obtain cross sections from field surveys, maps, or aerial photographs. For these channels, estimate velocity by Manning's equation:

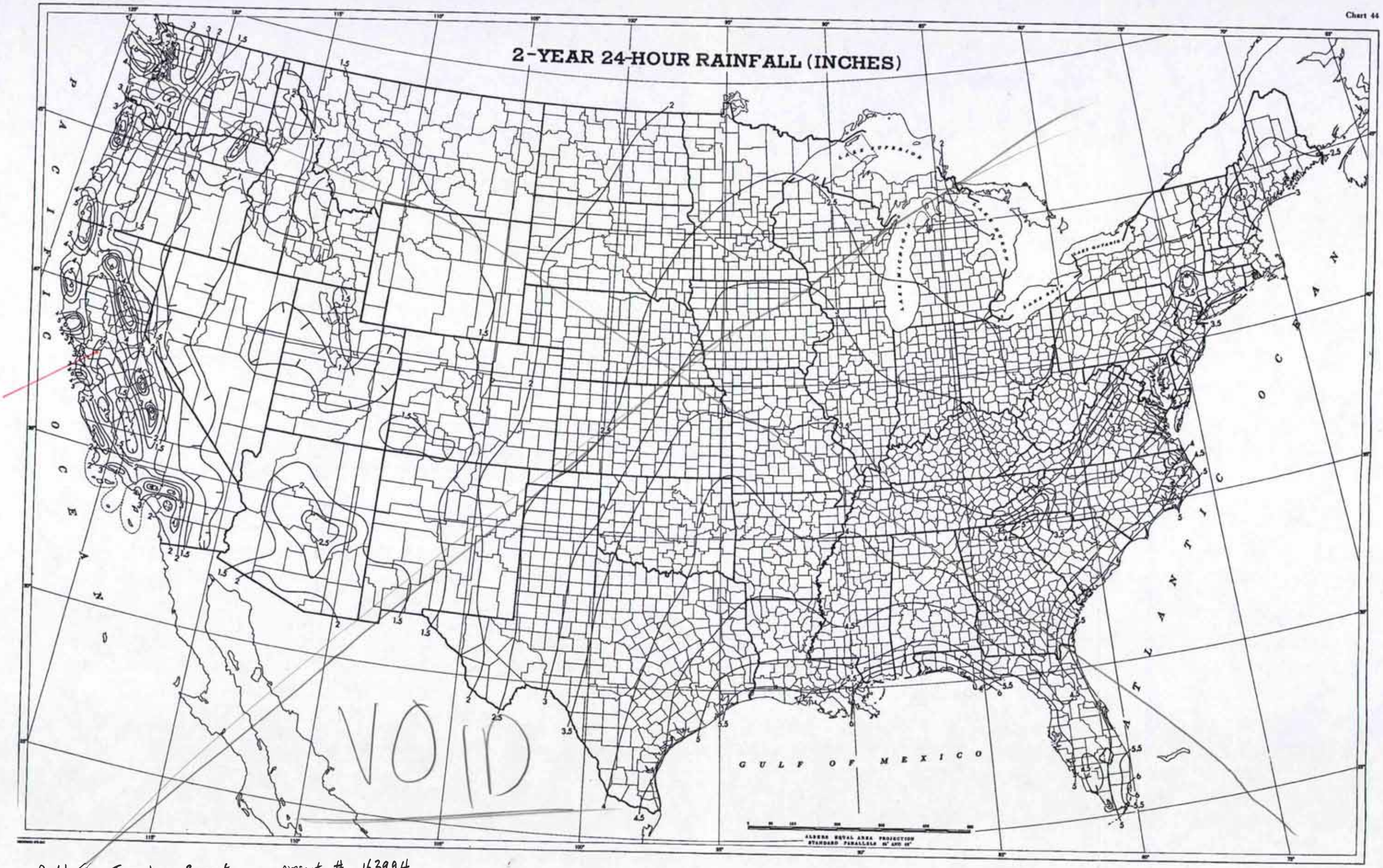
$$V = \frac{CR^{2/3}S^{1/2}}{n} \qquad (6\text{-}12)$$

where V = average velocity; R = the hydraulic radius (defined as the ratio of channel cross-section area to wetted perimeter); S = slope of the energy grade

REV 2) Radback Tenaska Project
Stormwater Analysis

Project # 163994
page 8 of 53
52.5406.1003

Note:
This page is from Ref. 9



Radback Tenaska Project
Stormwater Analysis

project # 163994
page 8 of 53
52.5416.1003

NOTE: THIS PAGE IS FROM REF. 5.

SUPERSEDED BY REV 2

Section 2.0 Rainfall Distribution

From Ref. 2, Figure B-2, the rainfall distribution for the site in Contra Costa County, California should be Type I distribution.

From Ref. 5, the 100-year 24-hour rainfall amount for the site is ~~4~~ 3.9 (Rev. 2) PLN 6/10/10 inches. (See Page 10) + 10A

Section 3.0 Determine the Composite SCS Curve Number

"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area.

The drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

Per Ref. 2, Table 2-2b, the curve number (CN) for "Row Crops, straight row (SR) with crop residue cover (CR)" for Group A soil is between 64 (good condition) and 71 (poor condition). Use the average curve number 68 for the vineyard area.

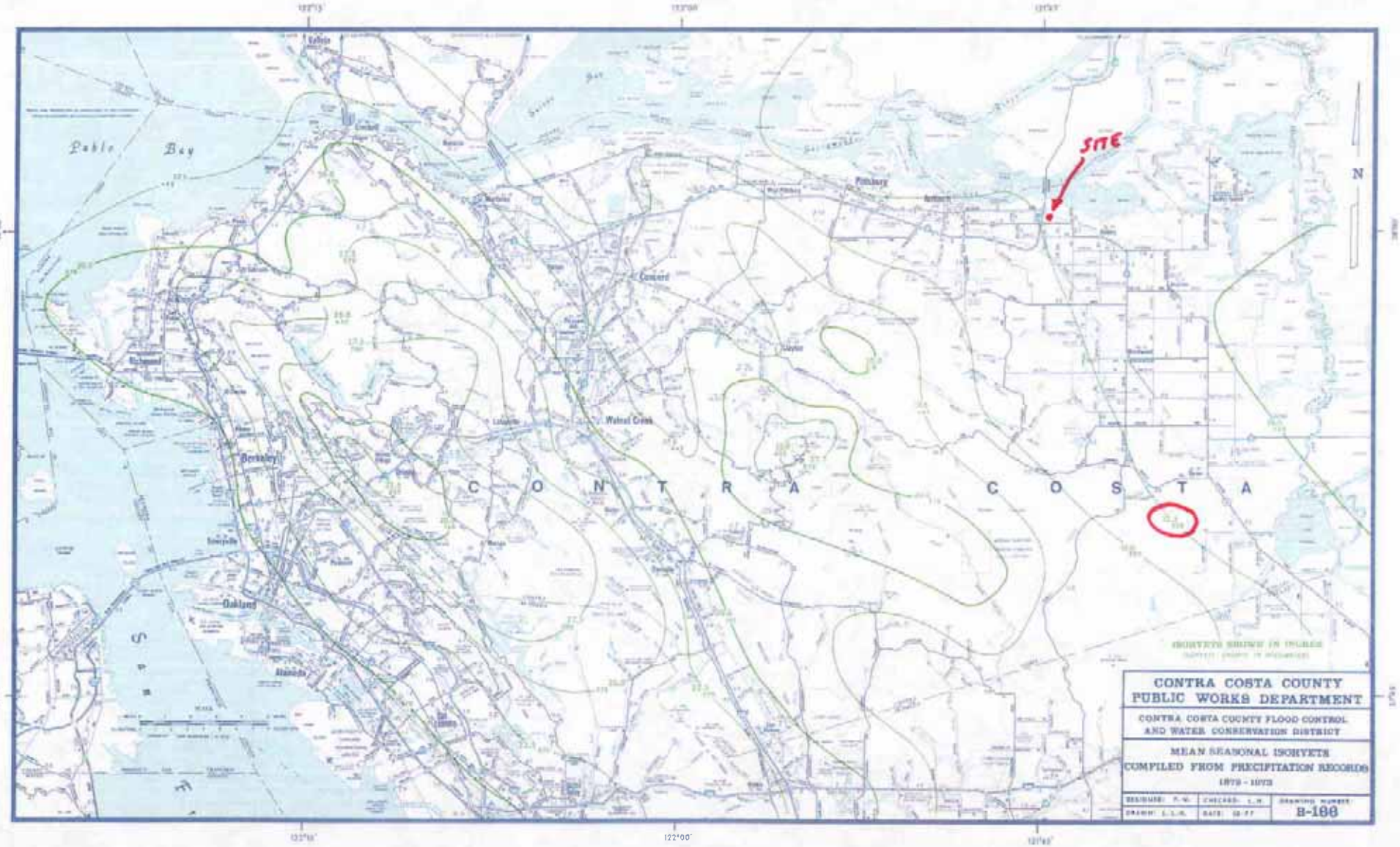
Per Ref. 2, Table 2-2a, the curve number for gravel area for Group A soil is 76. The ground cover in railroad yard is similar to the gravel area. Use the same curve number (76) for the railroad yard.

Treat the wetland as an impervious area since it may have standing water in it. Per Ref. 2, Table 2-2a, a curve number of 98 can be used for this area.

Thus the composite curve number (CN) for the drainage area is calculated as:

$$CN = (19.85 \times 68 + 3.96 \times 76 + 0.94 \times 76 + 0.40 \times 98) / 25.15 = 70.$$

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It



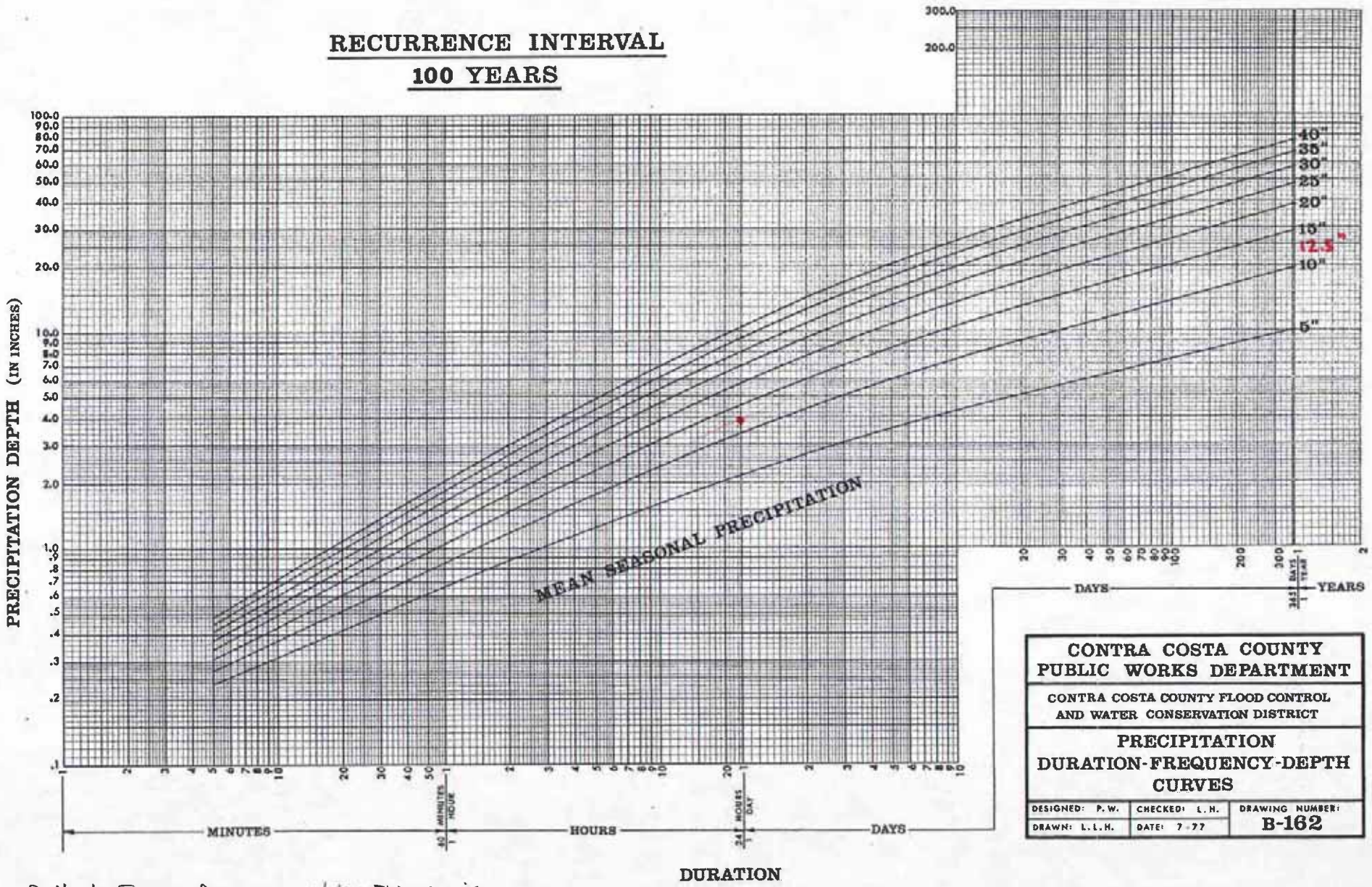
Rev 2

Radback Tenaska Project
Stormwater Analysis

Project # 167994
Page 10 of 53
52.5406.1003

Note: this page is from Ref. 9

MSP = 12.5"



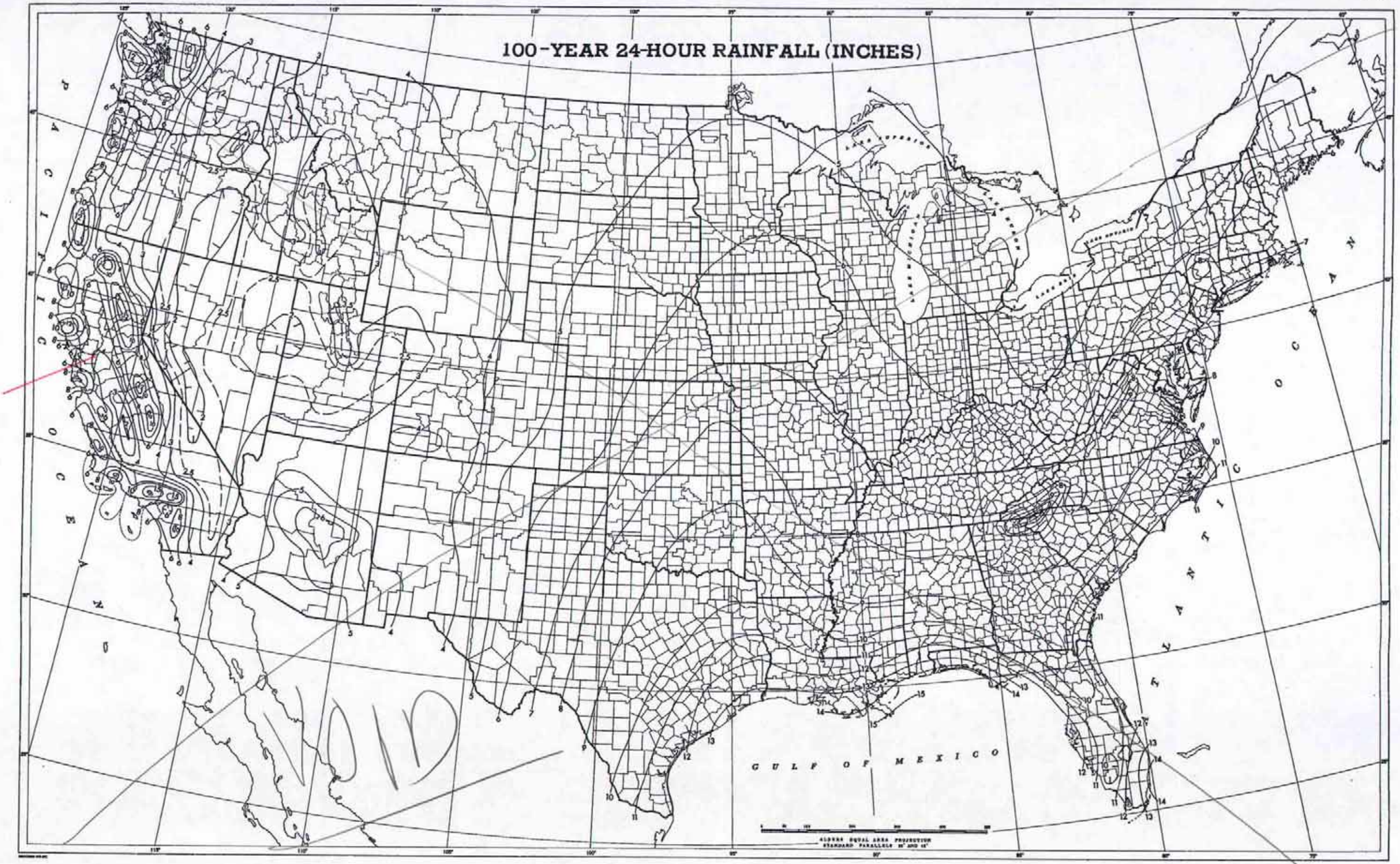
CONTRA COSTA COUNTY PUBLIC WORKS DEPARTMENT		
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT		
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES		
DESIGNED: P.W.	CHECKED: L.H.	DRAWING NUMBER: B-162
DRAWN: L.L.H.	DATE: 7-77	

REV 2

Redback Tenaska Project
Stormwater Analysis
Project # 163994
Page 10a of 53
52.5406.1003

Note: This pg. is from Ref. 9

MSP = 12.5" (DWG B-166)
24-HR = 3.9" (ABOVE)



56

Radback Tenaska project
Stormwater Analysis

project # 163994
page 10 of 53
52.5406.1003

SUPERSEDED BY REV. 2

NOTE: THIS PAGE IS FROM REF. 5.

includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2)

Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 70, the initial abstraction is calculated to be:

$$I_a = 0.2 \times (1000/70 - 10) = 0.857 \text{ inch.}$$

and pavement

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. The impervious area consists of the roofs of a few small buildings in the southwest portion of the drainage area. By using AutoCAD, the total roof area is measured to be ~~0.17~~ acre. Thus,

% impervious = ~~0.17~~ / 25.15 = ~~0.68~~%, say ~~1~~%.

REV 3 0.65 0.65/25.15 = 2.58% 2.6%

✓ PW 9/16/10

Section 4.0 Wetland Area versus Elevation

The bottom of the wetland is at an approximate elevation of 5 feet. See B&V Drawing SS-3001 (Page 5). The relationship of Area versus Elevation for the wetland area was presented in the table below. The wetland area was measured by using AutoCAD. It should be noted that a small portion of the wetland at the east side within the project property will be filled at a later time. This area will be graded at a 4 (H) to 1 (V) slope towards the wetland. The area in the table below at Elevation 10 (1.44 acres) has already had the future fill area been deducted to accurately model the wetland storage capacity.

Elevation (ft)	Wetland Area (acre)
5.0	0.40
7.5	0.62
10.0	1.44

Section 5.0 HEC-HMS Output

The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The initial water elevation in the wetland is specified to be at

EL 5 assuming that standing water in the wetland is not higher than EL 5 before the 100-year 24-hour storm begins.

The maximum water elevation in the wetland was calculated by running the HEC-HMS program.

The output results are included in Attachment 2 and are summarized below.

			(Rev 2)	(Rev 3)
Peak Inflow:	~~9.0~~ 11.8 ft³/sec.	12.3		
~~Peak Storage~~ Total Runoff:	~~2.8~~ acre-feet	2.10	2.79	
Peak Elevation:	~~9.1~~ 8.9 feet.	9.0		

PLN 6/10/10

Rev 1 ~~Reference 8 demonstrates that the developed project meets the requirements of Contra Costa County's Stormwater C.3 Guidebook. The basis of the C.3 guidebook is flow control and treatment of stormwater runoff. Hence, the post development runoff will be no greater than pre-development runoff.~~

VOID Rev 2 PLN 6/10/10

Conclusion:

Based on the HEC-HMS analysis, the existing wetland will be able to contain all the runoff from its drainage area at current ground cover conditions for a 100-year 24-hour storm.

From B&V Drawing SS-3001, the lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm. Rev 1 ~~Since the project site will be developed based on Contra Costa County's Stormwater C.3 Guidebook, the post development runoff will be no greater than pre-development runoff~~

VOID Rev 2 PLN 6/10/10

SUPERSEDED 9/7/10 CAK

SEE PG 12a

EL 5 assuming that standing water in the wetland is not higher than EL 5 before the 100-year 24-hour storm begins.

The maximum water elevation in the wetland was calculated by running the HEC-HMS program.

The output results are included in Attachment 2 and are summarized below.

Peak Inflow:	12.3 ft^3/sec.
Total Runoff:	2.79 acre-feet
Peak Elevation:	9.0 feet

Conclusion:

Based on the HEC-HMS analysis, the existing wetland will be able to contain all the runoff from its drainage area at current ground cover conditions for a 100-year 24-hour storm.

From B&V Drawing SS-3001, the lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.5 feet. Based on the HEC-HMS analysis, the stormwater runoff to the wetland will not overflow to other properties for a 100-year 24-hour storm.

Radback Tenaska project
project # 163994

Stormwater Analysis

JZ 3/4/09

# of pages : 12
52.5406.1003

Including This Page.

Attachment 1

HEC-HMS Input

Rev 3 all pages
PKW 16 Sept 10

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

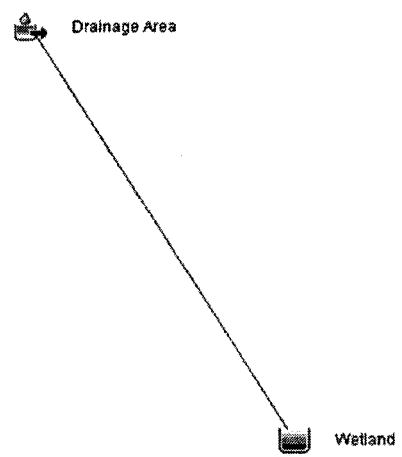
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Description:	Tenaska Site
Downstream:	Wetland
Area (MI2)	0.0393
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
  - Control Specifications
  - Time-Series Data
  - Paired Data

Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

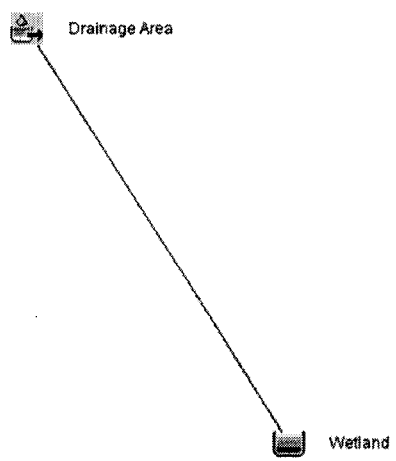
Initial Abstraction (IN) 0.857

Curve Number: 70

Impervious (%) 2.6

REV3

Basin Model [Basin 1] Current Run [Run 1]



NOTE 10179: Opened basin model "Basin 1" at time 11Mar2009, 13:42:37.
NOTE 10181: Opened control specifications "Control 1" at time 11Mar2009, 13:42:56.
NOTE 10180: Opened meteorologic model "Met 1" at time 11Mar2009, 13:42:56.
NOTE 10184: Began computing simulation run "Run 1" at time 11Mar2009, 13:42:58.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 11Mar2009, 13:42:58.

start | Inbox - Microsoft Out... | HEC-HMS 3.3 [C:\hms... | 1:45 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

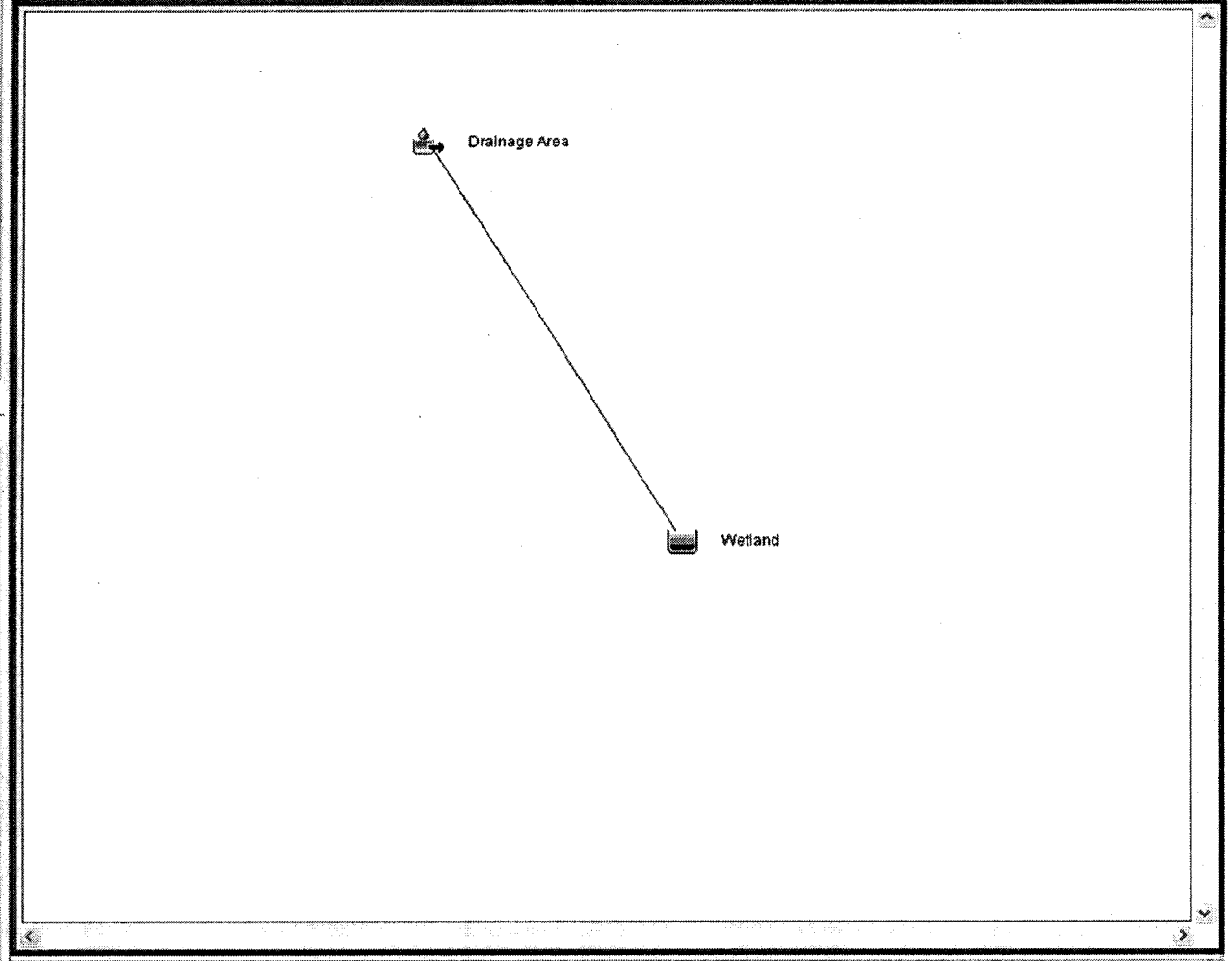
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area
Graph Type: Standard
Lag Time (MIN) 33.800000

19.4 (Rev 2)

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

Start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:22 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

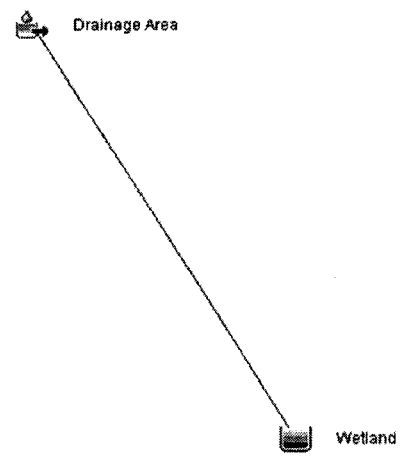
Components | Compute | Results

Subbasin | Loss | Transform | Options

Basin Name: Basin 1
Element Name: Drainage Area

Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

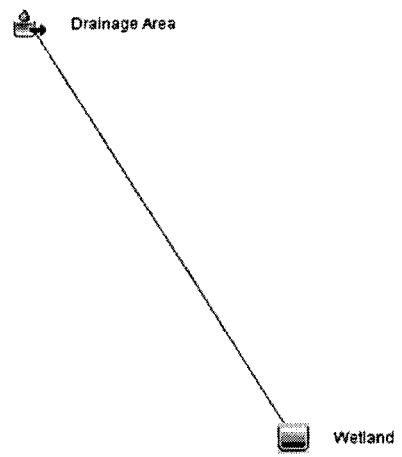
Components | Compute | Results

Reservoir | Options

Basin Name: Basin 1
Element Name: Wetland

Description:	Wetland Storage
Downstream:	--None--
Method:	Specified Release
Storage Method:	Elevation-Area
Elev-Area Function:	Reservoir-1(Basin 1)
Initial Condition:	Elevation
Initial Elevation (FT)	5.0
Discharge Gage:	Gage 1
Max Release (CFS)	
Max Capacity (AC-FT)	

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:24 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

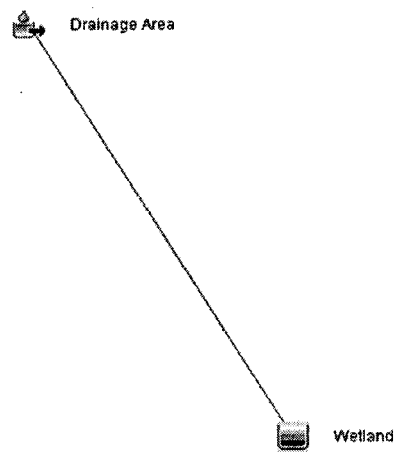
Components | Compute | Results

Reservoir | Options

Basin Name: Basin 1
Element Name: Wetland

Observed Flow: --None--
Observed Stage: --None--
Observed Pool Elevation: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:

Basin Model [Basin 1] Current Run [Run 1]



NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:25 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

Components | Compute | Results

Meteorology Model | Basins

Name: Met 1

Description: Antioch, CA (100-yr 24-hr storm)

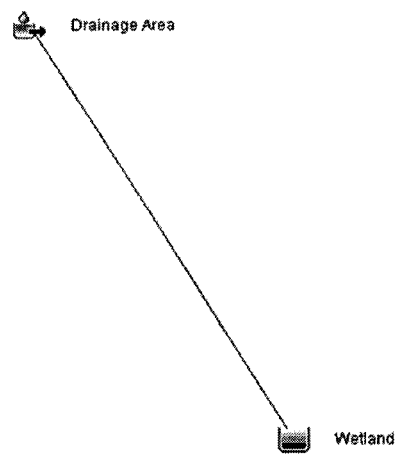
Precipitation: SCS Storm

Evapotranspiration: --None--

Snowmelt: --None--

Unit System: U.S. Customary

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | Untitled - Paint | 2:26 PM

HEC-HMS 3.3 [C:\hmaproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

Components | Compute | Results

Precipitation

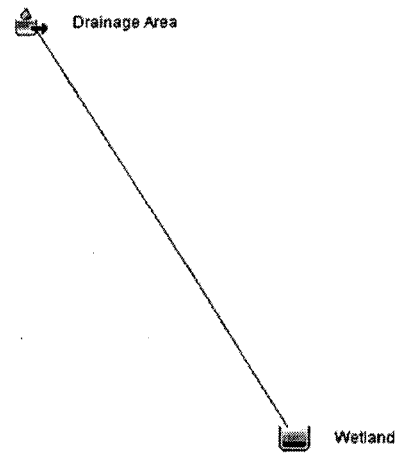
Name: Met 1

Method: Type 1

Depth (IN) ~~4.8~~

3.9 (Rev 2)

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

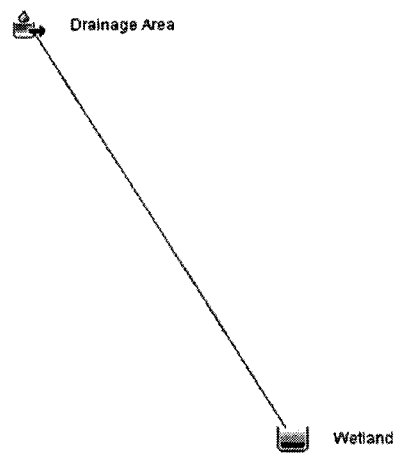
- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
      - Gage 1
  - Paired Data
    - Elevation-Area Functions
      - Reservoir-1(Basin1)

Components | Compute | Results

Paired Data | Table | Graph

Elevation (FT)	Area (AC)
5.0	0.40
7.5	0.62
10.0	1.44

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:29 PM

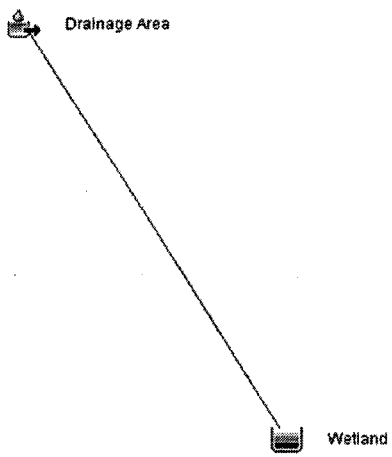
HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
      - Gage 1
        - 10Jan2020, 06:00 - 12Jan2020, 06:00
  - Paired Data
    - Elevation-Area Functions
      - Reservoir-1(Basin 1)

Components | Compute | Results

Basin Model [Basin 1] Current Run [Run 1]



Time-Series Gage | Time Window | Table | Graph

Time (ddMMMYYYY, HH:mm)	Discharge (CFS)
10Jan2020, 06:00	0.0
10Jan2020, 07:00	0.0
10Jan2020, 08:00	0.0
10Jan2020, 09:00	0.0
10Jan2020, 10:00	0.0
10Jan2020, 11:00	0.0
10Jan2020, 12:00	0.0
10Jan2020, 13:00	0.0
10Jan2020, 14:00	0.0
10Jan2020, 15:00	0.0
10Jan2020, 16:00	0.0
10Jan2020, 17:00	0.0
10Jan2020, 18:00	0.0
10Jan2020, 19:00	0.0
10Jan2020, 20:00	0.0
10Jan2020, 21:00	0.0
10Jan2020, 22:00	0.0
10Jan2020, 23:00	0.0
11Jan2020, 00:00	0.0
11Jan2020, 01:00	0.0
11Jan2020, 02:00	0.0
11Jan2020, 03:00	0.0
11Jan2020, 04:00	0.0
11Jan2020, 05:00	0.0
11Jan2020, 06:00	0.0

```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start | HEC-HMS 3.3 [C:\hm... | untitled - Paint | 2:11 PM

HEC-HMS 3.3 [C:\hmsproj\Radback\Radback.hms]

File Edit View Components Parameters Compute Results Tools Help

- Radback
  - Basin Models
    - Basin 1
      - Drainage Area
        - SCS Curve Number
        - SCS Unit Hydrograph
        - No Baseflow
      - Wetland
  - Meteorologic Models
    - Met 1
      - SCS Storm
  - Control Specifications
    - Control 1
  - Time-Series Data
    - Discharge Gages
  - Paired Data
    - Elevation-Area Functions

Components | Compute | Results

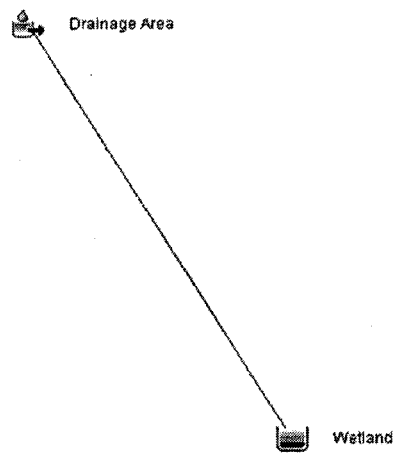
Control Specifications

Name: Control 1

Description:	Duration
Start Date (ddMMMYYYY)	10Jan2020
Start Time (HH:mm)	06:00
End Date (ddMMMYYYY)	12Jan2020
End Time (HH:mm)	06:00
Time Interval:	5 Minutes

3 (Rev 2)

Basin Model [Basin 1] Current Run [Run 1]




```
NOTE 10181: Opened control specifications "Control 1" at time 05Mar2009, 14:14:46.
NOTE 10179: Opened basin model "Basin 1" at time 05Mar2009, 14:14:46.
NOTE 10180: Opened meteorologic model "Met 1" at time 05Mar2009, 14:14:47.
NOTE 10184: Began computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Run 1" at time 05Mar2009, 14:14:48.
```

start

Radback Tenaska Project stormwater Analysis JZ 3/4/09

project # 163994

# of pages: ~~15~~ 18

52.5406.1003

Rev 3 9/7/10

All Pages

CAK

Attachment 2

HEC-HMS Output

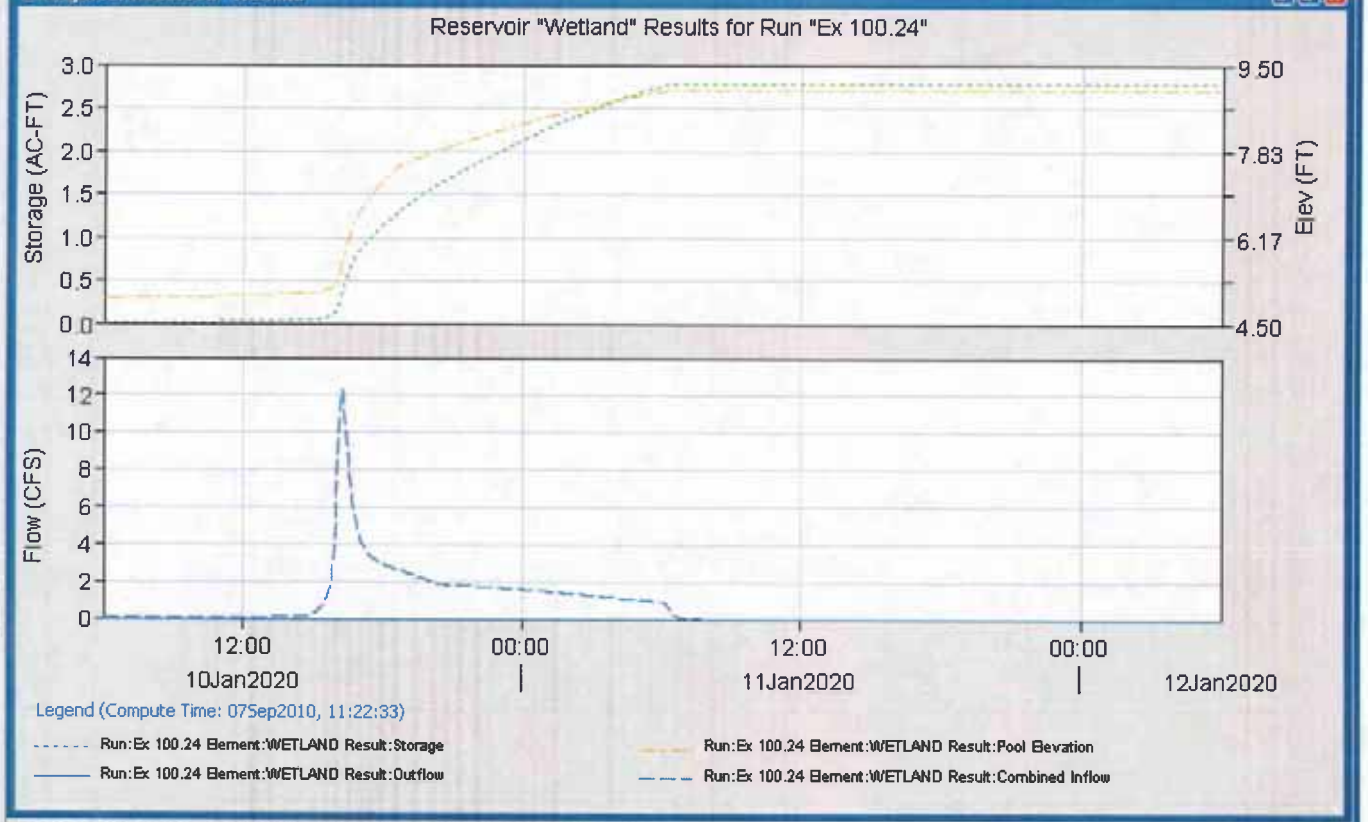
HEC-HMS 3.3 [C:_Projects\163994 Radback Oakley\Oakley2\Oakley2.hms]

File Edit View Components Parameters Compute Results Tools Help

- Oakley2
  - Simulation Runs
    - Ex 10.24
    - Ex 100.24
      - Global Summary
      - Drainage Area
      - Wetland
        - Graph
        - Summary Table
        - Time-Series Table
        - Outflow
        - Combined Inflow
        - Storage
        - Pool Elevation
        - Reservoir Area
    - Ex 1-inch
    - Pond 10.24
    - Pond 100.24
    - Pond 1-inch
    - REV1 - 100.24 per CEC
    - REV2 - 100.24 per CEC
    - REV3 - 100.24 reconfigured

Components | Compute | Results

Graph for Reservoir "Wetland"




```
NOTE 40049: Found no parameter problems in basin model "Basin 1 - Existing".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Ex 10.24" at time 07Sep2010, 11:22:37.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 07Sep2010, 11:22:39.
NOTE 10184: Began computing simulation run "Ex 1-inch" at time 07Sep2010, 11:22:41.
NOTE 20364: Found no parameter problems in meteorologic model "Storm3 - 1 inch".
NOTE 40049: Found no parameter problems in basin model "Basin 1 - Existing".
NOTE 41743: Initial abstraction ratio for subbasin "Drainage Area" is 0.2.
NOTE 10185: Finished computing simulation run "Ex 1-inch" at time 07Sep2010, 11:22:41.
```

REV 3

Project: Oakley2
Simulation Run: Ex 100.24 Reservoir: Wetland

Start of Run: 10Jan2020, 06:00 Basin Model: Basin 1 - Existing
End of Run: 12Jan2020, 06:00 Meteorologic Model: Storm1 - 100.24
Compute Time: 07Sep2010, 11:22:33 Control Specifications: Control 1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	06:00	0.0000	0.000	5.00	0.0000
10Jan2020	06:03	0.0003	0.000	5.00	0.0000
10Jan2020	06:06	0.0011	0.000	5.00	0.0000
10Jan2020	06:09	0.0028	0.000	5.00	0.0000
10Jan2020	06:12	0.0057	0.000	5.00	0.0000
10Jan2020	06:15	0.0097	0.000	5.00	0.0000
10Jan2020	06:18	0.0144	0.000	5.00	0.0000
10Jan2020	06:21	0.0193	0.000	5.00	0.0000
10Jan2020	06:24	0.0240	0.000	5.00	0.0000
10Jan2020	06:27	0.0282	0.000	5.00	0.0000
10Jan2020	06:30	0.0318	0.001	5.00	0.0000
10Jan2020	06:33	0.0347	0.001	5.00	0.0000
10Jan2020	06:36	0.0368	0.001	5.00	0.0000
10Jan2020	06:39	0.0385	0.001	5.00	0.0000
10Jan2020	06:42	0.0398	0.001	5.00	0.0000
10Jan2020	06:45	0.0409	0.001	5.00	0.0000
10Jan2020	06:48	0.0418	0.001	5.00	0.0000
10Jan2020	06:51	0.0424	0.002	5.00	0.0000
10Jan2020	06:54	0.0428	0.002	5.00	0.0000
10Jan2020	06:57	0.0432	0.002	5.00	0.0000
10Jan2020	07:00	0.0435	0.002	5.00	0.0000
10Jan2020	07:03	0.0438	0.002	5.00	0.0000
10Jan2020	07:06	0.0440	0.003	5.00	0.0000
10Jan2020	07:09	0.0442	0.003	5.01	0.0000
10Jan2020	07:12	0.0444	0.003	5.01	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	07:15	0.0447	0.003	5.01	0.0000
10Jan2020	07:18	0.0449	0.003	5.01	0.0000
10Jan2020	07:21	0.0450	0.003	5.01	0.0000
10Jan2020	07:24	0.0451	0.004	5.01	0.0000
10Jan2020	07:27	0.0451	0.004	5.01	0.0000
10Jan2020	07:30	0.0452	0.004	5.01	0.0000
10Jan2020	07:33	0.0452	0.004	5.01	0.0000
10Jan2020	07:36	0.0452	0.004	5.01	0.0000
10Jan2020	07:39	0.0451	0.005	5.01	0.0000
10Jan2020	07:42	0.0451	0.005	5.01	0.0000
10Jan2020	07:45	0.0451	0.005	5.01	0.0000
10Jan2020	07:48	0.0451	0.005	5.01	0.0000
10Jan2020	07:51	0.0451	0.005	5.01	0.0000
10Jan2020	07:54	0.0450	0.005	5.01	0.0000
10Jan2020	07:57	0.0450	0.006	5.01	0.0000
10Jan2020	08:00	0.0450	0.006	5.01	0.0000
10Jan2020	08:03	0.0450	0.006	5.01	0.0000
10Jan2020	08:06	0.0451	0.006	5.01	0.0000
10Jan2020	08:09	0.0451	0.006	5.01	0.0000
10Jan2020	08:12	0.0453	0.007	5.01	0.0000
10Jan2020	08:15	0.0454	0.007	5.01	0.0000
10Jan2020	08:18	0.0456	0.007	5.01	0.0000
10Jan2020	08:21	0.0457	0.007	5.01	0.0000
10Jan2020	08:24	0.0459	0.007	5.01	0.0000
10Jan2020	08:27	0.0461	0.008	5.01	0.0000
10Jan2020	08:30	0.0463	0.008	5.02	0.0000
10Jan2020	08:33	0.0466	0.008	5.02	0.0000
10Jan2020	08:36	0.0469	0.008	5.02	0.0000
10Jan2020	08:39	0.0473	0.008	5.02	0.0000
10Jan2020	08:42	0.0476	0.009	5.02	0.0000
10Jan2020	08:45	0.0478	0.009	5.02	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	08:48	0.0481	0.009	5.02	0.0000
10Jan2020	08:51	0.0484	0.009	5.02	0.0000
10Jan2020	08:54	0.0487	0.009	5.02	0.0000
10Jan2020	08:57	0.0490	0.010	5.02	0.0000
10Jan2020	09:00	0.0494	0.010	5.02	0.0000
10Jan2020	09:03	0.0497	0.010	5.02	0.0000
10Jan2020	09:06	0.0501	0.010	5.02	0.0000
10Jan2020	09:09	0.0505	0.010	5.02	0.0000
10Jan2020	09:12	0.0509	0.011	5.02	0.0000
10Jan2020	09:15	0.0513	0.011	5.02	0.0000
10Jan2020	09:18	0.0517	0.011	5.02	0.0000
10Jan2020	09:21	0.0521	0.011	5.02	0.0000
10Jan2020	09:24	0.0525	0.011	5.02	0.0000
10Jan2020	09:27	0.0529	0.012	5.02	0.0000
10Jan2020	09:30	0.0534	0.012	5.02	0.0000
10Jan2020	09:33	0.0538	0.012	5.02	0.0000
10Jan2020	09:36	0.0543	0.012	5.02	0.0000
10Jan2020	09:39	0.0547	0.012	5.02	0.0000
10Jan2020	09:42	0.0550	0.013	5.03	0.0000
10Jan2020	09:45	0.0554	0.013	5.03	0.0000
10Jan2020	09:48	0.0557	0.013	5.03	0.0000
10Jan2020	09:51	0.0560	0.013	5.03	0.0000
10Jan2020	09:54	0.0563	0.014	5.03	0.0000
10Jan2020	09:57	0.0567	0.014	5.03	0.0000
10Jan2020	10:00	0.0570	0.014	5.03	0.0000
10Jan2020	10:03	0.0574	0.014	5.03	0.0000
10Jan2020	10:06	0.0578	0.015	5.03	0.0000
10Jan2020	10:09	0.0582	0.015	5.03	0.0000
10Jan2020	10:12	0.0585	0.015	5.03	0.0000
10Jan2020	10:15	0.0589	0.015	5.03	0.0000
10Jan2020	10:18	0.0592	0.016	5.03	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	10:21	0.0594	0.016	5.03	0.0000
10Jan2020	10:24	0.0597	0.016	5.03	0.0000
10Jan2020	10:27	0.0599	0.016	5.03	0.0000
10Jan2020	10:30	0.0602	0.017	5.03	0.0000
10Jan2020	10:33	0.0603	0.017	5.03	0.0000
10Jan2020	10:36	0.0604	0.017	5.03	0.0000
10Jan2020	10:39	0.0605	0.017	5.03	0.0000
10Jan2020	10:42	0.0606	0.018	5.03	0.0000
10Jan2020	10:45	0.0607	0.018	5.04	0.0000
10Jan2020	10:48	0.0608	0.018	5.04	0.0000
10Jan2020	10:51	0.0610	0.018	5.04	0.0000
10Jan2020	10:54	0.0613	0.019	5.04	0.0000
10Jan2020	10:57	0.0616	0.019	5.04	0.0000
10Jan2020	11:00	0.0619	0.019	5.04	0.0000
10Jan2020	11:03	0.0621	0.019	5.04	0.0000
10Jan2020	11:06	0.0623	0.020	5.04	0.0000
10Jan2020	11:09	0.0624	0.020	5.04	0.0000
10Jan2020	11:12	0.0625	0.020	5.04	0.0000
10Jan2020	11:15	0.0626	0.020	5.04	0.0000
10Jan2020	11:18	0.0626	0.021	5.04	0.0000
10Jan2020	11:21	0.0627	0.021	5.04	0.0000
10Jan2020	11:24	0.0628	0.021	5.04	0.0000
10Jan2020	11:27	0.0628	0.021	5.04	0.0000
10Jan2020	11:30	0.0629	0.022	5.04	0.0000
10Jan2020	11:33	0.0631	0.022	5.04	0.0000
10Jan2020	11:36	0.0633	0.022	5.04	0.0000
10Jan2020	11:39	0.0634	0.022	5.04	0.0000
10Jan2020	11:42	0.0636	0.023	5.04	0.0000
10Jan2020	11:45	0.0638	0.023	5.05	0.0000
10Jan2020	11:48	0.0640	0.023	5.05	0.0000
10Jan2020	11:51	0.0643	0.023	5.05	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	11:54	0.0645	0.024	5.05	0.0000
10Jan2020	11:57	0.0647	0.024	5.05	0.0000
10Jan2020	12:00	0.0649	0.024	5.05	0.0000
10Jan2020	12:03	0.0651	0.025	5.05	0.0000
10Jan2020	12:06	0.0653	0.025	5.05	0.0000
10Jan2020	12:09	0.0654	0.025	5.05	0.0000
10Jan2020	12:12	0.0655	0.025	5.05	0.0000
10Jan2020	12:15	0.0657	0.026	5.05	0.0000
10Jan2020	12:18	0.0661	0.026	5.05	0.0000
10Jan2020	12:21	0.0667	0.026	5.05	0.0000
10Jan2020	12:24	0.0674	0.026	5.05	0.0000
10Jan2020	12:27	0.0683	0.027	5.05	0.0000
10Jan2020	12:30	0.0693	0.027	5.05	0.0000
10Jan2020	12:33	0.0704	0.027	5.05	0.0000
10Jan2020	12:36	0.0716	0.028	5.05	0.0000
10Jan2020	12:39	0.0728	0.028	5.06	0.0000
10Jan2020	12:42	0.0740	0.028	5.06	0.0000
10Jan2020	12:45	0.0753	0.029	5.06	0.0000
10Jan2020	12:48	0.0766	0.029	5.06	0.0000
10Jan2020	12:51	0.0779	0.029	5.06	0.0000
10Jan2020	12:54	0.0792	0.029	5.06	0.0000
10Jan2020	12:57	0.0805	0.030	5.06	0.0000
10Jan2020	13:00	0.0819	0.030	5.06	0.0000
10Jan2020	13:03	0.0833	0.030	5.06	0.0000
10Jan2020	13:06	0.0847	0.031	5.06	0.0000
10Jan2020	13:09	0.0861	0.031	5.06	0.0000
10Jan2020	13:12	0.0875	0.032	5.06	0.0000
10Jan2020	13:15	0.0887	0.032	5.06	0.0000
10Jan2020	13:18	0.0898	0.032	5.06	0.0000
10Jan2020	13:21	0.0907	0.033	5.06	0.0000
10Jan2020	13:24	0.0916	0.033	5.07	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	13:27	0.0924	0.033	5.07	0.0000
10Jan2020	13:30	0.0931	0.034	5.07	0.0000
10Jan2020	13:33	0.0937	0.034	5.07	0.0000
10Jan2020	13:36	0.0943	0.035	5.07	0.0000
10Jan2020	13:39	0.0949	0.035	5.07	0.0000
10Jan2020	13:42	0.0954	0.035	5.07	0.0000
10Jan2020	13:45	0.0959	0.036	5.07	0.0000
10Jan2020	13:48	0.0964	0.036	5.07	0.0000
10Jan2020	13:51	0.0969	0.037	5.07	0.0000
10Jan2020	13:54	0.0974	0.037	5.07	0.0000
10Jan2020	13:57	0.0978	0.037	5.07	0.0000
10Jan2020	14:00	0.0982	0.038	5.07	0.0000
10Jan2020	14:03	0.0987	0.038	5.08	0.0000
10Jan2020	14:06	0.0992	0.039	5.08	0.0000
10Jan2020	14:09	0.0999	0.039	5.08	0.0000
10Jan2020	14:12	0.1008	0.039	5.08	0.0000
10Jan2020	14:15	0.1020	0.040	5.08	0.0000
10Jan2020	14:18	0.1037	0.040	5.08	0.0000
10Jan2020	14:21	0.1059	0.041	5.08	0.0000
10Jan2020	14:24	0.1086	0.041	5.08	0.0000
10Jan2020	14:27	0.1119	0.042	5.08	0.0000
10Jan2020	14:30	0.1157	0.042	5.08	0.0000
10Jan2020	14:33	0.1199	0.043	5.08	0.0000
10Jan2020	14:36	0.1248	0.043	5.09	0.0000
10Jan2020	14:39	0.1306	0.044	5.09	0.0000
10Jan2020	14:42	0.1381	0.044	5.09	0.0000
10Jan2020	14:45	0.1483	0.045	5.09	0.0000
10Jan2020	14:48	0.1622	0.045	5.09	0.0000
10Jan2020	14:51	0.1804	0.046	5.09	0.0000
10Jan2020	14:54	0.2032	0.047	5.09	0.0000
10Jan2020	14:57	0.2309	0.048	5.09	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	15:00	0.2634	0.049	5.10	0.0000
10Jan2020	15:03	0.3005	0.050	5.10	0.0000
10Jan2020	15:06	0.3419	0.051	5.10	0.0000
10Jan2020	15:09	0.3879	0.053	5.10	0.0000
10Jan2020	15:12	0.4386	0.054	5.11	0.0000
10Jan2020	15:15	0.4945	0.056	5.11	0.0000
10Jan2020	15:18	0.5560	0.059	5.12	0.0000
10Jan2020	15:21	0.6237	0.061	5.12	0.0000
10Jan2020	15:24	0.6977	0.064	5.13	0.0000
10Jan2020	15:27	0.7782	0.067	5.13	0.0000
10Jan2020	15:30	0.8656	0.070	5.14	0.0000
10Jan2020	15:33	0.9627	0.074	5.15	0.0000
10Jan2020	15:36	1.0769	0.078	5.15	0.0000
10Jan2020	15:39	1.2229	0.083	5.16	0.0000
10Jan2020	15:42	1.4229	0.088	5.17	0.0000
10Jan2020	15:45	1.7068	0.095	5.19	0.0000
10Jan2020	15:48	2.1253	0.103	5.20	0.0000
10Jan2020	15:51	2.7659	0.113	5.22	0.0000
10Jan2020	15:54	3.7253	0.126	5.25	0.0000
10Jan2020	15:57	5.0629	0.144	5.29	0.0000
10Jan2020	16:00	6.7488	0.169	5.33	0.0000
10Jan2020	16:03	8.5962	0.201	5.40	0.0000
10Jan2020	16:06	10.2955	0.240	5.47	0.0000
10Jan2020	16:09	11.5563	0.285	5.56	0.0000
10Jan2020	16:12	12.2183	0.334	5.66	0.0000
10Jan2020	16:15	12.2873	0.384	5.76	0.0000
10Jan2020	16:18	11.8892	0.434	5.86	0.0000
10Jan2020	16:21	11.1762	0.482	5.95	0.0000
10Jan2020	16:24	10.2956	0.526	6.04	0.0000
10Jan2020	16:27	9.3922	0.567	6.12	0.0000
10Jan2020	16:30	8.5708	0.604	6.19	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	16:33	7.8738	0.638	6.26	0.0000
10Jan2020	16:36	7.2858	0.670	6.32	0.0000
10Jan2020	16:39	6.7646	0.699	6.38	0.0000
10Jan2020	16:42	6.2888	0.726	6.43	0.0000
10Jan2020	16:45	5.8612	0.751	6.48	0.0000
10Jan2020	16:48	5.4863	0.774	6.53	0.0000
10Jan2020	16:51	5.1620	0.796	6.57	0.0000
10Jan2020	16:54	4.8829	0.817	6.61	0.0000
10Jan2020	16:57	4.6441	0.837	6.65	0.0000
10Jan2020	17:00	4.4396	0.855	6.69	0.0000
10Jan2020	17:03	4.2622	0.873	6.73	0.0000
10Jan2020	17:06	4.1052	0.891	6.76	0.0000
10Jan2020	17:09	3.9649	0.907	6.79	0.0000
10Jan2020	17:12	3.8404	0.923	6.82	0.0000
10Jan2020	17:15	3.7314	0.939	6.86	0.0000
10Jan2020	17:18	3.6359	0.954	6.89	0.0000
10Jan2020	17:21	3.5516	0.969	6.92	0.0000
10Jan2020	17:24	3.4766	0.984	6.94	0.0000
10Jan2020	17:27	3.4094	0.998	6.97	0.0000
10Jan2020	17:30	3.3488	1.012	7.00	0.0000
10Jan2020	17:33	3.2942	1.026	7.03	0.0000
10Jan2020	17:36	3.2459	1.039	7.05	0.0000
10Jan2020	17:39	3.2039	1.052	7.08	0.0000
10Jan2020	17:42	3.1670	1.066	7.11	0.0000
10Jan2020	17:45	3.1339	1.079	7.13	0.0000
10Jan2020	17:48	3.1030	1.091	7.16	0.0000
10Jan2020	17:51	3.0731	1.104	7.18	0.0000
10Jan2020	17:54	3.0430	1.117	7.21	0.0000
10Jan2020	17:57	3.0125	1.129	7.23	0.0000
10Jan2020	18:00	2.9811	1.142	7.26	0.0000
10Jan2020	18:03	2.9491	1.154	7.28	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	18:06	2.9171	1.166	7.30	0.0000
10Jan2020	18:09	2.8855	1.178	7.33	0.0000
10Jan2020	18:12	2.8552	1.190	7.35	0.0000
10Jan2020	18:15	2.8268	1.202	7.37	0.0000
10Jan2020	18:18	2.8010	1.213	7.40	0.0000
10Jan2020	18:21	2.7779	1.225	7.42	0.0000
10Jan2020	18:24	2.7563	1.236	7.44	0.0000
10Jan2020	18:27	2.7348	1.248	7.47	0.0000
10Jan2020	18:30	2.7122	1.259	7.49	0.0000
10Jan2020	18:33	2.6890	1.270	7.51	0.0000
10Jan2020	18:36	2.6656	1.281	7.52	0.0000
10Jan2020	18:39	2.6427	1.292	7.53	0.0000
10Jan2020	18:42	2.6206	1.303	7.54	0.0000
10Jan2020	18:45	2.5995	1.314	7.55	0.0000
10Jan2020	18:48	2.5792	1.324	7.56	0.0000
10Jan2020	18:51	2.5593	1.335	7.57	0.0000
10Jan2020	18:54	2.5400	1.346	7.58	0.0000
10Jan2020	18:57	2.5210	1.356	7.59	0.0000
10Jan2020	19:00	2.5015	1.366	7.60	0.0000
10Jan2020	19:03	2.4813	1.377	7.61	0.0000
10Jan2020	19:06	2.4607	1.387	7.62	0.0000
10Jan2020	19:09	2.4404	1.397	7.63	0.0000
10Jan2020	19:12	2.4199	1.407	7.64	0.0000
10Jan2020	19:15	2.3987	1.417	7.65	0.0000
10Jan2020	19:18	2.3773	1.427	7.66	0.0000
10Jan2020	19:21	2.3560	1.437	7.67	0.0000
10Jan2020	19:24	2.3346	1.446	7.68	0.0000
10Jan2020	19:27	2.3133	1.456	7.69	0.0000
10Jan2020	19:30	2.2925	1.465	7.70	0.0000
10Jan2020	19:33	2.2726	1.475	7.71	0.0000
10Jan2020	19:36	2.2527	1.484	7.72	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	19:39	2.2312	1.494	7.73	0.0000
10Jan2020	19:42	2.2075	1.503	7.74	0.0000
10Jan2020	19:45	2.1821	1.512	7.75	0.0000
10Jan2020	19:48	2.1560	1.521	7.76	0.0000
10Jan2020	19:51	2.1306	1.530	7.76	0.0000
10Jan2020	19:54	2.1064	1.538	7.77	0.0000
10Jan2020	19:57	2.0836	1.547	7.78	0.0000
10Jan2020	20:00	2.0618	1.556	7.79	0.0000
10Jan2020	20:03	2.0392	1.564	7.80	0.0000
10Jan2020	20:06	2.0160	1.572	7.81	0.0000
10Jan2020	20:09	1.9924	1.581	7.82	0.0000
10Jan2020	20:12	1.9691	1.589	7.82	0.0000
10Jan2020	20:15	1.9480	1.597	7.83	0.0000
10Jan2020	20:18	1.9294	1.605	7.84	0.0000
10Jan2020	20:21	1.9122	1.613	7.85	0.0000
10Jan2020	20:24	1.8965	1.621	7.86	0.0000
10Jan2020	20:27	1.8825	1.629	7.86	0.0000
10Jan2020	20:30	1.8705	1.636	7.87	0.0000
10Jan2020	20:33	1.8605	1.644	7.88	0.0000
10Jan2020	20:36	1.8517	1.652	7.89	0.0000
10Jan2020	20:39	1.8444	1.659	7.89	0.0000
10Jan2020	20:42	1.8391	1.667	7.90	0.0000
10Jan2020	20:45	1.8357	1.675	7.91	0.0000
10Jan2020	20:48	1.8336	1.682	7.92	0.0000
10Jan2020	20:51	1.8325	1.690	7.92	0.0000
10Jan2020	20:54	1.8314	1.697	7.93	0.0000
10Jan2020	20:57	1.8294	1.705	7.94	0.0000
10Jan2020	21:00	1.8264	1.712	7.95	0.0000
10Jan2020	21:03	1.8214	1.720	7.95	0.0000
10Jan2020	21:06	1.8154	1.727	7.96	0.0000
10Jan2020	21:09	1.8103	1.735	7.97	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	21:12	1.8063	1.742	7.98	0.0000
10Jan2020	21:15	1.8032	1.750	7.98	0.0000
10Jan2020	21:18	1.8009	1.757	7.99	0.0000
10Jan2020	21:21	1.7976	1.765	8.00	0.0000
10Jan2020	21:24	1.7933	1.772	8.01	0.0000
10Jan2020	21:27	1.7891	1.780	8.01	0.0000
10Jan2020	21:30	1.7847	1.787	8.02	0.0000
10Jan2020	21:33	1.7813	1.794	8.03	0.0000
10Jan2020	21:36	1.7784	1.802	8.04	0.0000
10Jan2020	21:39	1.7751	1.809	8.04	0.0000
10Jan2020	21:42	1.7714	1.816	8.05	0.0000
10Jan2020	21:45	1.7667	1.824	8.06	0.0000
10Jan2020	21:48	1.7624	1.831	8.07	0.0000
10Jan2020	21:51	1.7593	1.838	8.07	0.0000
10Jan2020	21:54	1.7568	1.846	8.08	0.0000
10Jan2020	21:57	1.7535	1.853	8.09	0.0000
10Jan2020	22:00	1.7501	1.860	8.09	0.0000
10Jan2020	22:03	1.7453	1.867	8.10	0.0000
10Jan2020	22:06	1.7401	1.874	8.11	0.0000
10Jan2020	22:09	1.7359	1.882	8.12	0.0000
10Jan2020	22:12	1.7321	1.889	8.12	0.0000
10Jan2020	22:15	1.7291	1.896	8.13	0.0000
10Jan2020	22:18	1.7266	1.903	8.14	0.0000
10Jan2020	22:21	1.7232	1.910	8.14	0.0000
10Jan2020	22:24	1.7186	1.917	8.15	0.0000
10Jan2020	22:27	1.7133	1.924	8.16	0.0000
10Jan2020	22:30	1.7071	1.931	8.17	0.0000
10Jan2020	22:33	1.7009	1.939	8.17	0.0000
10Jan2020	22:36	1.6952	1.946	8.18	0.0000
10Jan2020	22:39	1.6900	1.953	8.19	0.0000
10Jan2020	22:42	1.6865	1.959	8.19	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	22:45	1.6842	1.966	8.20	0.0000
10Jan2020	22:48	1.6828	1.973	8.21	0.0000
10Jan2020	22:51	1.6821	1.980	8.21	0.0000
10Jan2020	22:54	1.6811	1.987	8.22	0.0000
10Jan2020	22:57	1.6789	1.994	8.23	0.0000
10Jan2020	23:00	1.6755	2.001	8.23	0.0000
10Jan2020	23:03	1.6699	2.008	8.24	0.0000
10Jan2020	23:06	1.6630	2.015	8.25	0.0000
10Jan2020	23:09	1.6572	2.022	8.26	0.0000
10Jan2020	23:12	1.6523	2.029	8.26	0.0000
10Jan2020	23:15	1.6484	2.036	8.27	0.0000
10Jan2020	23:18	1.6452	2.042	8.28	0.0000
10Jan2020	23:21	1.6410	2.049	8.28	0.0000
10Jan2020	23:24	1.6357	2.056	8.29	0.0000
10Jan2020	23:27	1.6305	2.063	8.30	0.0000
10Jan2020	23:30	1.6252	2.069	8.30	0.0000
10Jan2020	23:33	1.6208	2.076	8.31	0.0000
10Jan2020	23:36	1.6170	2.083	8.32	0.0000
10Jan2020	23:39	1.6127	2.089	8.32	0.0000
10Jan2020	23:42	1.6079	2.096	8.33	0.0000
10Jan2020	23:45	1.6023	2.103	8.34	0.0000
10Jan2020	23:48	1.5970	2.109	8.34	0.0000
10Jan2020	23:51	1.5930	2.116	8.35	0.0000
10Jan2020	23:54	1.5895	2.122	8.36	0.0000
10Jan2020	23:57	1.5854	2.129	8.36	0.0000
11Jan2020	00:00	1.5810	2.136	8.37	0.0000
11Jan2020	00:03	1.5752	2.142	8.38	0.0000
11Jan2020	00:06	1.5690	2.149	8.38	0.0000
11Jan2020	00:09	1.5639	2.155	8.39	0.0000
11Jan2020	00:12	1.5592	2.162	8.40	0.0000
11Jan2020	00:15	1.5553	2.168	8.40	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	00:18	1.5520	2.174	8.41	0.0000
11Jan2020	00:21	1.5478	2.181	8.41	0.0000
11Jan2020	00:24	1.5423	2.187	8.42	0.0000
11Jan2020	00:27	1.5360	2.194	8.43	0.0000
11Jan2020	00:30	1.5289	2.200	8.43	0.0000
11Jan2020	00:33	1.5218	2.206	8.44	0.0000
11Jan2020	00:36	1.5152	2.212	8.45	0.0000
11Jan2020	00:39	1.5091	2.219	8.45	0.0000
11Jan2020	00:42	1.5047	2.225	8.46	0.0000
11Jan2020	00:45	1.5016	2.231	8.46	0.0000
11Jan2020	00:48	1.4995	2.237	8.47	0.0000
11Jan2020	00:51	1.4981	2.244	8.48	0.0000
11Jan2020	00:54	1.4964	2.250	8.48	0.0000
11Jan2020	00:57	1.4935	2.256	8.49	0.0000
11Jan2020	01:00	1.4894	2.262	8.50	0.0000
11Jan2020	01:03	1.4829	2.268	8.50	0.0000
11Jan2020	01:06	1.4752	2.274	8.51	0.0000
11Jan2020	01:09	1.4685	2.280	8.51	0.0000
11Jan2020	01:12	1.4628	2.286	8.52	0.0000
11Jan2020	01:15	1.4581	2.292	8.53	0.0000
11Jan2020	01:18	1.4542	2.298	8.53	0.0000
11Jan2020	01:21	1.4493	2.304	8.54	0.0000
11Jan2020	01:24	1.4432	2.310	8.54	0.0000
11Jan2020	01:27	1.4364	2.316	8.55	0.0000
11Jan2020	01:30	1.4287	2.322	8.56	0.0000
11Jan2020	01:33	1.4211	2.328	8.56	0.0000
11Jan2020	01:36	1.4140	2.334	8.57	0.0000
11Jan2020	01:39	1.4075	2.340	8.57	0.0000
11Jan2020	01:42	1.4027	2.346	8.58	0.0000
11Jan2020	01:45	1.3993	2.351	8.58	0.0000
11Jan2020	01:48	1.3968	2.357	8.59	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	01:51	1.3952	2.363	8.60	0.0000
11Jan2020	01:54	1.3931	2.369	8.60	0.0000
11Jan2020	01:57	1.3899	2.375	8.61	0.0000
11Jan2020	02:00	1.3855	2.380	8.61	0.0000
11Jan2020	02:03	1.3787	2.386	8.62	0.0000
11Jan2020	02:06	1.3706	2.392	8.62	0.0000
11Jan2020	02:09	1.3635	2.397	8.63	0.0000
11Jan2020	02:12	1.3575	2.403	8.64	0.0000
11Jan2020	02:15	1.3525	2.409	8.64	0.0000
11Jan2020	02:18	1.3483	2.414	8.65	0.0000
11Jan2020	02:21	1.3431	2.420	8.65	0.0000
11Jan2020	02:24	1.3367	2.425	8.66	0.0000
11Jan2020	02:27	1.3304	2.431	8.66	0.0000
11Jan2020	02:30	1.3239	2.436	8.67	0.0000
11Jan2020	02:33	1.3185	2.442	8.67	0.0000
11Jan2020	02:36	1.3137	2.447	8.68	0.0000
11Jan2020	02:39	1.3085	2.453	8.69	0.0000
11Jan2020	02:42	1.3027	2.458	8.69	0.0000
11Jan2020	02:45	1.2960	2.463	8.70	0.0000
11Jan2020	02:48	1.2896	2.469	8.70	0.0000
11Jan2020	02:51	1.2846	2.474	8.71	0.0000
11Jan2020	02:54	1.2803	2.479	8.71	0.0000
11Jan2020	02:57	1.2752	2.485	8.72	0.0000
11Jan2020	03:00	1.2698	2.490	8.72	0.0000
11Jan2020	03:03	1.2631	2.495	8.73	0.0000
11Jan2020	03:06	1.2559	2.500	8.73	0.0000
11Jan2020	03:09	1.2498	2.505	8.74	0.0000
11Jan2020	03:12	1.2441	2.511	8.74	0.0000
11Jan2020	03:15	1.2394	2.516	8.75	0.0000
11Jan2020	03:18	1.2352	2.521	8.75	0.0000
11Jan2020	03:21	1.2300	2.526	8.76	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	03:24	1.2236	2.531	8.76	0.0000
11Jan2020	03:27	1.2173	2.536	8.77	0.0000
11Jan2020	03:30	1.2107	2.541	8.77	0.0000
11Jan2020	03:33	1.2052	2.546	8.78	0.0000
11Jan2020	03:36	1.2003	2.551	8.78	0.0000
11Jan2020	03:39	1.1948	2.556	8.79	0.0000
11Jan2020	03:42	1.1888	2.561	8.79	0.0000
11Jan2020	03:45	1.1819	2.566	8.80	0.0000
11Jan2020	03:48	1.1754	2.571	8.80	0.0000
11Jan2020	03:51	1.1702	2.575	8.81	0.0000
11Jan2020	03:54	1.1656	2.580	8.81	0.0000
11Jan2020	03:57	1.1603	2.585	8.82	0.0000
11Jan2020	04:00	1.1547	2.590	8.82	0.0000
11Jan2020	04:03	1.1477	2.595	8.83	0.0000
11Jan2020	04:06	1.1403	2.599	8.83	0.0000
11Jan2020	04:09	1.1339	2.604	8.84	0.0000
11Jan2020	04:12	1.1281	2.609	8.84	0.0000
11Jan2020	04:15	1.1231	2.613	8.85	0.0000
11Jan2020	04:18	1.1188	2.618	8.85	0.0000
11Jan2020	04:21	1.1134	2.623	8.86	0.0000
11Jan2020	04:24	1.1068	2.627	8.86	0.0000
11Jan2020	04:27	1.1002	2.632	8.86	0.0000
11Jan2020	04:30	1.0934	2.636	8.87	0.0000
11Jan2020	04:33	1.0876	2.641	8.87	0.0000
11Jan2020	04:36	1.0825	2.645	8.88	0.0000
11Jan2020	04:39	1.0769	2.650	8.88	0.0000
11Jan2020	04:42	1.0707	2.654	8.89	0.0000
11Jan2020	04:45	1.0636	2.659	8.89	0.0000
11Jan2020	04:48	1.0568	2.663	8.90	0.0000
11Jan2020	04:51	1.0514	2.667	8.90	0.0000
11Jan2020	04:54	1.0466	2.672	8.90	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	04:57	1.0411	2.676	8.91	0.0000
11Jan2020	05:00	1.0353	2.680	8.91	0.0000
11Jan2020	05:03	1.0281	2.685	8.92	0.0000
11Jan2020	05:06	1.0205	2.689	8.92	0.0000
11Jan2020	05:09	1.0139	2.693	8.93	0.0000
11Jan2020	05:12	1.0079	2.697	8.93	0.0000
11Jan2020	05:15	1.0027	2.701	8.93	0.0000
11Jan2020	05:18	0.9982	2.705	8.94	0.0000
11Jan2020	05:21	0.9927	2.710	8.94	0.0000
11Jan2020	05:24	0.9858	2.714	8.95	0.0000
11Jan2020	05:27	0.9790	2.718	8.95	0.0000
11Jan2020	05:30	0.9721	2.722	8.95	0.0000
11Jan2020	05:33	0.9661	2.726	8.96	0.0000
11Jan2020	05:36	0.9608	2.730	8.96	0.0000
11Jan2020	05:39	0.9550	2.734	8.97	0.0000
11Jan2020	05:42	0.9486	2.738	8.97	0.0000
11Jan2020	05:45	0.9413	2.742	8.97	0.0000
11Jan2020	05:48	0.9344	2.745	8.98	0.0000
11Jan2020	05:51	0.9288	2.749	8.98	0.0000
11Jan2020	05:54	0.9239	2.753	8.99	0.0000
11Jan2020	05:57	0.9182	2.757	8.99	0.0000
11Jan2020	06:00	0.9123	2.761	8.99	0.0000
11Jan2020	06:03	0.8997	2.764	9.00	0.0000
11Jan2020	06:06	0.8759	2.768	9.00	0.0000
11Jan2020	06:09	0.8360	2.772	9.00	0.0000
11Jan2020	06:12	0.7736	2.775	9.01	0.0000
11Jan2020	06:15	0.6907	2.778	9.01	0.0000
11Jan2020	06:18	0.5968	2.781	9.01	0.0000
11Jan2020	06:21	0.5009	2.783	9.02	0.0000
11Jan2020	06:24	0.4097	2.785	9.02	0.0000
11Jan2020	06:27	0.3282	2.786	9.02	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	06:30	0.2577	2.788	9.02	0.0000
11Jan2020	06:33	0.2022	2.788	9.02	0.0000
11Jan2020	06:36	0.1600	2.789	9.02	0.0000
11Jan2020	06:39	0.1266	2.790	9.02	0.0000
11Jan2020	06:42	0.1004	2.790	9.02	0.0000
11Jan2020	06:45	0.0792	2.791	9.02	0.0000
11Jan2020	06:48	0.0623	2.791	9.02	0.0000
11Jan2020	06:51	0.0491	2.791	9.02	0.0000
11Jan2020	06:54	0.0387	2.791	9.02	0.0000
11Jan2020	06:57	0.0303	2.792	9.02	0.0000
11Jan2020	07:00	0.0237	2.792	9.02	0.0000
11Jan2020	07:03	0.0186	2.792	9.02	0.0000
11Jan2020	07:06	0.0145	2.792	9.02	0.0000
11Jan2020	07:09	0.0113	2.792	9.02	0.0000
11Jan2020	07:12	0.0087	2.792	9.02	0.0000
11Jan2020	07:15	0.0067	2.792	9.02	0.0000
11Jan2020	07:18	0.0051	2.792	9.02	0.0000
11Jan2020	07:21	0.0038	2.792	9.02	0.0000
11Jan2020	07:24	0.0028	2.792	9.02	0.0000
11Jan2020	07:27	0.0019	2.792	9.02	0.0000
11Jan2020	07:30	0.0012	2.792	9.02	0.0000
11Jan2020	07:33	0.0007	2.792	9.02	0.0000
11Jan2020	07:36	0.0004	2.792	9.02	0.0000
11Jan2020	07:39	0.0001	2.792	9.02	0.0000
11Jan2020	07:42	0.0000	2.792	9.02	0.0000
11Jan2020	07:45	0.0000	2.792	9.02	0.0000
11Jan2020	07:48	0.0000	2.792	9.02	0.0000
11Jan2020	07:51	0.0000	2.792	9.02	0.0000
11Jan2020	07:54	0.0000	2.792	9.02	0.0000
11Jan2020	07:57	0.0000	2.792	9.02	0.0000
11Jan2020	08:00	0.0000	2.792	9.02	0.0000

Radback Tenaska project stormwater Analysis JZ 3/4/09

project # 163994 # of pages: 9

52.5406.1003

Attachment 3

Reference 2

select pages

Chapter 2 Estimating Runoff

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information compiled by Engman (1986).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Rev 2

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull elevation.

Chapter 3 Time of Concentration and Travel Time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[eq. 3-2]}$$

where:

T_c = time of concentration (hr)
m = number of flow segments

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow

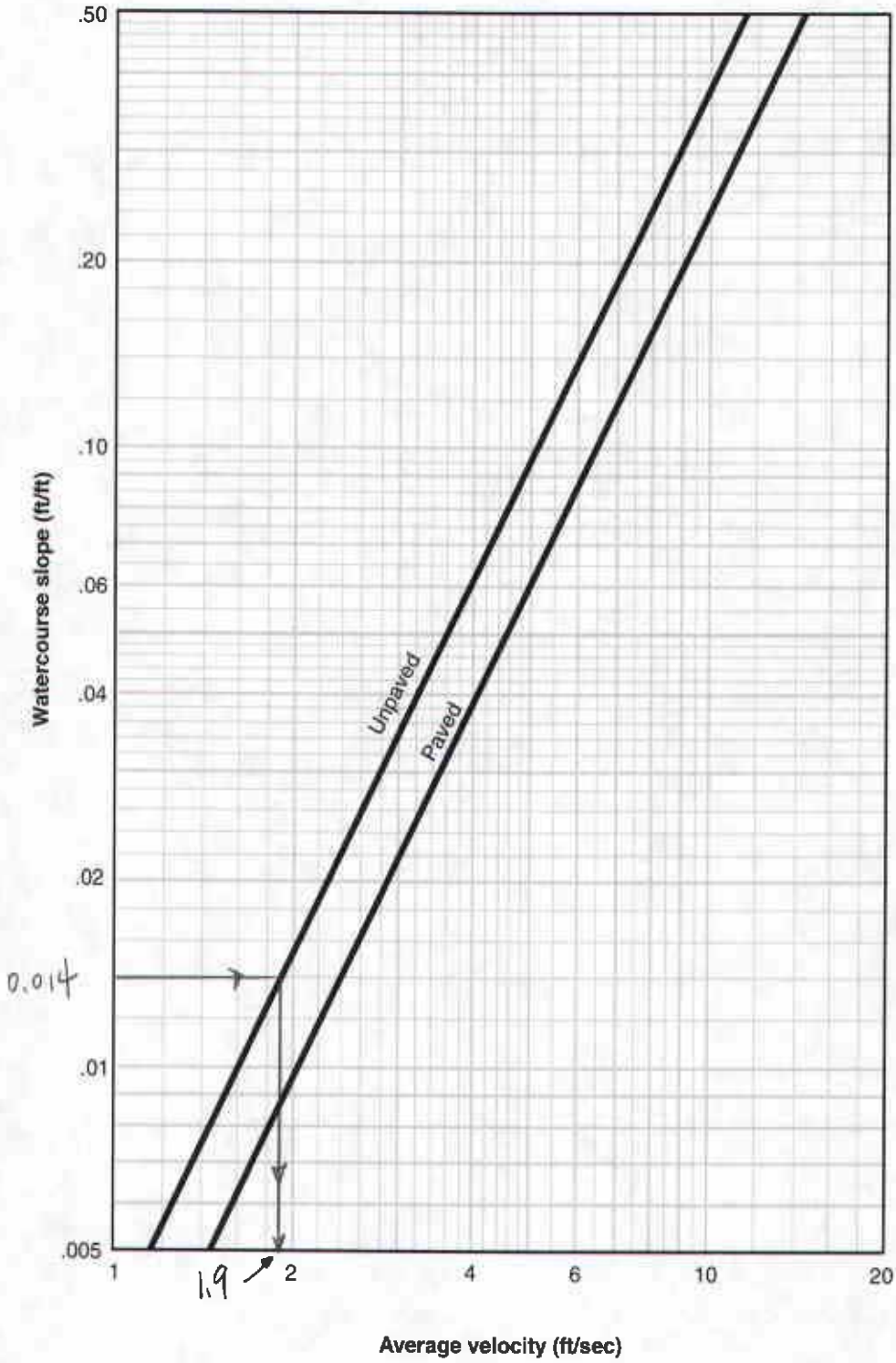
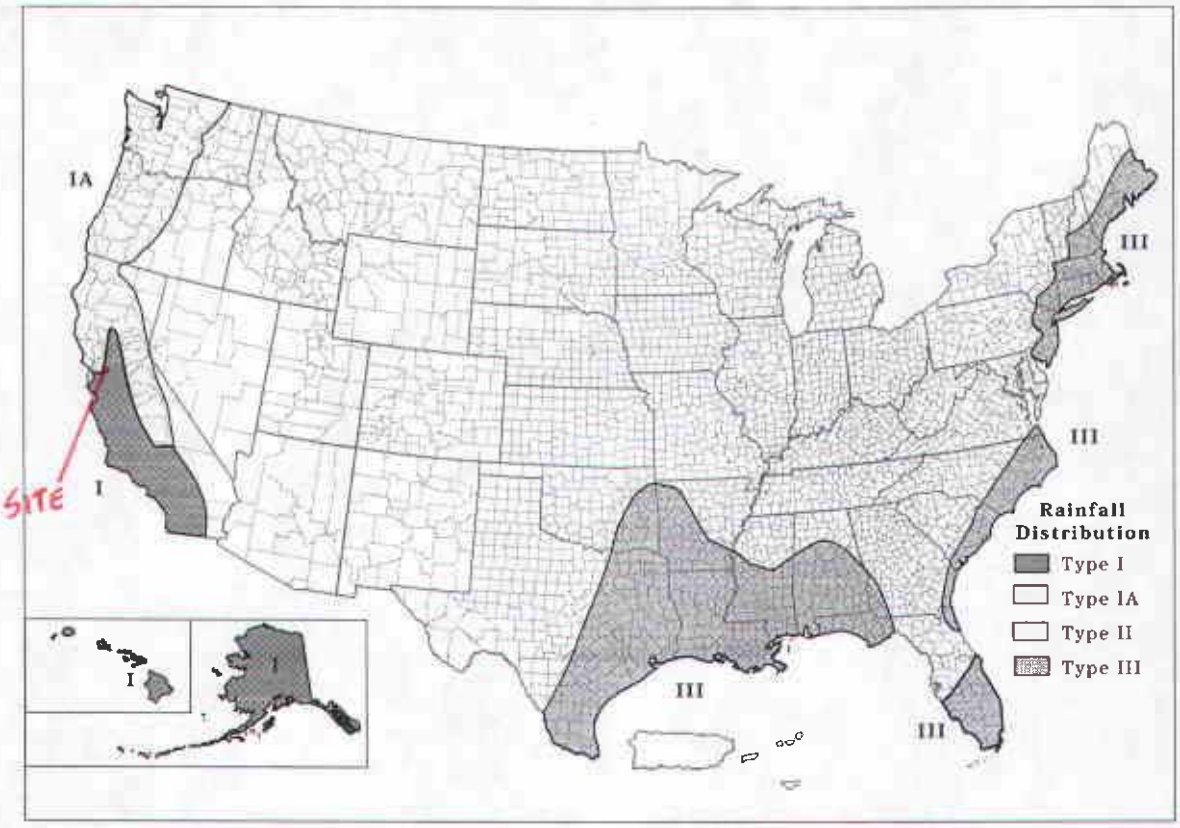


Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Radback Tenaska project Stormwater Analysis JT 3/4/09

project # 163994

# of pages : 5

52, 5406, 1003

Attachment 4

Reference 6

Select pages

(printed out from the Online Web Soil Survey)

Project site

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

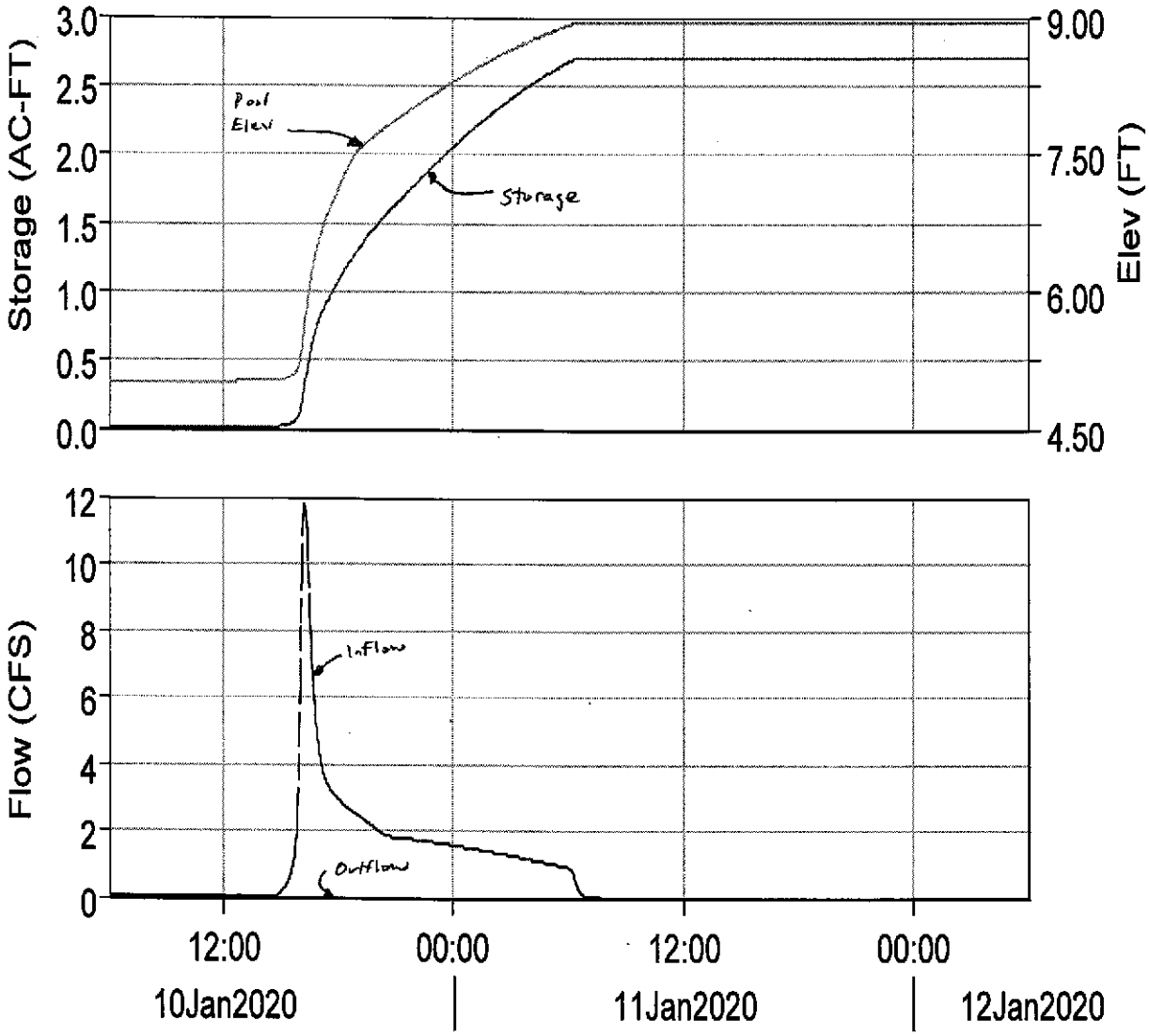
Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

VOID ATT #2

.1003 CALC (REV 2)

Reservoir "Wetland" Results for Run "Run1 - Ex 100.24"



------ Run:Run1 - Ex 100.24 Element:WETLAND Result:Storage

—·—·— Run:Run1 - Ex 100.24 Element:WETLAND Result:Pool Elevation

——— Run:Run1 - Ex 100.24 Element:WETLAND Result:Outflow

— — — Run:Run1 - Ex 100.24 Element:WETLAND Result:Combined Inflow

REV 2

Superseded by Rev 3

Project: Oakley
Simulation Run: Run1 - Ex 100.24 Reservoir: Wetland

Start of Run: 10Jan2020, 06:00 Basin Model: Basin 1 - Existin
End of Run: 12Jan2020, 06:00 Meteorologic Model: Storm1 - 10
Compute Time: 22Jun2010, 08:13:54 Control Specifications: Control

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	06:00	0.0000	0.000	5.00	0.0000
10Jan2020	06:03	0.0001	0.000	5.00	0.0000
10Jan2020	06:06	0.0004	0.000	5.00	0.0000
10Jan2020	06:09	0.0011	0.000	5.00	0.0000
10Jan2020	06:12	0.0022	0.000	5.00	0.0000
10Jan2020	06:15	0.0037	0.000	5.00	0.0000
10Jan2020	06:18	0.0055	0.000	5.00	0.0000
10Jan2020	06:21	0.0074	0.000	5.00	0.0000
10Jan2020	06:24	0.0092	0.000	5.00	0.0000
10Jan2020	06:27	0.0108	0.000	5.00	0.0000
10Jan2020	06:30	0.0122	0.000	5.00	0.0000
10Jan2020	06:33	0.0133	0.000	5.00	0.0000
10Jan2020	06:36	0.0142	0.000	5.00	0.0000
10Jan2020	06:39	0.0148	0.000	5.00	0.0000
10Jan2020	06:42	0.0153	0.000	5.00	0.0000
10Jan2020	06:45	0.0157	0.000	5.00	0.0000
10Jan2020	06:48	0.0161	0.001	5.00	0.0000
10Jan2020	06:51	0.0163	0.001	5.00	0.0000
10Jan2020	06:54	0.0165	0.001	5.00	0.0000
10Jan2020	06:57	0.0166	0.001	5.00	0.0000
10Jan2020	07:00	0.0167	0.001	5.00	0.0000
10Jan2020	07:03	0.0168	0.001	5.00	0.0000
10Jan2020	07:06	0.0169	0.001	5.00	0.0000
10Jan2020	07:09	0.0170	0.001	5.00	0.0000
10Jan2020	07:12	0.0171	0.001	5.00	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	07:15	0.0172	0.001	5.00	0.0000
10Jan2020	07:18	0.0173	0.001	5.00	0.0000
10Jan2020	07:21	0.0173	0.001	5.00	0.0000
10Jan2020	07:24	0.0173	0.001	5.00	0.0000
10Jan2020	07:27	0.0174	0.001	5.00	0.0000
10Jan2020	07:30	0.0174	0.002	5.00	0.0000
10Jan2020	07:33	0.0174	0.002	5.00	0.0000
10Jan2020	07:36	0.0174	0.002	5.00	0.0000
10Jan2020	07:39	0.0174	0.002	5.00	0.0000
10Jan2020	07:42	0.0173	0.002	5.00	0.0000
10Jan2020	07:45	0.0173	0.002	5.00	0.0000
10Jan2020	07:48	0.0173	0.002	5.00	0.0000
10Jan2020	07:51	0.0173	0.002	5.00	0.0000
10Jan2020	07:54	0.0173	0.002	5.00	0.0000
10Jan2020	07:57	0.0173	0.002	5.00	0.0000
10Jan2020	08:00	0.0173	0.002	5.00	0.0000
10Jan2020	08:03	0.0173	0.002	5.00	0.0000
10Jan2020	08:06	0.0173	0.002	5.00	0.0000
10Jan2020	08:09	0.0174	0.002	5.00	0.0000
10Jan2020	08:12	0.0174	0.003	5.01	0.0000
10Jan2020	08:15	0.0175	0.003	5.01	0.0000
10Jan2020	08:18	0.0175	0.003	5.01	0.0000
10Jan2020	08:21	0.0176	0.003	5.01	0.0000
10Jan2020	08:24	0.0176	0.003	5.01	0.0000
10Jan2020	08:27	0.0177	0.003	5.01	0.0000
10Jan2020	08:30	0.0178	0.003	5.01	0.0000
10Jan2020	08:33	0.0179	0.003	5.01	0.0000
10Jan2020	08:36	0.0181	0.003	5.01	0.0000
10Jan2020	08:39	0.0182	0.003	5.01	0.0000
10Jan2020	08:42	0.0183	0.003	5.01	0.0000
10Jan2020	08:45	0.0184	0.003	5.01	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	08:48	0.0185	0.003	5.01	0.0000
10Jan2020	08:51	0.0186	0.004	5.01	0.0000
10Jan2020	08:54	0.0187	0.004	5.01	0.0000
10Jan2020	08:57	0.0189	0.004	5.01	0.0000
10Jan2020	09:00	0.0190	0.004	5.01	0.0000
10Jan2020	09:03	0.0191	0.004	5.01	0.0000
10Jan2020	09:06	0.0193	0.004	5.01	0.0000
10Jan2020	09:09	0.0194	0.004	5.01	0.0000
10Jan2020	09:12	0.0196	0.004	5.01	0.0000
10Jan2020	09:15	0.0197	0.004	5.01	0.0000
10Jan2020	09:18	0.0199	0.004	5.01	0.0000
10Jan2020	09:21	0.0201	0.004	5.01	0.0000
10Jan2020	09:24	0.0202	0.004	5.01	0.0000
10Jan2020	09:27	0.0204	0.004	5.01	0.0000
10Jan2020	09:30	0.0205	0.005	5.01	0.0000
10Jan2020	09:33	0.0207	0.005	5.01	0.0000
10Jan2020	09:36	0.0209	0.005	5.01	0.0000
10Jan2020	09:39	0.0210	0.005	5.01	0.0000
10Jan2020	09:42	0.0212	0.005	5.01	0.0000
10Jan2020	09:45	0.0213	0.005	5.01	0.0000
10Jan2020	09:48	0.0214	0.005	5.01	0.0000
10Jan2020	09:51	0.0215	0.005	5.01	0.0000
10Jan2020	09:54	0.0217	0.005	5.01	0.0000
10Jan2020	09:57	0.0218	0.005	5.01	0.0000
10Jan2020	10:00	0.0219	0.005	5.01	0.0000
10Jan2020	10:03	0.0221	0.006	5.01	0.0000
10Jan2020	10:06	0.0222	0.006	5.01	0.0000
10Jan2020	10:09	0.0224	0.006	5.01	0.0000
10Jan2020	10:12	0.0225	0.006	5.01	0.0000
10Jan2020	10:15	0.0226	0.006	5.01	0.0000
10Jan2020	10:18	0.0228	0.006	5.01	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	10:21	0.0229	0.006	5.01	0.0000
10Jan2020	10:24	0.0230	0.006	5.01	0.0000
10Jan2020	10:27	0.0231	0.006	5.01	0.0000
10Jan2020	10:30	0.0231	0.006	5.01	0.0000
10Jan2020	10:33	0.0232	0.006	5.01	0.0000
10Jan2020	10:36	0.0232	0.007	5.01	0.0000
10Jan2020	10:39	0.0233	0.007	5.01	0.0000
10Jan2020	10:42	0.0233	0.007	5.01	0.0000
10Jan2020	10:45	0.0233	0.007	5.01	0.0000
10Jan2020	10:48	0.0234	0.007	5.01	0.0000
10Jan2020	10:51	0.0235	0.007	5.01	0.0000
10Jan2020	10:54	0.0236	0.007	5.01	0.0000
10Jan2020	10:57	0.0237	0.007	5.01	0.0000
10Jan2020	11:00	0.0238	0.007	5.01	0.0000
10Jan2020	11:03	0.0239	0.007	5.01	0.0000
10Jan2020	11:06	0.0240	0.008	5.01	0.0000
10Jan2020	11:09	0.0240	0.008	5.02	0.0000
10Jan2020	11:12	0.0241	0.008	5.02	0.0000
10Jan2020	11:15	0.0241	0.008	5.02	0.0000
10Jan2020	11:18	0.0241	0.008	5.02	0.0000
10Jan2020	11:21	0.0241	0.008	5.02	0.0000
10Jan2020	11:24	0.0241	0.008	5.02	0.0000
10Jan2020	11:27	0.0242	0.008	5.02	0.0000
10Jan2020	11:30	0.0242	0.008	5.02	0.0000
10Jan2020	11:33	0.0243	0.008	5.02	0.0000
10Jan2020	11:36	0.0243	0.009	5.02	0.0000
10Jan2020	11:39	0.0244	0.009	5.02	0.0000
10Jan2020	11:42	0.0245	0.009	5.02	0.0000
10Jan2020	11:45	0.0245	0.009	5.02	0.0000
10Jan2020	11:48	0.0246	0.009	5.02	0.0000
10Jan2020	11:51	0.0247	0.009	5.02	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	11:54	0.0248	0.009	5.02	0.0000
10Jan2020	11:57	0.0249	0.009	5.02	0.0000
10Jan2020	12:00	0.0250	0.009	5.02	0.0000
10Jan2020	12:03	0.0251	0.009	5.02	0.0000
10Jan2020	12:06	0.0251	0.010	5.02	0.0000
10Jan2020	12:09	0.0252	0.010	5.02	0.0000
10Jan2020	12:12	0.0252	0.010	5.02	0.0000
10Jan2020	12:15	0.0253	0.010	5.02	0.0000
10Jan2020	12:18	0.0254	0.010	5.02	0.0000
10Jan2020	12:21	0.0256	0.010	5.02	0.0000
10Jan2020	12:24	0.0259	0.010	5.02	0.0000
10Jan2020	12:27	0.0263	0.010	5.02	0.0000
10Jan2020	12:30	0.0267	0.010	5.02	0.0000
10Jan2020	12:33	0.0271	0.011	5.02	0.0000
10Jan2020	12:36	0.0275	0.011	5.02	0.0000
10Jan2020	12:39	0.0280	0.011	5.02	0.0000
10Jan2020	12:42	0.0285	0.011	5.02	0.0000
10Jan2020	12:45	0.0290	0.011	5.02	0.0000
10Jan2020	12:48	0.0295	0.011	5.02	0.0000
10Jan2020	12:51	0.0300	0.011	5.02	0.0000
10Jan2020	12:54	0.0305	0.011	5.02	0.0000
10Jan2020	12:57	0.0310	0.011	5.02	0.0000
10Jan2020	13:00	0.0315	0.012	5.02	0.0000
10Jan2020	13:03	0.0320	0.012	5.02	0.0000
10Jan2020	13:06	0.0326	0.012	5.02	0.0000
10Jan2020	13:09	0.0331	0.012	5.02	0.0000
10Jan2020	13:12	0.0336	0.012	5.02	0.0000
10Jan2020	13:15	0.0341	0.012	5.02	0.0000
10Jan2020	13:18	0.0345	0.012	5.02	0.0000
10Jan2020	13:21	0.0349	0.013	5.02	0.0000
10Jan2020	13:24	0.0352	0.013	5.03	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	13:27	0.0355	0.013	5.03	0.0000
10Jan2020	13:30	0.0358	0.013	5.03	0.0000
10Jan2020	13:33	0.0360	0.013	5.03	0.0000
10Jan2020	13:36	0.0363	0.013	5.03	0.0000
10Jan2020	13:39	0.0365	0.013	5.03	0.0000
10Jan2020	13:42	0.0367	0.014	5.03	0.0000
10Jan2020	13:45	0.0369	0.014	5.03	0.0000
10Jan2020	13:48	0.0371	0.014	5.03	0.0000
10Jan2020	13:51	0.0373	0.014	5.03	0.0000
10Jan2020	13:54	0.0374	0.014	5.03	0.0000
10Jan2020	13:57	0.0376	0.014	5.03	0.0000
10Jan2020	14:00	0.0378	0.015	5.03	0.0000
10Jan2020	14:03	0.0380	0.015	5.03	0.0000
10Jan2020	14:06	0.0382	0.015	5.03	0.0000
10Jan2020	14:09	0.0384	0.015	5.03	0.0000
10Jan2020	14:12	0.0388	0.015	5.03	0.0000
10Jan2020	14:15	0.0392	0.015	5.03	0.0000
10Jan2020	14:18	0.0399	0.015	5.03	0.0000
10Jan2020	14:21	0.0407	0.016	5.03	0.0000
10Jan2020	14:24	0.0418	0.016	5.03	0.0000
10Jan2020	14:27	0.0430	0.016	5.03	0.0000
10Jan2020	14:30	0.0445	0.016	5.03	0.0000
10Jan2020	14:33	0.0462	0.016	5.03	0.0000
10Jan2020	14:36	0.0483	0.017	5.03	0.0000
10Jan2020	14:39	0.0513	0.017	5.03	0.0000
10Jan2020	14:42	0.0560	0.017	5.03	0.0000
10Jan2020	14:45	0.0634	0.017	5.03	0.0000
10Jan2020	14:48	0.0745	0.018	5.03	0.0000
10Jan2020	14:51	0.0900	0.018	5.04	0.0000
10Jan2020	14:54	0.1101	0.018	5.04	0.0000
10Jan2020	14:57	0.1351	0.019	5.04	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	15:00	0.1650	0.019	5.04	0.0000
10Jan2020	15:03	0.1996	0.020	5.04	0.0000
10Jan2020	15:06	0.2385	0.021	5.04	0.0000
10Jan2020	15:09	0.2819	0.022	5.04	0.0000
10Jan2020	15:12	0.3300	0.023	5.05	0.0000
10Jan2020	15:15	0.3831	0.025	5.05	0.0000
10Jan2020	15:18	0.4418	0.027	5.05	0.0000
10Jan2020	15:21	0.5063	0.029	5.06	0.0000
10Jan2020	15:24	0.5771	0.031	5.06	0.0000
10Jan2020	15:27	0.6542	0.033	5.07	0.0000
10Jan2020	15:30	0.7381	0.036	5.07	0.0000
10Jan2020	15:33	0.8313	0.039	5.08	0.0000
10Jan2020	15:36	0.9409	0.043	5.09	0.0000
10Jan2020	15:39	1.0805	0.047	5.09	0.0000
10Jan2020	15:42	1.2711	0.052	5.10	0.0000
10Jan2020	15:45	1.5412	0.058	5.11	0.0000
10Jan2020	15:48	1.9399	0.065	5.13	0.0000
10Jan2020	15:51	2.5519	0.074	5.15	0.0000
10Jan2020	15:54	3.4727	0.087	5.17	0.0000
10Jan2020	15:57	4.7619	0.104	5.21	0.0000
10Jan2020	16:00	6.3932	0.127	5.25	0.0000
10Jan2020	16:03	8.1882	0.157	5.31	0.0000
10Jan2020	16:06	9.8475	0.194	5.38	0.0000
10Jan2020	16:09	11.0883	0.238	5.47	0.0000
10Jan2020	16:12	11.7521	0.285	5.56	0.0000
10Jan2020	16:15	11.8419	0.333	5.66	0.0000
10Jan2020	16:18	11.4779	0.382	5.75	0.0000
10Jan2020	16:21	10.8064	0.428	5.85	0.0000
10Jan2020	16:24	9.9691	0.471	5.93	0.0000
10Jan2020	16:27	9.1061	0.510	6.01	0.0000
10Jan2020	16:30	8.3194	0.546	6.08	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	16:33	7.6513	0.579	6.14	0.0000
10Jan2020	16:36	7.0873	0.610	6.20	0.0000
10Jan2020	16:39	6.5866	0.638	6.26	0.0000
10Jan2020	16:42	6.1289	0.664	6.31	0.0000
10Jan2020	16:45	5.7169	0.689	6.36	0.0000
10Jan2020	16:48	5.3553	0.711	6.41	0.0000
10Jan2020	16:51	5.0424	0.733	6.45	0.0000
10Jan2020	16:54	4.7729	0.753	6.49	0.0000
10Jan2020	16:57	4.5421	0.772	6.53	0.0000
10Jan2020	17:00	4.3445	0.791	6.56	0.0000
10Jan2020	17:03	4.1730	0.808	6.60	0.0000
10Jan2020	17:06	4.0212	0.825	6.63	0.0000
10Jan2020	17:09	3.8854	0.842	6.66	0.0000
10Jan2020	17:12	3.7648	0.857	6.69	0.0000
10Jan2020	17:15	3.6592	0.873	6.72	0.0000
10Jan2020	17:18	3.5667	0.888	6.75	0.0000
10Jan2020	17:21	3.4851	0.902	6.78	0.0000
10Jan2020	17:24	3.4126	0.917	6.81	0.0000
10Jan2020	17:27	3.3475	0.930	6.84	0.0000
10Jan2020	17:30	3.2888	0.944	6.87	0.0000
10Jan2020	17:33	3.2360	0.958	6.89	0.0000
10Jan2020	17:36	3.1892	0.971	6.92	0.0000
10Jan2020	17:39	3.1484	0.984	6.94	0.0000
10Jan2020	17:42	3.1128	0.997	6.97	0.0000
10Jan2020	17:45	3.0807	1.010	7.00	0.0000
10Jan2020	17:48	3.0508	1.022	7.02	0.0000
10Jan2020	17:51	3.0218	1.035	7.05	0.0000
10Jan2020	17:54	2.9927	1.047	7.07	0.0000
10Jan2020	17:57	2.9631	1.060	7.09	0.0000
10Jan2020	18:00	2.9326	1.072	7.12	0.0000
10Jan2020	18:03	2.9015	1.084	7.14	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	18:06	2.8703	1.096	7.17	0.0000
10Jan2020	18:09	2.8396	1.108	7.19	0.0000
10Jan2020	18:12	2.8102	1.119	7.21	0.0000
10Jan2020	18:15	2.7825	1.131	7.23	0.0000
10Jan2020	18:18	2.7574	1.142	7.26	0.0000
10Jan2020	18:21	2.7349	1.154	7.28	0.0000
10Jan2020	18:24	2.7140	1.165	7.30	0.0000
10Jan2020	18:27	2.6931	1.176	7.32	0.0000
10Jan2020	18:30	2.6711	1.187	7.35	0.0000
10Jan2020	18:33	2.6485	1.198	7.37	0.0000
10Jan2020	18:36	2.6258	1.209	7.39	0.0000
10Jan2020	18:39	2.6034	1.220	7.41	0.0000
10Jan2020	18:42	2.5819	1.231	7.43	0.0000
10Jan2020	18:45	2.5613	1.241	7.45	0.0000
10Jan2020	18:48	2.5416	1.252	7.47	0.0000
10Jan2020	18:51	2.5222	1.262	7.49	0.0000
10Jan2020	18:54	2.5034	1.273	7.51	0.0000
10Jan2020	18:57	2.4849	1.283	7.52	0.0000
10Jan2020	19:00	2.4658	1.293	7.53	0.0000
10Jan2020	19:03	2.4461	1.303	7.54	0.0000
10Jan2020	19:06	2.4260	1.313	7.55	0.0000
10Jan2020	19:09	2.4061	1.323	7.56	0.0000
10Jan2020	19:12	2.3861	1.333	7.57	0.0000
10Jan2020	19:15	2.3654	1.343	7.58	0.0000
10Jan2020	19:18	2.3444	1.353	7.59	0.0000
10Jan2020	19:21	2.3237	1.362	7.60	0.0000
10Jan2020	19:24	2.3027	1.372	7.61	0.0000
10Jan2020	19:27	2.2819	1.381	7.62	0.0000
10Jan2020	19:30	2.2614	1.391	7.63	0.0000
10Jan2020	19:33	2.2420	1.400	7.63	0.0000
10Jan2020	19:36	2.2225	1.409	7.64	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	19:39	2.2014	1.419	7.65	0.0000
10Jan2020	19:42	2.1782	1.428	7.66	0.0000
10Jan2020	19:45	2.1533	1.437	7.67	0.0000
10Jan2020	19:48	2.1276	1.445	7.68	0.0000
10Jan2020	19:51	2.1026	1.454	7.69	0.0000
10Jan2020	19:54	2.0789	1.463	7.70	0.0000
10Jan2020	19:57	2.0565	1.471	7.71	0.0000
10Jan2020	20:00	2.0351	1.480	7.71	0.0000
10Jan2020	20:03	2.0129	1.488	7.72	0.0000
10Jan2020	20:06	1.9900	1.496	7.73	0.0000
10Jan2020	20:09	1.9669	1.505	7.74	0.0000
10Jan2020	20:12	1.9440	1.513	7.75	0.0000
10Jan2020	20:15	1.9233	1.521	7.76	0.0000
10Jan2020	20:18	1.9050	1.529	7.76	0.0000
10Jan2020	20:21	1.8881	1.536	7.77	0.0000
10Jan2020	20:24	1.8727	1.544	7.78	0.0000
10Jan2020	20:27	1.8590	1.552	7.79	0.0000
10Jan2020	20:30	1.8472	1.560	7.79	0.0000
10Jan2020	20:33	1.8374	1.567	7.80	0.0000
10Jan2020	20:36	1.8288	1.575	7.81	0.0000
10Jan2020	20:39	1.8216	1.582	7.82	0.0000
10Jan2020	20:42	1.8165	1.590	7.82	0.0000
10Jan2020	20:45	1.8132	1.597	7.83	0.0000
10Jan2020	20:48	1.8112	1.605	7.84	0.0000
10Jan2020	20:51	1.8102	1.612	7.85	0.0000
10Jan2020	20:54	1.8092	1.620	7.85	0.0000
10Jan2020	20:57	1.8073	1.627	7.86	0.0000
10Jan2020	21:00	1.8044	1.635	7.87	0.0000
10Jan2020	21:03	1.7995	1.642	7.88	0.0000
10Jan2020	21:06	1.7936	1.650	7.88	0.0000
10Jan2020	21:09	1.7887	1.657	7.89	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	21:12	1.7848	1.664	7.90	0.0000
10Jan2020	21:15	1.7819	1.672	7.91	0.0000
10Jan2020	21:18	1.7796	1.679	7.91	0.0000
10Jan2020	21:21	1.7765	1.686	7.92	0.0000
10Jan2020	21:24	1.7722	1.694	7.93	0.0000
10Jan2020	21:27	1.7681	1.701	7.94	0.0000
10Jan2020	21:30	1.7639	1.708	7.94	0.0000
10Jan2020	21:33	1.7606	1.716	7.95	0.0000
10Jan2020	21:36	1.7578	1.723	7.96	0.0000
10Jan2020	21:39	1.7546	1.730	7.96	0.0000
10Jan2020	21:42	1.7510	1.737	7.97	0.0000
10Jan2020	21:45	1.7465	1.745	7.98	0.0000
10Jan2020	21:48	1.7422	1.752	7.99	0.0000
10Jan2020	21:51	1.7392	1.759	7.99	0.0000
10Jan2020	21:54	1.7368	1.766	8.00	0.0000
10Jan2020	21:57	1.7337	1.773	8.01	0.0000
10Jan2020	22:00	1.7303	1.781	8.01	0.0000
10Jan2020	22:03	1.7256	1.788	8.02	0.0000
10Jan2020	22:06	1.7205	1.795	8.03	0.0000
10Jan2020	22:09	1.7164	1.802	8.04	0.0000
10Jan2020	22:12	1.7127	1.809	8.04	0.0000
10Jan2020	22:15	1.7098	1.816	8.05	0.0000
10Jan2020	22:18	1.7074	1.823	8.06	0.0000
10Jan2020	22:21	1.7041	1.830	8.06	0.0000
10Jan2020	22:24	1.6996	1.837	8.07	0.0000
10Jan2020	22:27	1.6944	1.844	8.08	0.0000
10Jan2020	22:30	1.6883	1.851	8.09	0.0000
10Jan2020	22:33	1.6823	1.858	8.09	0.0000
10Jan2020	22:36	1.6767	1.865	8.10	0.0000
10Jan2020	22:39	1.6716	1.872	8.11	0.0000
10Jan2020	22:42	1.6681	1.879	8.11	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	22:45	1.6659	1.886	8.12	0.0000
10Jan2020	22:48	1.6646	1.893	8.13	0.0000
10Jan2020	22:51	1.6639	1.900	8.13	0.0000
10Jan2020	22:54	1.6630	1.906	8.14	0.0000
10Jan2020	22:57	1.6609	1.913	8.15	0.0000
10Jan2020	23:00	1.6576	1.920	8.15	0.0000
10Jan2020	23:03	1.6521	1.927	8.16	0.0000
10Jan2020	23:06	1.6454	1.934	8.17	0.0000
10Jan2020	23:09	1.6396	1.941	8.17	0.0000
10Jan2020	23:12	1.6348	1.947	8.18	0.0000
10Jan2020	23:15	1.6310	1.954	8.19	0.0000
10Jan2020	23:18	1.6279	1.961	8.19	0.0000
10Jan2020	23:21	1.6238	1.968	8.20	0.0000
10Jan2020	23:24	1.6186	1.974	8.21	0.0000
10Jan2020	23:27	1.6135	1.981	8.21	0.0000
10Jan2020	23:30	1.6082	1.988	8.22	0.0000
10Jan2020	23:33	1.6039	1.994	8.23	0.0000
10Jan2020	23:36	1.6002	2.001	8.23	0.0000
10Jan2020	23:39	1.5960	2.007	8.24	0.0000
10Jan2020	23:42	1.5913	2.014	8.25	0.0000
10Jan2020	23:45	1.5858	2.021	8.25	0.0000
10Jan2020	23:48	1.5806	2.027	8.26	0.0000
10Jan2020	23:51	1.5767	2.034	8.27	0.0000
10Jan2020	23:54	1.5733	2.040	8.27	0.0000
10Jan2020	23:57	1.5692	2.047	8.28	0.0000
11Jan2020	00:00	1.5649	2.053	8.29	0.0000
11Jan2020	00:03	1.5593	2.060	8.29	0.0000
11Jan2020	00:06	1.5532	2.066	8.30	0.0000
11Jan2020	00:09	1.5481	2.072	8.31	0.0000
11Jan2020	00:12	1.5435	2.079	8.31	0.0000
11Jan2020	00:15	1.5397	2.085	8.32	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	00:18	1.5365	2.092	8.33	0.0000
11Jan2020	00:21	1.5323	2.098	8.33	0.0000
11Jan2020	00:24	1.5269	2.104	8.34	0.0000
11Jan2020	00:27	1.5208	2.111	8.34	0.0000
11Jan2020	00:30	1.5137	2.117	8.35	0.0000
11Jan2020	00:33	1.5067	2.123	8.36	0.0000
11Jan2020	00:36	1.5002	2.129	8.36	0.0000
11Jan2020	00:39	1.4942	2.135	8.37	0.0000
11Jan2020	00:42	1.4899	2.142	8.38	0.0000
11Jan2020	00:45	1.4869	2.148	8.38	0.0000
11Jan2020	00:48	1.4848	2.154	8.39	0.0000
11Jan2020	00:51	1.4835	2.160	8.39	0.0000
11Jan2020	00:54	1.4818	2.166	8.40	0.0000
11Jan2020	00:57	1.4790	2.172	8.41	0.0000
11Jan2020	01:00	1.4749	2.178	8.41	0.0000
11Jan2020	01:03	1.4685	2.184	8.42	0.0000
11Jan2020	01:06	1.4609	2.190	8.42	0.0000
11Jan2020	01:09	1.4543	2.197	8.43	0.0000
11Jan2020	01:12	1.4487	2.203	8.44	0.0000
11Jan2020	01:15	1.4441	2.208	8.44	0.0000
11Jan2020	01:18	1.4402	2.214	8.45	0.0000
11Jan2020	01:21	1.4354	2.220	8.45	0.0000
11Jan2020	01:24	1.4294	2.226	8.46	0.0000
11Jan2020	01:27	1.4227	2.232	8.47	0.0000
11Jan2020	01:30	1.4151	2.238	8.47	0.0000
11Jan2020	01:33	1.4076	2.244	8.48	0.0000
11Jan2020	01:36	1.4006	2.250	8.48	0.0000
11Jan2020	01:39	1.3942	2.255	8.49	0.0000
11Jan2020	01:42	1.3895	2.261	8.49	0.0000
11Jan2020	01:45	1.3861	2.267	8.50	0.0000
11Jan2020	01:48	1.3837	2.273	8.51	0.0000

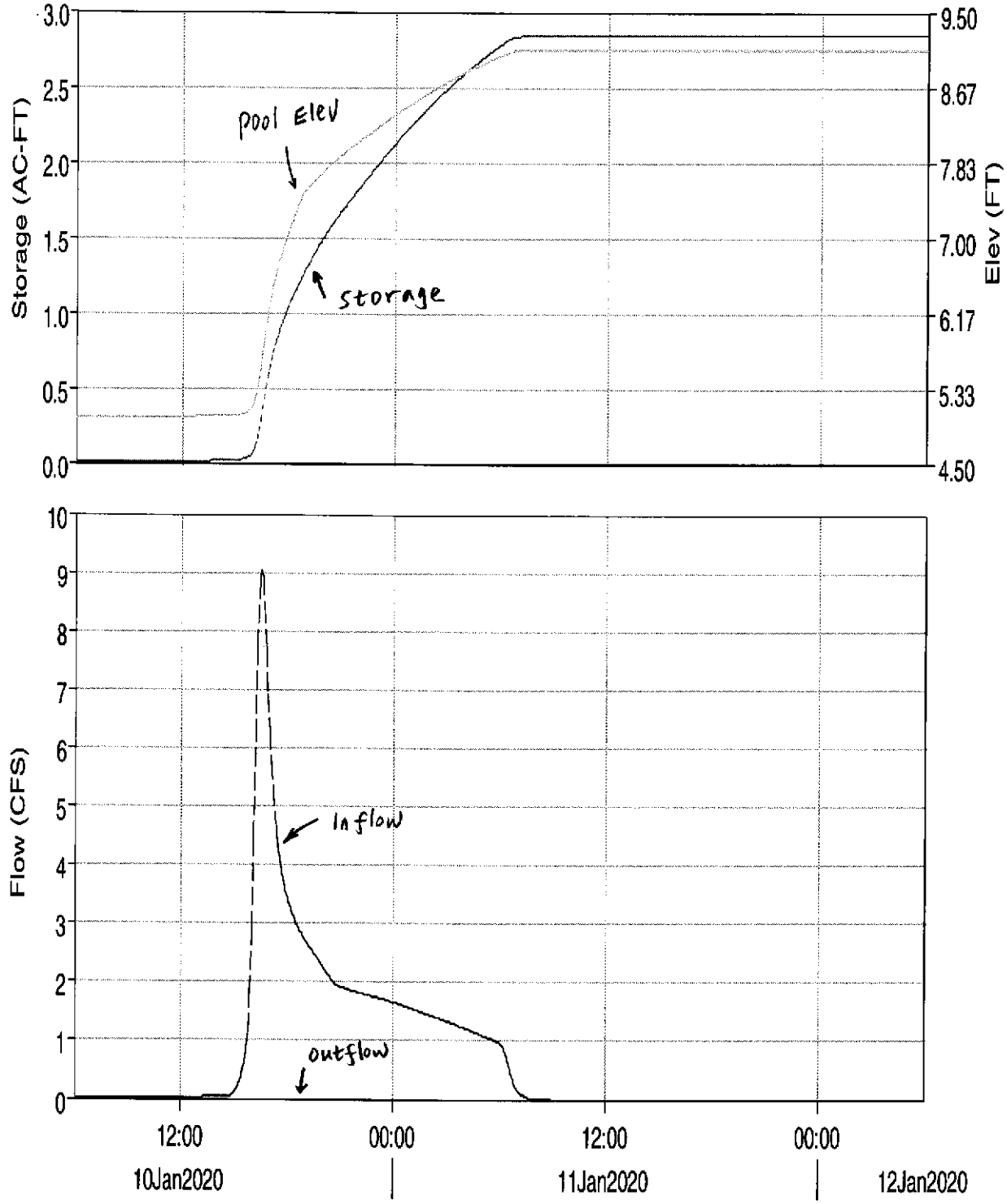
Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	01:51	1.3821	2.278	8.51	0.0000
11Jan2020	01:54	1.3801	2.284	8.52	0.0000
11Jan2020	01:57	1.3769	2.290	8.52	0.0000
11Jan2020	02:00	1.3726	2.295	8.53	0.0000
11Jan2020	02:03	1.3658	2.301	8.53	0.0000
11Jan2020	02:06	1.3578	2.307	8.54	0.0000
11Jan2020	02:09	1.3509	2.312	8.55	0.0000
11Jan2020	02:12	1.3449	2.318	8.55	0.0000
11Jan2020	02:15	1.3400	2.323	8.56	0.0000
11Jan2020	02:18	1.3359	2.329	8.56	0.0000
11Jan2020	02:21	1.3307	2.335	8.57	0.0000
11Jan2020	02:24	1.3244	2.340	8.57	0.0000
11Jan2020	02:27	1.3182	2.345	8.58	0.0000
11Jan2020	02:30	1.3118	2.351	8.58	0.0000
11Jan2020	02:33	1.3065	2.356	8.59	0.0000
11Jan2020	02:36	1.3017	2.362	8.59	0.0000
11Jan2020	02:39	1.2965	2.367	8.60	0.0000
11Jan2020	02:42	1.2908	2.372	8.61	0.0000
11Jan2020	02:45	1.2842	2.378	8.61	0.0000
11Jan2020	02:48	1.2779	2.383	8.62	0.0000
11Jan2020	02:51	1.2730	2.388	8.62	0.0000
11Jan2020	02:54	1.2687	2.394	8.63	0.0000
11Jan2020	02:57	1.2637	2.399	8.63	0.0000
11Jan2020	03:00	1.2584	2.404	8.64	0.0000
11Jan2020	03:03	1.2517	2.409	8.64	0.0000
11Jan2020	03:06	1.2446	2.414	8.65	0.0000
11Jan2020	03:09	1.2386	2.419	8.65	0.0000
11Jan2020	03:12	1.2330	2.425	8.66	0.0000
11Jan2020	03:15	1.2283	2.430	8.66	0.0000
11Jan2020	03:18	1.2242	2.435	8.67	0.0000
11Jan2020	03:21	1.2191	2.440	8.67	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	03:24	1.2127	2.445	8.68	0.0000
11Jan2020	03:27	1.2065	2.450	8.68	0.0000
11Jan2020	03:30	1.2000	2.455	8.69	0.0000
11Jan2020	03:33	1.1945	2.460	8.69	0.0000
11Jan2020	03:36	1.1897	2.465	8.70	0.0000
11Jan2020	03:39	1.1843	2.470	8.70	0.0000
11Jan2020	03:42	1.1784	2.474	8.71	0.0000
11Jan2020	03:45	1.1715	2.479	8.71	0.0000
11Jan2020	03:48	1.1650	2.484	8.72	0.0000
11Jan2020	03:51	1.1599	2.489	8.72	0.0000
11Jan2020	03:54	1.1554	2.494	8.73	0.0000
11Jan2020	03:57	1.1502	2.498	8.73	0.0000
11Jan2020	04:00	1.1446	2.503	8.74	0.0000
11Jan2020	04:03	1.1377	2.508	8.74	0.0000
11Jan2020	04:06	1.1304	2.513	8.75	0.0000
11Jan2020	04:09	1.1241	2.517	8.75	0.0000
11Jan2020	04:12	1.1183	2.522	8.75	0.0000
11Jan2020	04:15	1.1134	2.526	8.76	0.0000
11Jan2020	04:18	1.1091	2.531	8.76	0.0000
11Jan2020	04:21	1.1038	2.536	8.77	0.0000
11Jan2020	04:24	1.0972	2.540	8.77	0.0000
11Jan2020	04:27	1.0907	2.545	8.78	0.0000
11Jan2020	04:30	1.0840	2.549	8.78	0.0000
11Jan2020	04:33	1.0783	2.554	8.79	0.0000
11Jan2020	04:36	1.0732	2.558	8.79	0.0000
11Jan2020	04:39	1.0676	2.563	8.80	0.0000
11Jan2020	04:42	1.0615	2.567	8.80	0.0000
11Jan2020	04:45	1.0545	2.571	8.80	0.0000
11Jan2020	04:48	1.0477	2.576	8.81	0.0000
11Jan2020	04:51	1.0424	2.580	8.81	0.0000
11Jan2020	04:54	1.0377	2.584	8.82	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	04:57	1.0323	2.589	8.82	0.0000
11Jan2020	05:00	1.0265	2.593	8.83	0.0000
11Jan2020	05:03	1.0194	2.597	8.83	0.0000
11Jan2020	05:06	1.0118	2.601	8.83	0.0000
11Jan2020	05:09	1.0054	2.605	8.84	0.0000
11Jan2020	05:12	0.9994	2.610	8.84	0.0000
11Jan2020	05:15	0.9943	2.614	8.85	0.0000
11Jan2020	05:18	0.9898	2.618	8.85	0.0000
11Jan2020	05:21	0.9843	2.622	8.85	0.0000
11Jan2020	05:24	0.9775	2.626	8.86	0.0000
11Jan2020	05:27	0.9708	2.630	8.86	0.0000
11Jan2020	05:30	0.9639	2.634	8.87	0.0000
11Jan2020	05:33	0.9581	2.638	8.87	0.0000
11Jan2020	05:36	0.9528	2.642	8.87	0.0000
11Jan2020	05:39	0.9470	2.646	8.88	0.0000
11Jan2020	05:42	0.9407	2.650	8.88	0.0000
11Jan2020	05:45	0.9335	2.654	8.89	0.0000
11Jan2020	05:48	0.9266	2.657	8.89	0.0000
11Jan2020	05:51	0.9211	2.661	8.89	0.0000
11Jan2020	05:54	0.9162	2.665	8.90	0.0000
11Jan2020	05:57	0.9106	2.669	8.90	0.0000
11Jan2020	06:00	0.9047	2.673	8.91	0.0000
11Jan2020	06:03	0.8923	2.676	8.91	0.0000
11Jan2020	06:06	0.8686	2.680	8.91	0.0000
11Jan2020	06:09	0.8291	2.683	8.92	0.0000
11Jan2020	06:12	0.7672	2.687	8.92	0.0000
11Jan2020	06:15	0.6850	2.690	8.92	0.0000
11Jan2020	06:18	0.5919	2.692	8.93	0.0000
11Jan2020	06:21	0.4968	2.695	8.93	0.0000
11Jan2020	06:24	0.4063	2.696	8.93	0.0000
11Jan2020	06:27	0.3255	2.698	8.93	0.0000

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	06:30	0.2556	2.699	8.93	0.0000
11Jan2020	06:33	0.2005	2.700	8.93	0.0000
11Jan2020	06:36	0.1586	2.701	8.93	0.0000
11Jan2020	06:39	0.1256	2.701	8.93	0.0000
11Jan2020	06:42	0.0996	2.702	8.93	0.0000
11Jan2020	06:45	0.0785	2.702	8.93	0.0000
11Jan2020	06:48	0.0617	2.703	8.94	0.0000
11Jan2020	06:51	0.0487	2.703	8.94	0.0000
11Jan2020	06:54	0.0383	2.703	8.94	0.0000
11Jan2020	06:57	0.0301	2.703	8.94	0.0000
11Jan2020	07:00	0.0236	2.703	8.94	0.0000
11Jan2020	07:03	0.0185	2.703	8.94	0.0000
11Jan2020	07:06	0.0144	2.703	8.94	0.0000
11Jan2020	07:09	0.0112	2.703	8.94	0.0000
11Jan2020	07:12	0.0086	2.703	8.94	0.0000
11Jan2020	07:15	0.0066	2.703	8.94	0.0000
11Jan2020	07:18	0.0050	2.704	8.94	0.0000
11Jan2020	07:21	0.0038	2.704	8.94	0.0000
11Jan2020	07:24	0.0028	2.704	8.94	0.0000
11Jan2020	07:27	0.0019	2.704	8.94	0.0000
11Jan2020	07:30	0.0012	2.704	8.94	0.0000
11Jan2020	07:33	0.0007	2.704	8.94	0.0000
11Jan2020	07:36	0.0004	2.704	8.94	0.0000
11Jan2020	07:39	0.0001	2.704	8.94	0.0000
11Jan2020	07:42	0.0000	2.704	8.94	0.0000
11Jan2020	07:45	0.0000	2.704	8.94	0.0000
11Jan2020	07:48	0.0000	2.704	8.94	0.0000
11Jan2020	07:51	0.0000	2.704	8.94	0.0000
11Jan2020	07:54	0.0000	2.704	8.94	0.0000
11Jan2020	07:57	0.0000	2.704	8.94	0.0000
11Jan2020	08:00	0.0000	2.704	8.94	0.0000

Reservoir "Wetland" Results for Run "Run 1"



------ Run:Run 1 Element:WETLAND Result:Storage

—— Run:Run 1 Element:WETLAND Result:Outflow

- - - - Run:Run 1 Element:WETLAND Result:Pool Elevation

— — — Run:Run 1 Element:WETLAND Result:Combined Inflow

Superseded by Rev 2

Project: Radback
Simulation Run: Run 1 Reservo

Start of Run: 10Jan2020, 06:00 Basin
End of Run: 12Jan2020, 06:00 M
Compute Time: 11Mar2009, 13:42:58

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	06:00	0.0	0.0	5.0	0.0
10Jan2020	06:06	0.0	0.0	5.0	0.0
10Jan2020	06:12	0.0	0.0	5.0	0.0
10Jan2020	06:18	0.0	0.0	5.0	0.0
10Jan2020	06:24	0.0	0.0	5.0	0.0
10Jan2020	06:30	0.0	0.0	5.0	0.0
10Jan2020	06:36	0.0	0.0	5.0	0.0
10Jan2020	06:42	0.0	0.0	5.0	0.0
10Jan2020	06:48	0.0	0.0	5.0	0.0
10Jan2020	06:54	0.0	0.0	5.0	0.0
10Jan2020	07:00	0.0	0.0	5.0	0.0
10Jan2020	07:06	0.0	0.0	5.0	0.0
10Jan2020	07:12	0.0	0.0	5.0	0.0
10Jan2020	07:18	0.0	0.0	5.0	0.0
10Jan2020	07:24	0.0	0.0	5.0	0.0
10Jan2020	07:30	0.0	0.0	5.0	0.0
10Jan2020	07:36	0.0	0.0	5.0	0.0
10Jan2020	07:42	0.0	0.0	5.0	0.0
10Jan2020	07:48	0.0	0.0	5.0	0.0
10Jan2020	07:54	0.0	0.0	5.0	0.0
10Jan2020	08:00	0.0	0.0	5.0	0.0
10Jan2020	08:06	0.0	0.0	5.0	0.0
10Jan2020	08:12	0.0	0.0	5.0	0.0
10Jan2020	08:18	0.0	0.0	5.0	0.0
10Jan2020	08:24	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	08:30	0.0	0.0	5.0	0.0
10Jan2020	08:36	0.0	0.0	5.0	0.0
10Jan2020	08:42	0.0	0.0	5.0	0.0
10Jan2020	08:48	0.0	0.0	5.0	0.0
10Jan2020	08:54	0.0	0.0	5.0	0.0
10Jan2020	09:00	0.0	0.0	5.0	0.0
10Jan2020	09:06	0.0	0.0	5.0	0.0
10Jan2020	09:12	0.0	0.0	5.0	0.0
10Jan2020	09:18	0.0	0.0	5.0	0.0
10Jan2020	09:24	0.0	0.0	5.0	0.0
10Jan2020	09:30	0.0	0.0	5.0	0.0
10Jan2020	09:36	0.0	0.0	5.0	0.0
10Jan2020	09:42	0.0	0.0	5.0	0.0
10Jan2020	09:48	0.0	0.0	5.0	0.0
10Jan2020	09:54	0.0	0.0	5.0	0.0
10Jan2020	10:00	0.0	0.0	5.0	0.0
10Jan2020	10:06	0.0	0.0	5.0	0.0
10Jan2020	10:12	0.0	0.0	5.0	0.0
10Jan2020	10:18	0.0	0.0	5.0	0.0
10Jan2020	10:24	0.0	0.0	5.0	0.0
10Jan2020	10:30	0.0	0.0	5.0	0.0
10Jan2020	10:36	0.0	0.0	5.0	0.0
10Jan2020	10:42	0.0	0.0	5.0	0.0
10Jan2020	10:48	0.0	0.0	5.0	0.0
10Jan2020	10:54	0.0	0.0	5.0	0.0
10Jan2020	11:00	0.0	0.0	5.0	0.0
10Jan2020	11:06	0.0	0.0	5.0	0.0
10Jan2020	11:12	0.0	0.0	5.0	0.0
10Jan2020	11:18	0.0	0.0	5.0	0.0
10Jan2020	11:24	0.0	0.0	5.0	0.0
10Jan2020	11:30	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	11:36	0.0	0.0	5.0	0.0
10Jan2020	11:42	0.0	0.0	5.0	0.0
10Jan2020	11:48	0.0	0.0	5.0	0.0
10Jan2020	11:54	0.0	0.0	5.0	0.0
10Jan2020	12:00	0.0	0.0	5.0	0.0
10Jan2020	12:06	0.0	0.0	5.0	0.0
10Jan2020	12:12	0.0	0.0	5.0	0.0
10Jan2020	12:18	0.0	0.0	5.0	0.0
10Jan2020	12:24	0.0	0.0	5.0	0.0
10Jan2020	12:30	0.0	0.0	5.0	0.0
10Jan2020	12:36	0.0	0.0	5.0	0.0
10Jan2020	12:42	0.0	0.0	5.0	0.0
10Jan2020	12:48	0.0	0.0	5.0	0.0
10Jan2020	12:54	0.0	0.0	5.0	0.0
10Jan2020	13:00	0.0	0.0	5.0	0.0
10Jan2020	13:06	0.0	0.0	5.0	0.0
10Jan2020	13:12	0.0	0.0	5.0	0.0
10Jan2020	13:18	0.0	0.0	5.0	0.0
10Jan2020	13:24	0.0	0.0	5.0	0.0
10Jan2020	13:30	0.0	0.0	5.0	0.0
10Jan2020	13:36	0.0	0.0	5.0	0.0
10Jan2020	13:42	0.0	0.0	5.0	0.0
10Jan2020	13:48	0.0	0.0	5.0	0.0
10Jan2020	13:54	0.0	0.0	5.0	0.0
10Jan2020	14:00	0.0	0.0	5.0	0.0
10Jan2020	14:06	0.0	0.0	5.0	0.0
10Jan2020	14:12	0.0	0.0	5.0	0.0
10Jan2020	14:18	0.0	0.0	5.0	0.0
10Jan2020	14:24	0.0	0.0	5.0	0.0
10Jan2020	14:30	0.0	0.0	5.0	0.0
10Jan2020	14:36	0.0	0.0	5.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	14:42	0.1	0.0	5.0	0.0
10Jan2020	14:48	0.1	0.0	5.0	0.0
10Jan2020	14:54	0.1	0.0	5.0	0.0
10Jan2020	15:00	0.1	0.0	5.0	0.0
10Jan2020	15:06	0.2	0.0	5.0	0.0
10Jan2020	15:12	0.2	0.0	5.0	0.0
10Jan2020	15:18	0.3	0.0	5.0	0.0
10Jan2020	15:24	0.4	0.0	5.1	0.0
10Jan2020	15:30	0.5	0.0	5.1	0.0
10Jan2020	15:36	0.6	0.0	5.1	0.0
10Jan2020	15:42	0.8	0.0	5.1	0.0
10Jan2020	15:48	1.1	0.0	5.1	0.0
10Jan2020	15:54	1.8	0.1	5.1	0.0
10Jan2020	16:00	2.9	0.1	5.2	0.0
10Jan2020	16:06	4.4	0.1	5.2	0.0
10Jan2020	16:12	6.2	0.2	5.3	0.0
10Jan2020	16:18	7.7	0.2	5.4	0.0
10Jan2020	16:24	8.7	0.3	5.6	0.0
10Jan2020	16:30	9.0	0.4	5.7	0.0
10Jan2020	16:36	8.9	0.4	5.8	0.0
10Jan2020	16:42	8.4	0.5	6.0	0.0
10Jan2020	16:48	7.7	0.6	6.1	0.0
10Jan2020	16:54	6.9	0.6	6.2	0.0
10Jan2020	17:00	6.3	0.7	6.3	0.0
10Jan2020	17:06	5.8	0.7	6.4	0.0
10Jan2020	17:12	5.3	0.8	6.5	0.0
10Jan2020	17:18	4.9	0.8	6.6	0.0
10Jan2020	17:24	4.6	0.9	6.7	0.0
10Jan2020	17:30	4.3	0.9	6.8	0.0
10Jan2020	17:36	4.1	0.9	6.8	0.0
10Jan2020	17:42	3.9	1.0	6.9	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	17:48	3.7	1.0	7.0	0.0
10Jan2020	17:54	3.6	1.0	7.0	0.0
10Jan2020	18:00	3.5	1.1	7.1	0.0
10Jan2020	18:06	3.3	1.1	7.1	0.0
10Jan2020	18:12	3.3	1.1	7.2	0.0
10Jan2020	18:18	3.2	1.1	7.2	0.0
10Jan2020	18:24	3.1	1.2	7.3	0.0
10Jan2020	18:30	3.0	1.2	7.3	0.0
10Jan2020	18:36	3.0	1.2	7.4	0.0
10Jan2020	18:42	2.9	1.2	7.4	0.0
10Jan2020	18:48	2.8	1.3	7.5	0.0
10Jan2020	18:54	2.8	1.3	7.5	0.0
10Jan2020	19:00	2.7	1.3	7.5	0.0
10Jan2020	19:06	2.7	1.3	7.6	0.0
10Jan2020	19:12	2.6	1.3	7.6	0.0
10Jan2020	19:18	2.6	1.4	7.6	0.0
10Jan2020	19:24	2.5	1.4	7.6	0.0
10Jan2020	19:30	2.5	1.4	7.6	0.0
10Jan2020	19:36	2.5	1.4	7.7	0.0
10Jan2020	19:42	2.4	1.5	7.7	0.0
10Jan2020	19:48	2.4	1.5	7.7	0.0
10Jan2020	19:54	2.3	1.5	7.7	0.0
10Jan2020	20:00	2.3	1.5	7.7	0.0
10Jan2020	20:06	2.2	1.5	7.8	0.0
10Jan2020	20:12	2.2	1.5	7.8	0.0
10Jan2020	20:18	2.1	1.6	7.8	0.0
10Jan2020	20:24	2.1	1.6	7.8	0.0
10Jan2020	20:30	2.1	1.6	7.8	0.0
10Jan2020	20:36	2.0	1.6	7.8	0.0
10Jan2020	20:42	2.0	1.6	7.9	0.0
10Jan2020	20:48	2.0	1.6	7.9	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
10Jan2020	20:54	1.9	1.7	7.9	0.0
10Jan2020	21:00	1.9	1.7	7.9	0.0
10Jan2020	21:06	1.9	1.7	7.9	0.0
10Jan2020	21:12	1.9	1.7	7.9	0.0
10Jan2020	21:18	1.9	1.7	8.0	0.0
10Jan2020	21:24	1.9	1.7	8.0	0.0
10Jan2020	21:30	1.9	1.8	8.0	0.0
10Jan2020	21:36	1.9	1.8	8.0	0.0
10Jan2020	21:42	1.9	1.8	8.0	0.0
10Jan2020	21:48	1.8	1.8	8.0	0.0
10Jan2020	21:54	1.8	1.8	8.1	0.0
10Jan2020	22:00	1.8	1.8	8.1	0.0
10Jan2020	22:06	1.8	1.8	8.1	0.0
10Jan2020	22:12	1.8	1.9	8.1	0.0
10Jan2020	22:18	1.8	1.9	8.1	0.0
10Jan2020	22:24	1.8	1.9	8.1	0.0
10Jan2020	22:30	1.8	1.9	8.1	0.0
10Jan2020	22:36	1.8	1.9	8.2	0.0
10Jan2020	22:42	1.8	1.9	8.2	0.0
10Jan2020	22:48	1.8	2.0	8.2	0.0
10Jan2020	22:54	1.8	2.0	8.2	0.0
10Jan2020	23:00	1.7	2.0	8.2	0.0
10Jan2020	23:06	1.7	2.0	8.2	0.0
10Jan2020	23:12	1.7	2.0	8.2	0.0
10Jan2020	23:18	1.7	2.0	8.3	0.0
10Jan2020	23:24	1.7	2.0	8.3	0.0
10Jan2020	23:30	1.7	2.1	8.3	0.0
10Jan2020	23:36	1.7	2.1	8.3	0.0
10Jan2020	23:42	1.7	2.1	8.3	0.0
10Jan2020	23:48	1.7	2.1	8.3	0.0
10Jan2020	23:54	1.7	2.1	8.3	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	00:00	1.7	2.1	8.4	0.0
11Jan2020	00:06	1.6	2.1	8.4	0.0
11Jan2020	00:12	1.6	2.2	8.4	0.0
11Jan2020	00:18	1.6	2.2	8.4	0.0
11Jan2020	00:24	1.6	2.2	8.4	0.0
11Jan2020	00:30	1.6	2.2	8.4	0.0
11Jan2020	00:36	1.6	2.2	8.4	0.0
11Jan2020	00:42	1.6	2.2	8.5	0.0
11Jan2020	00:48	1.6	2.2	8.5	0.0
11Jan2020	00:54	1.6	2.2	8.5	0.0
11Jan2020	01:00	1.6	2.3	8.5	0.0
11Jan2020	01:06	1.6	2.3	8.5	0.0
11Jan2020	01:12	1.5	2.3	8.5	0.0
11Jan2020	01:18	1.5	2.3	8.5	0.0
11Jan2020	01:24	1.5	2.3	8.5	0.0
11Jan2020	01:30	1.5	2.3	8.6	0.0
11Jan2020	01:36	1.5	2.3	8.6	0.0
11Jan2020	01:42	1.5	2.3	8.6	0.0
11Jan2020	01:48	1.5	2.4	8.6	0.0
11Jan2020	01:54	1.5	2.4	8.6	0.0
11Jan2020	02:00	1.5	2.4	8.6	0.0
11Jan2020	02:06	1.4	2.4	8.6	0.0
11Jan2020	02:12	1.4	2.4	8.6	0.0
11Jan2020	02:18	1.4	2.4	8.6	0.0
11Jan2020	02:24	1.4	2.4	8.7	0.0
11Jan2020	02:30	1.4	2.4	8.7	0.0
11Jan2020	02:36	1.4	2.5	8.7	0.0
11Jan2020	02:42	1.4	2.5	8.7	0.0
11Jan2020	02:48	1.4	2.5	8.7	0.0
11Jan2020	02:54	1.4	2.5	8.7	0.0
11Jan2020	03:00	1.3	2.5	8.7	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	03:06	1.3	2.5	8.7	0.0
11Jan2020	03:12	1.3	2.5	8.8	0.0
11Jan2020	03:18	1.3	2.5	8.8	0.0
11Jan2020	03:24	1.3	2.5	8.8	0.0
11Jan2020	03:30	1.3	2.6	8.8	0.0
11Jan2020	03:36	1.3	2.6	8.8	0.0
11Jan2020	03:42	1.3	2.6	8.8	0.0
11Jan2020	03:48	1.2	2.6	8.8	0.0
11Jan2020	03:54	1.2	2.6	8.8	0.0
11Jan2020	04:00	1.2	2.6	8.8	0.0
11Jan2020	04:06	1.2	2.6	8.8	0.0
11Jan2020	04:12	1.2	2.6	8.9	0.0
11Jan2020	04:18	1.2	2.6	8.9	0.0
11Jan2020	04:24	1.2	2.6	8.9	0.0
11Jan2020	04:30	1.2	2.7	8.9	0.0
11Jan2020	04:36	1.2	2.7	8.9	0.0
11Jan2020	04:42	1.1	2.7	8.9	0.0
11Jan2020	04:48	1.1	2.7	8.9	0.0
11Jan2020	04:54	1.1	2.7	8.9	0.0
11Jan2020	05:00	1.1	2.7	8.9	0.0
11Jan2020	05:06	1.1	2.7	8.9	0.0
11Jan2020	05:12	1.1	2.7	8.9	0.0
11Jan2020	05:18	1.1	2.7	9.0	0.0
11Jan2020	05:24	1.1	2.7	9.0	0.0
11Jan2020	05:30	1.0	2.7	9.0	0.0
11Jan2020	05:36	1.0	2.8	9.0	0.0
11Jan2020	05:42	1.0	2.8	9.0	0.0
11Jan2020	05:48	1.0	2.8	9.0	0.0
11Jan2020	05:54	1.0	2.8	9.0	0.0
11Jan2020	06:00	1.0	2.8	9.0	0.0
11Jan2020	06:06	1.0	2.8	9.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	06:12	0.9	2.8	9.0	0.0
11Jan2020	06:18	0.9	2.8	9.0	0.0
11Jan2020	06:24	0.8	2.8	9.0	0.0
11Jan2020	06:30	0.7	2.8	9.1	0.0
11Jan2020	06:36	0.5	2.8	9.1	0.0
11Jan2020	06:42	0.4	2.8	9.1	0.0
11Jan2020	06:48	0.3	2.8	9.1	0.0
11Jan2020	06:54	0.2	2.8	9.1	0.0
11Jan2020	07:00	0.2	2.8	9.1	0.0
11Jan2020	07:06	0.1	2.8	9.1	0.0
11Jan2020	07:12	0.1	2.8	9.1	0.0
11Jan2020	07:18	0.1	2.8	9.1	0.0
11Jan2020	07:24	0.1	2.8	9.1	0.0
11Jan2020	07:30	0.0	2.8	9.1	0.0
11Jan2020	07:36	0.0	2.8	9.1	0.0
11Jan2020	07:42	0.0	2.8	9.1	0.0
11Jan2020	07:48	0.0	2.8	9.1	0.0
11Jan2020	07:54	0.0	2.8	9.1	0.0
11Jan2020	08:00	0.0	2.8	9.1	0.0
11Jan2020	08:06	0.0	2.8	9.1	0.0
11Jan2020	08:12	0.0	2.8	9.1	0.0
11Jan2020	08:18	0.0	2.8	9.1	0.0
11Jan2020	08:24	0.0	2.8	9.1	0.0
11Jan2020	08:30	0.0	2.8	9.1	0.0
11Jan2020	08:36	0.0	2.8	9.1	0.0
11Jan2020	08:42	0.0	2.8	9.1	0.0
11Jan2020	08:48	0.0	2.8	9.1	0.0
11Jan2020	08:54	0.0	2.8	9.1	0.0
11Jan2020	09:00	0.0	2.8	9.1	0.0
11Jan2020	09:06	0.0	2.8	9.1	0.0
11Jan2020	09:12	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	09:18	0.0	2.8	9.1	0.0
11Jan2020	09:24	0.0	2.8	9.1	0.0
11Jan2020	09:30	0.0	2.8	9.1	0.0
11Jan2020	09:36	0.0	2.8	9.1	0.0
11Jan2020	09:42	0.0	2.8	9.1	0.0
11Jan2020	09:48	0.0	2.8	9.1	0.0
11Jan2020	09:54	0.0	2.8	9.1	0.0
11Jan2020	10:00	0.0	2.8	9.1	0.0
11Jan2020	10:06	0.0	2.8	9.1	0.0
11Jan2020	10:12	0.0	2.8	9.1	0.0
11Jan2020	10:18	0.0	2.8	9.1	0.0
11Jan2020	10:24	0.0	2.8	9.1	0.0
11Jan2020	10:30	0.0	2.8	9.1	0.0
11Jan2020	10:36	0.0	2.8	9.1	0.0
11Jan2020	10:42	0.0	2.8	9.1	0.0
11Jan2020	10:48	0.0	2.8	9.1	0.0
11Jan2020	10:54	0.0	2.8	9.1	0.0
11Jan2020	11:00	0.0	2.8	9.1	0.0
11Jan2020	11:06	0.0	2.8	9.1	0.0
11Jan2020	11:12	0.0	2.8	9.1	0.0
11Jan2020	11:18	0.0	2.8	9.1	0.0
11Jan2020	11:24	0.0	2.8	9.1	0.0
11Jan2020	11:30	0.0	2.8	9.1	0.0
11Jan2020	11:36	0.0	2.8	9.1	0.0
11Jan2020	11:42	0.0	2.8	9.1	0.0
11Jan2020	11:48	0.0	2.8	9.1	0.0
11Jan2020	11:54	0.0	2.8	9.1	0.0
11Jan2020	12:00	0.0	2.8	9.1	0.0
11Jan2020	12:06	0.0	2.8	9.1	0.0
11Jan2020	12:12	0.0	2.8	9.1	0.0
11Jan2020	12:18	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	12:24	0.0	2.8	9.1	0.0
11Jan2020	12:30	0.0	2.8	9.1	0.0
11Jan2020	12:36	0.0	2.8	9.1	0.0
11Jan2020	12:42	0.0	2.8	9.1	0.0
11Jan2020	12:48	0.0	2.8	9.1	0.0
11Jan2020	12:54	0.0	2.8	9.1	0.0
11Jan2020	13:00	0.0	2.8	9.1	0.0
11Jan2020	13:06	0.0	2.8	9.1	0.0
11Jan2020	13:12	0.0	2.8	9.1	0.0
11Jan2020	13:18	0.0	2.8	9.1	0.0
11Jan2020	13:24	0.0	2.8	9.1	0.0
11Jan2020	13:30	0.0	2.8	9.1	0.0
11Jan2020	13:36	0.0	2.8	9.1	0.0
11Jan2020	13:42	0.0	2.8	9.1	0.0
11Jan2020	13:48	0.0	2.8	9.1	0.0
11Jan2020	13:54	0.0	2.8	9.1	0.0
11Jan2020	14:00	0.0	2.8	9.1	0.0
11Jan2020	14:06	0.0	2.8	9.1	0.0
11Jan2020	14:12	0.0	2.8	9.1	0.0
11Jan2020	14:18	0.0	2.8	9.1	0.0
11Jan2020	14:24	0.0	2.8	9.1	0.0
11Jan2020	14:30	0.0	2.8	9.1	0.0
11Jan2020	14:36	0.0	2.8	9.1	0.0
11Jan2020	14:42	0.0	2.8	9.1	0.0
11Jan2020	14:48	0.0	2.8	9.1	0.0
11Jan2020	14:54	0.0	2.8	9.1	0.0
11Jan2020	15:00	0.0	2.8	9.1	0.0
11Jan2020	15:06	0.0	2.8	9.1	0.0
11Jan2020	15:12	0.0	2.8	9.1	0.0
11Jan2020	15:18	0.0	2.8	9.1	0.0
11Jan2020	15:24	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	15:30	0.0	2.8	9.1	0.0
11Jan2020	15:36	0.0	2.8	9.1	0.0
11Jan2020	15:42	0.0	2.8	9.1	0.0
11Jan2020	15:48	0.0	2.8	9.1	0.0
11Jan2020	15:54	0.0	2.8	9.1	0.0
11Jan2020	16:00	0.0	2.8	9.1	0.0
11Jan2020	16:06	0.0	2.8	9.1	0.0
11Jan2020	16:12	0.0	2.8	9.1	0.0
11Jan2020	16:18	0.0	2.8	9.1	0.0
11Jan2020	16:24	0.0	2.8	9.1	0.0
11Jan2020	16:30	0.0	2.8	9.1	0.0
11Jan2020	16:36	0.0	2.8	9.1	0.0
11Jan2020	16:42	0.0	2.8	9.1	0.0
11Jan2020	16:48	0.0	2.8	9.1	0.0
11Jan2020	16:54	0.0	2.8	9.1	0.0
11Jan2020	17:00	0.0	2.8	9.1	0.0
11Jan2020	17:06	0.0	2.8	9.1	0.0
11Jan2020	17:12	0.0	2.8	9.1	0.0
11Jan2020	17:18	0.0	2.8	9.1	0.0
11Jan2020	17:24	0.0	2.8	9.1	0.0
11Jan2020	17:30	0.0	2.8	9.1	0.0
11Jan2020	17:36	0.0	2.8	9.1	0.0
11Jan2020	17:42	0.0	2.8	9.1	0.0
11Jan2020	17:48	0.0	2.8	9.1	0.0
11Jan2020	17:54	0.0	2.8	9.1	0.0
11Jan2020	18:00	0.0	2.8	9.1	0.0
11Jan2020	18:06	0.0	2.8	9.1	0.0
11Jan2020	18:12	0.0	2.8	9.1	0.0
11Jan2020	18:18	0.0	2.8	9.1	0.0
11Jan2020	18:24	0.0	2.8	9.1	0.0
11Jan2020	18:30	0.0	2.8	9.1	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
11Jan2020	18:36	0.0	2.8	9.1	0.0
11Jan2020	18:42	0.0	2.8	9.1	0.0
11Jan2020	18:48	0.0	2.8	9.1	0.0
11Jan2020	18:54	0.0	2.8	9.1	0.0
11Jan2020	19:00	0.0	2.8	9.1	0.0
11Jan2020	19:06	0.0	2.8	9.1	0.0
11Jan2020	19:12	0.0	2.8	9.1	0.0
11Jan2020	19:18	0.0	2.8	9.1	0.0
11Jan2020	19:24	0.0	2.8	9.1	0.0
11Jan2020	19:30	0.0	2.8	9.1	0.0
11Jan2020	19:36	0.0	2.8	9.1	0.0
11Jan2020	19:42	0.0	2.8	9.1	0.0
11Jan2020	19:48	0.0	2.8	9.1	0.0
11Jan2020	19:54	0.0	2.8	9.1	0.0
11Jan2020	20:00	0.0	2.8	9.1	0.0
11Jan2020	20:06	0.0	2.8	9.1	0.0
11Jan2020	20:12	0.0	2.8	9.1	0.0
11Jan2020	20:18	0.0	2.8	9.1	0.0
11Jan2020	20:24	0.0	2.8	9.1	0.0
11Jan2020	20:30	0.0	2.8	9.1	0.0
11Jan2020	20:36	0.0	2.8	9.1	0.0
11Jan2020	20:42	0.0	2.8	9.1	0.0
11Jan2020	20:48	0.0	2.8	9.1	0.0
11Jan2020	20:54	0.0	2.8	9.1	0.0
11Jan2020	21:00	0.0	2.8	9.1	0.0
11Jan2020	21:06	0.0	2.8	9.1	0.0
11Jan2020	21:12	0.0	2.8	9.1	0.0
11Jan2020	21:18	0.0	2.8	9.1	0.0
11Jan2020	21:24	0.0	2.8	9.1	0.0
11Jan2020	21:30	0.0	2.8	9.1	0.0
11Jan2020	21:36	0.0	2.8	9.1	0.0

BLACK & VEATCH
Building a world of difference.

CALCULATION RECORD

Client Name: Radback Energy Page 1 of 21

Project Name: Oakley Generating Station Project No.: 163994

Calculation Title: Post-Construction Wetland Volume and Water Surface Elevation

Calculation No./File No.: 52.5406.1006

Verification Method: ☒ Check and Review ☐ Alternate Calculations

Objective To determine if the existing wetland at the project site can retain the runoff from various storm events without overflowing to other properties.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

Refer to Page _____ of this calculation for additional assumptions.

This Section Used for Software-Generated Calculations

Program Name/Number: HEC-HMS Version: 3.3

Standard B&V Application Used? ☒ Yes ☐ No
If no, list approved deviation permit number below and attach approved deviation permit.

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	C Kantola	11 June 2010	PLNelson	18 June 2010	PLNelson	18 June 2010
1	C. Kantola	13 Sept 2010	PLNelson	16 Sept 10	PLNelson	16 Sept 10

Purpose

To determine the stormwater storage volume and water surface elevation for the existing wetland and the proposed pond at the Oakley project site for storm events including the 1-inch rainfall, 10-year/24-hour storm, and combined 100-year/24-hour plus 10-year/24-hour storm (100+10) events. The analyses are performed for pre-construction and post-construction ground conditions at the project site.

References

1. Black & Veatch Drawings:
   - 163994-SS-3001, Rev. A, "Grading & Drainage - Site"
   - 163994-SS-3001, Rev. 0, "Grading & Drainage - Site"
2. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
3. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, User's Manual, Version 3.3; September 2008.
4. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, Technical Reference Manual; March 2000.
5. Contra Costa County Dept. of Public Works Maps; Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973; Drawing No. B-166; December 1977; Precipitation Duration-Frequency-Depth Curves (100-yr and 10-yr); Drawing Nos. B-159 and B-162; July 1977
6. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
7. Mays, L. W.; Stormwater Collection Systems Design Handbook, McGraw-Hill; 2001.
8. Black & Veatch Calculation, "IMP Sizing for Plant Area", File No. 52.5406.1008 Rev 0, Same project, June 2010
9. Black & Veatch Calculation, "Stormwater Analysis", File No. 52.5406.1003 Rev 2, Same project, June 2010
10. Email Correspondence with Contra Costa County Flood Control, May 2010

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)

Drainage area in acres (ac)

Attachments

1. HEC-HMS Input
2. HEC-HMS Output
3. Reference 2 – Select Pages
4. Reference 6 – Select Pages
5. Reference 8 – Select Pages
6. Reference 9 – Select Pages
7. Reference 10

Summary

Based on the HEC-HMS analyses with current and proposed design conditions, the stormwater runoff to the wetland will not overflow to other properties for any of the analyzed storm events including the 100-year 24-hour storm followed by a 10-year 24-hour storm (100+10 event). This combined event was requested to be analyzed by Contra Costa County for the wetland area since there is no outlet within the wetland area. See Reference 10 – Attachment 7.

The maximum water surface elevation (WSEL) in the wetland is EL 10.7, produced by the combined 100+10 events. This is below the overflow elevation at the adjacent roadway of EL 11.7. The comparison between the existing and proposed site conditions for other storm events are summarized in the table below.

Summary of Runoff Volume & Wetland WSEL

Rainfall Event	Pre-Construction		Post-Construction	
	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)
1-inch	0.03	5.1	0.05	5.1
10-year	1.10	7.2	1.51	7.7
100-year	2.70	8.9	3.58	9.7
100-year + 10-year	3.80	10.0	5.42	10.7

superseded 9/13/10
See page 4A

Summary

Based on the HEC-HMS analyses with current and proposed design conditions, the stormwater runoff to the wetland will not overflow to other properties for any of the analyzed storm events including the 100-year 24-hour storm followed by a 10-year 24-hour storm (100+10 event). This combined event was requested to be analyzed by Contra Costa County for the wetland area since there is no outlet within the wetland area. See Reference 10 – Attachment 7.

The maximum water surface elevation (WSEL) in the wetland is produced by the combined 100+10 events which is below the overflow elevation at the adjacent roadway of EL 11.7. The comparison between the existing and proposed site conditions for other storm events are summarized in the table below.

Summary of Runoff Volume & Wetland WSEL

Rainfall Event	Pre-Construction		Post-Construction	
	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)
1-inch	0.06	5.1	0.15	5.3
10-year	1.17	7.3	1.90	8.1
100-year	2.79	9.0	3.58	9.8
100-year + 10-year	3.96	10.1	5.11	10.8

Hydrology Modeling – HEC-HMS

For the runoff volume and storage analysis, the entire site was modeled as one drainage area for the pre-construction (existing) condition (Reference 9) and separated into distinct drainage areas for the post-construction (proposed) condition (bioswales, and direct runoff to pond and wetland areas). See Page 6a7 for the boundary delineation of these areas. The drainage areas are summarized in the table below, with measurements taken from References 8 & 9 and also using AutoCAD.

VOID

Summary of Drainage Areas (in acres & square miles)

Ground Cover Type	Existing Site Acreage*	Post-Construction Site Acreage					
		Bioswale **				Direct to Pond	Direct to Wetland
		1+2	3	4	5		
Vineyard / Undisturbed	19.85	-	-	-	-	-	1.93
Gravel	3.96	2.30	-	2.51	3.35	-	-
Railroad Yard	0.94	-	-	-	0.94	-	-
Wetland	0.40	-	-	-	-	-	0.40
Lawn (Poor Coverage <50%)	-	4.55	0.45	0.54	1.50	0.85	-
Impervious Surface ***	-	2.75	0.14	1.21	0.88	0.13	0.27 (ex. roads)
Transformer Contain ****	-	0.10	-	0.12	-	-	-
Open Graded Aggregate	-	1.57	-	-	-	-	-
Total Acres:	25.15	11.17	0.59	4.26	6.67	0.98	2.60
Total (Sq. Mi.):	**0.0393**	**0.0175**	**0.0009**	**0.0067**	**0.0104**	**0.0015**	**0.0041**
		0.0411 sq. mi. (Total Post-Construction)					

* Existing site acreage as determined in BV Calc 52.5406.1003 (Ref 9)
** Post-construction areas as determined in BV Calc 52.5406.1008 (Ref 8)
*** Impervious surface computed as sum of Equipment/Roofs + Pavement (from Calc 52.5406.1002)
**** Transformer Containment area does not drain to Bioswales and is not included in total areas listed.

The stormwater runoff to the wetland for various storms was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

Superseded 9/13/10 See Pg 5A

Hydrology Modeling – HEC-HMS

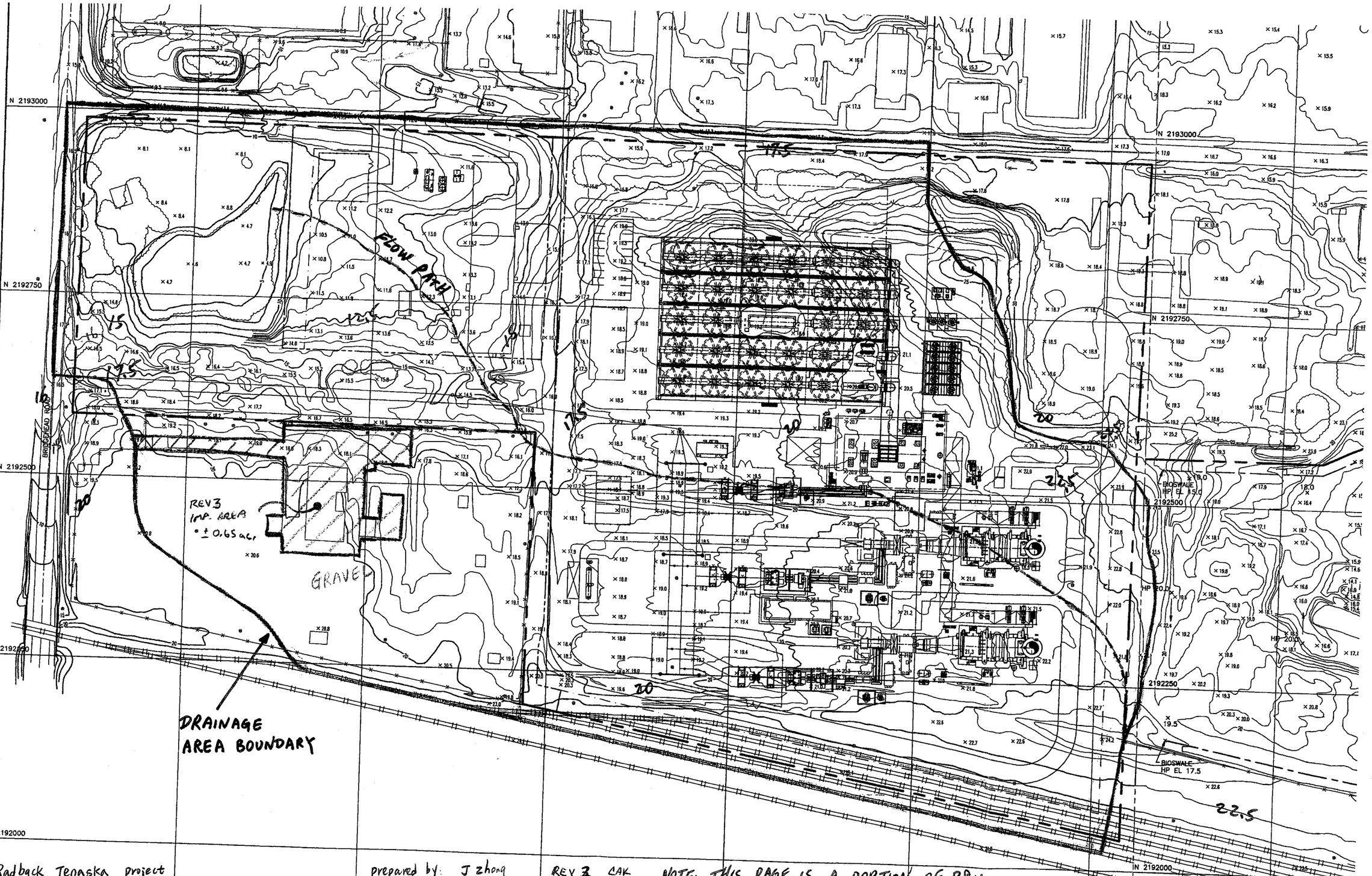
For the runoff volume and storage analysis, the entire site was modeled as one drainage area for the pre-construction (existing) condition (Reference 9) and separated into distinct drainage areas for the post-construction (proposed) condition (bioswales, and direct runoff to pond and wetland areas). See Page 6 & 7 for the boundary delineation of these areas. The drainage areas are summarized in the table below, with measurements taken from References 8 & 9 and also using AutoCAD.

Summary of Drainage Areas (in acres & square miles)

Ground Cover Type	Existing Site Acreage*	Post-Construction Site Acreage					
		Bioswale **				Direct to Pond	Direct to Wetland
		1+2	3	4	5		
Vineyard / Undisturbed	19.85	-	REMOVED IN REVISION 1	-	-	-	1.93
Gravel	3.96	2.30		2.51	2.87	0.1	-
Railroad Yard	0.94	-		-	0.94	-	-
Wetland	0.40	-		-	-	-	0.40
Lawn (Poor Coverage <50%)	-	4.55		0.54	0.95	1.28	0.47
Impervious Surface ***	-	2.75		1.21	1.32	0.30	0.28 (ex. roads)
Transformer Contain ****	-	0.10		0.12	-	-	-
Open Graded Aggregate	-	1.57		-	-	-	-
Total Acres:	25.15	11.17		4.26	6.08	1.68	3.08
Total (Sq. Mi.):	**0.0393**	**0.0175**	**0.0000**	**0.0067**	**0.0095**	**0.0026**	**0.0048**
		0.0411 sq. mi. (Total Post-Construction)					

* Existing site acreage as determined in BV Calc 52.5406.1003 (Ref 9)
** Post-construction areas as determined in BV Calc 52.5406.1008 (Ref 8)
*** Impervious surface computed as sum of Equipment/Roofs + Pavement (from Calc 52.5406.1002)
**** Transformer Containment area does not drain to Bioswales and is not included in total areas listed.

The stormwater runoff to the wetland for various storms was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).



Radback Tenaska project
project # 163994
~~52. 5406.~~ ~~1003~~
.1006

stormwater Analysis
page ~~5~~ of ~~53~~
6 of 21

prepared by: J zhong
Date: 3/4/09
checked by: PW
Date: 3/6/09

REV 3 CAK
DATE 9/7/10
CK BY: PW
DATE: 9/16/10

NOTE: THIS PAGE IS A PORTION OF B&V Drawing 163994-SS-3001 Rev A.

ACAD 16.1s (LMS Tech)
1=1
17:10

BIOSWALE #3

VOID 9-13-10 SUPERSEDED SEE P6 7A CAK

CONSERVATION EASEMENT

POND

WETLAND

BIOSWALE #1

SLOPE TO MATCH BRIDGEHEAD ROAD

BIOSWALE #5

VOID

DRAINAGE AREA FOR EA. BIOSWALE (TYP)

BIOSWALE #4

ALL BACKCIRCLED CHANGES PER ECN-N-S-00XX

OPEN
05/27/10

MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION

Radhika Oakley
Project # 163994
Stormwater Analysis
52.5406 ~~1007~~ 1006
File
page ~~[illegible]~~ 7 of 21
BY CK
Date 6/17/10
Ver: PMW
Date: 6/18/10

Base Dwg
163994-SS-3001 Rev 1

ABBRE

APPROX
ASPH
AVG
BND
BLDG
B/MH
BOC
BOD
BOP
BU
C
CB
CD
CHDPE
CL
CLR
CMH
CND
CONC
CO
CS
CW
DB
DBC
DET
DIA
DIP
DWG
DWP
EC
ECC
EF
EHH
EL
EMH
EW
FC
FDN
FF
FRP
GR
HDM
HDPE
HP
HYD
ID
INV
JBX
L
LP

1 S3000

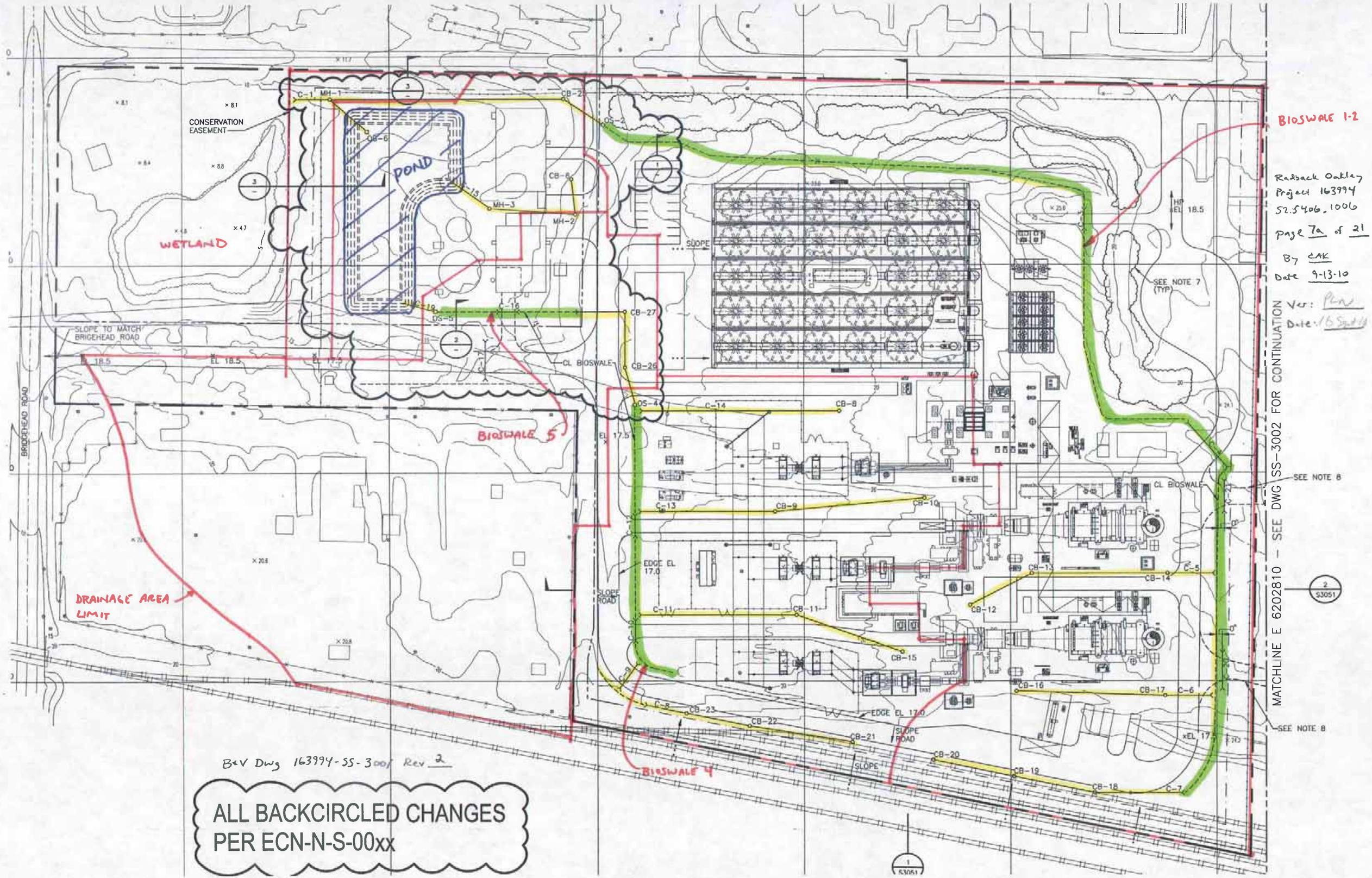
326.5

BM-1

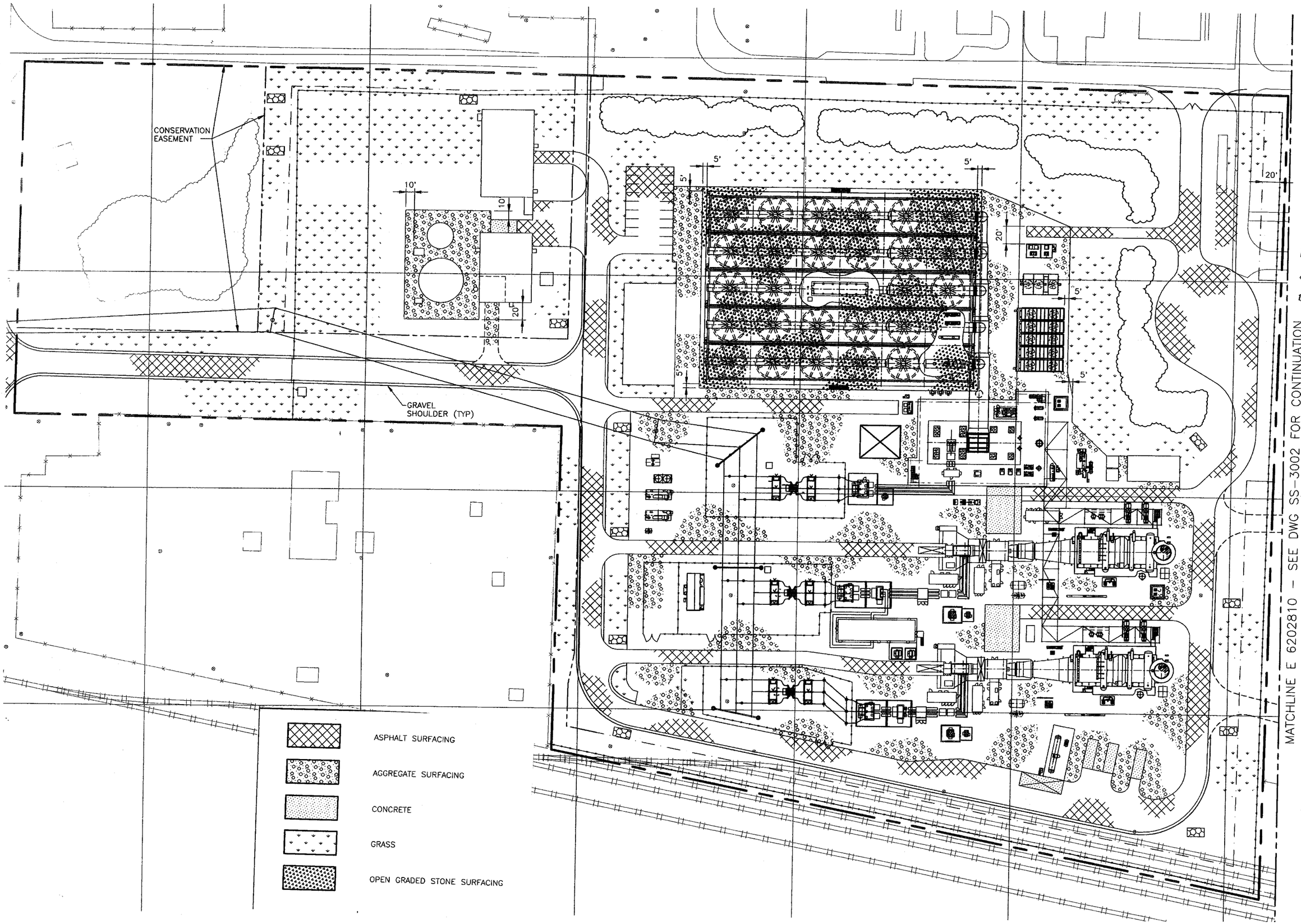
TR-1

N

1. COORDINATE NGVD 29 D THE FLAGPO DATUM ELEV PHOTOGRAPI ASSOCIATES.
2. NEW GRADE INDICATE FI
3. ALL CUT AN NOTED OTHI
4. SEE DWG S: AND OUTLET
5. TOP OF COI EL 18.0. FI
6. CL OF ALL
7. TREES TO F
8. TEMPORARY CONSTRUCTI



Radback Oakley
Project 163994
52.5406.1006
Page 7a of 21
By CAK
Date 9-13-10
Ver: Plan
Date: 10 Sept 10



Radback Oakley
Project 163994
52.5406.

BY: C. Kantola
Date: 9-13-10
Chk: PW
Date: 9/16/10

Note: This page is a portion of B&V Drawing 163994-SS-3201 REV. 0

Section 1.0 – Determine the Time of Concentration (Tc) and Lag Time

This calculation is a volumetric analysis only. Lag time (which is a function of the time of concentration) is used by HEC-HMS to compute peak flow rates only and does not affect the runoff volume computations. Therefore for simplicity, lag times of 6.0 min and 3.6 min were used for the post-construction condition. These values do not impact the volume of runoff computed within HEC-HMS. Refer to BV Calculation 52.5406.1007.

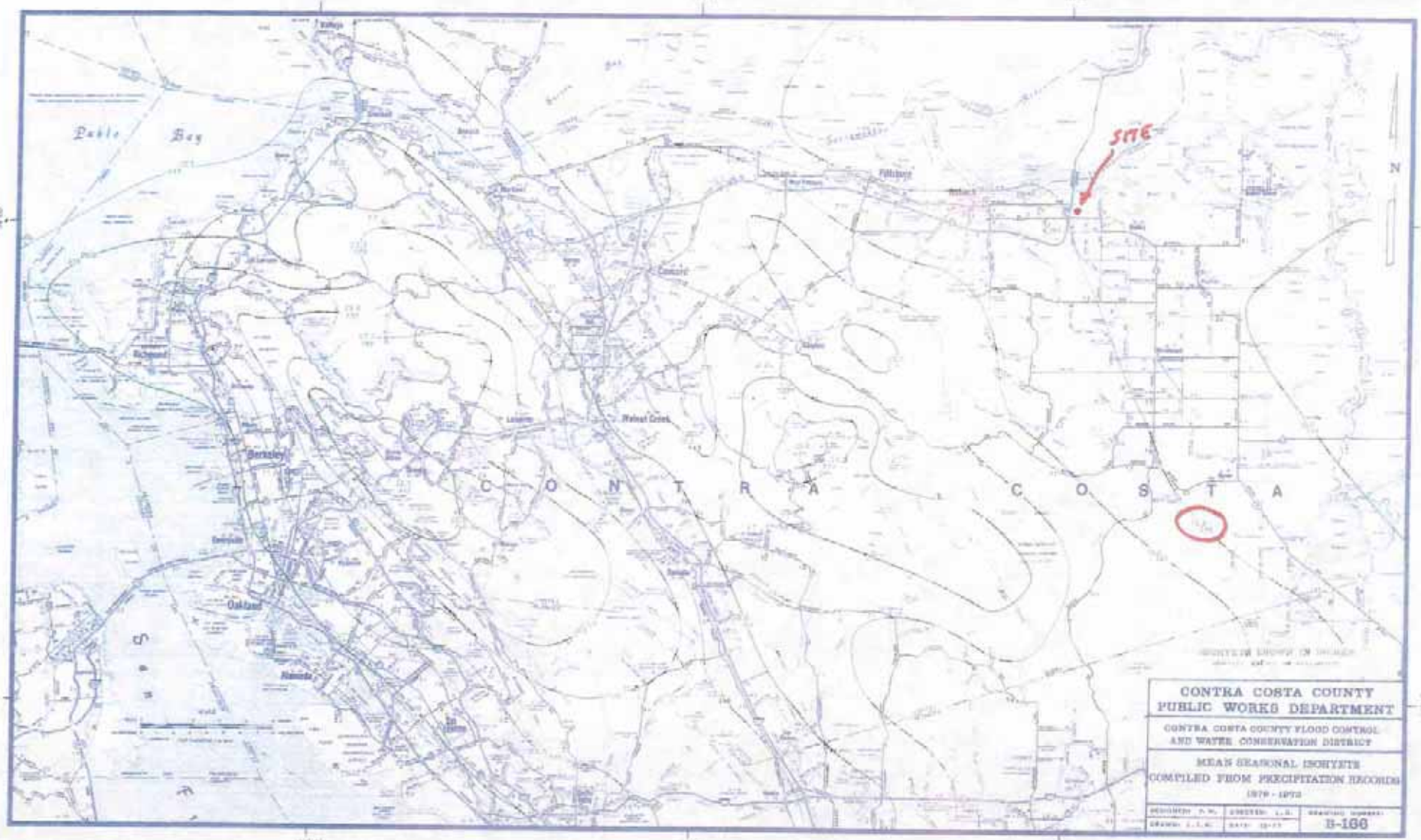
Section 2.0 – Rainfall Distribution

From Ref. 2, Figure B-2, the rainfall distribution for the site in Contra Costa County, California should be Type I distribution.

From Ref. 5, the 24-hour rainfall amounts for the site are: (See Pages 9&10)

Storm Event	100-year	10-year	Small event*
Rainfall	3.9 in.	2.6 in.	1.0 in.

* A smaller "typical" rain event of 0.75-1.0 inch was requested to be modeled by CEC

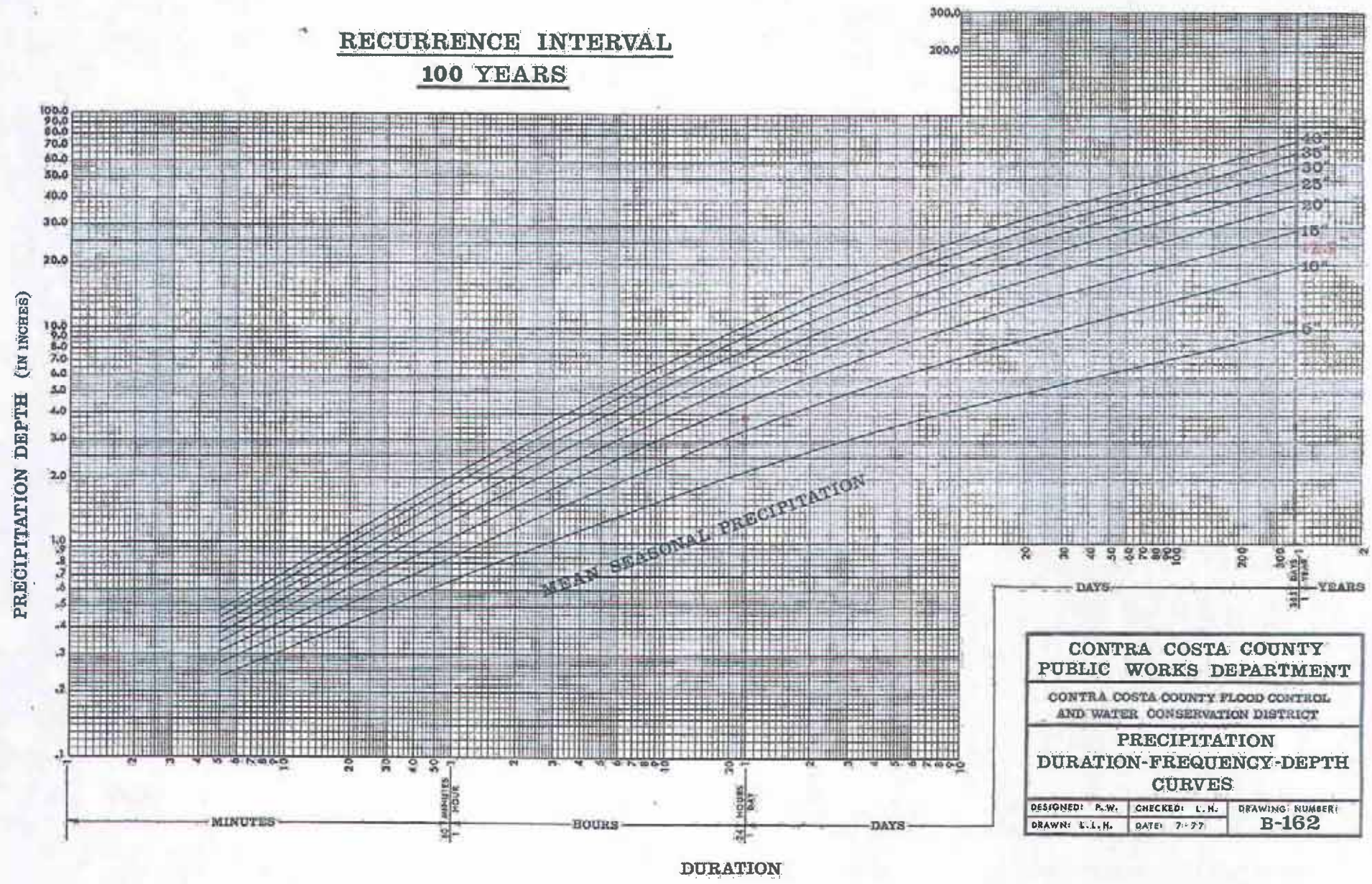


Radback Oakley Project #163994 (FROM REF. 5)

52.5406.~~1007~~ .1006

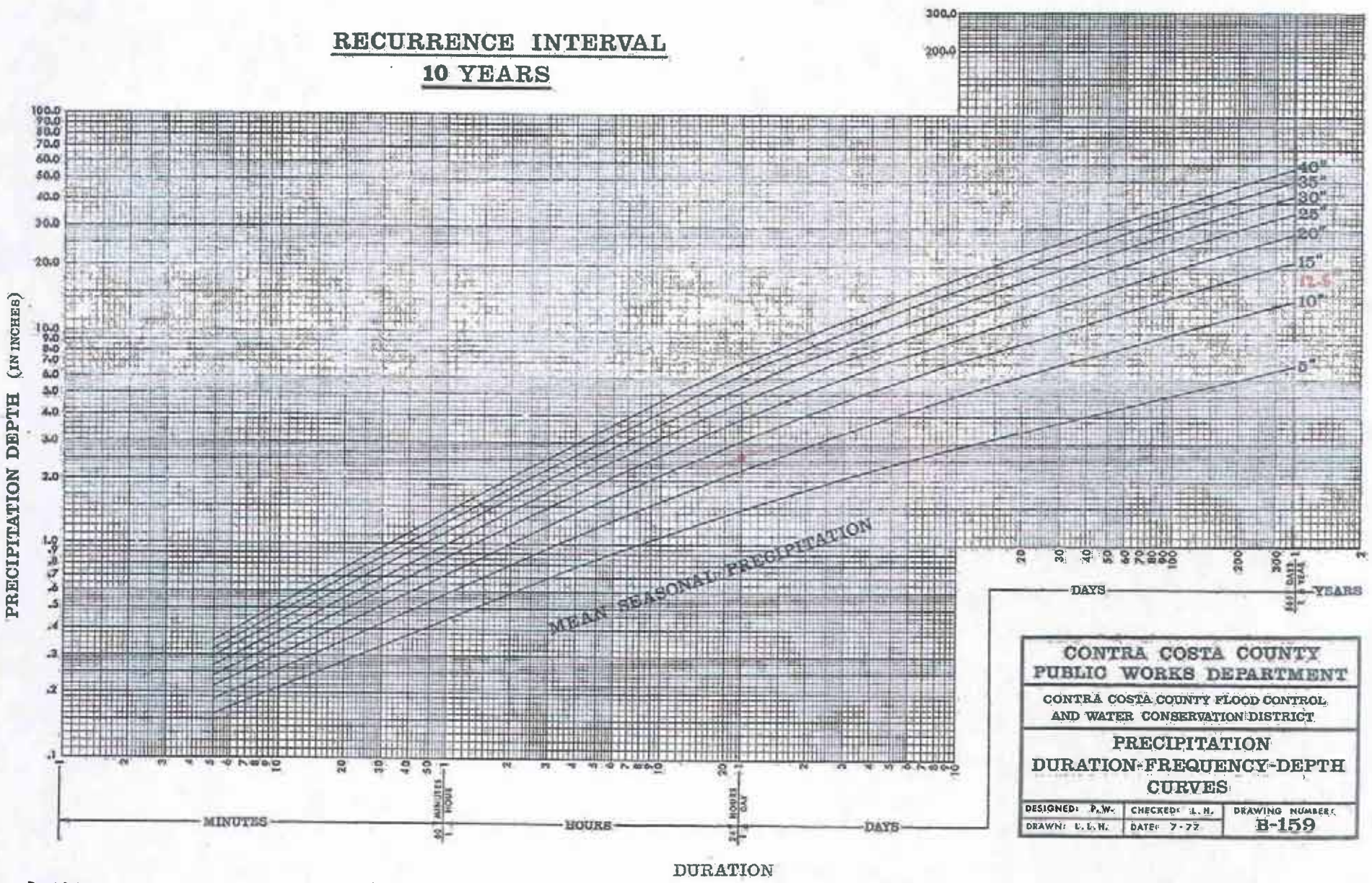
Page ~~18~~ ~~of 31~~ 9 of 21

MSP = 12.5"



MSP = 12.5" (DWG B-166)

24-HR = 3.9" (ABOVE)



RADBACK OAKLEY PROJECT # 163994

52.5406 ~~.1007~~ .1006 Page ~~16 of 31~~ 10 of 21

(FROM REF. ~~4~~ 5)

MSP = 12.5" (DWG B-166)

24-HR = 2.6" (ABOVE)

Section 3.0 – Determine Composite SCS Curve Number, Initial Abstraction & Impervious %

"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area. The SCS Curve Number (CN), Initial Abstraction (Ia) and Impervious % for the pre-construction site were determined in Reference 9 – see attachment 6.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

The proposed site drainage areas as determined earlier are summarized below, with individual CN values assigned to each type of ground cover (for Group A soils). CN values are based on Reference 2, Tables 2-2a and 2-2b.

For the pre-construction condition, the SCS Curve Number (CN = 70), Initial Abstraction (Ia = 0.857) and Impervious (% = 1) were determined in Reference 9 – see Attachment 6.

A summary of the pre- and post-construction basin parameter values determined in the following pages, and input into the HEC-HMS model are included in the table below:

Condition	Area (sq. mi.)	Composite CN	Initial Abstraction (in)	Impervious %	Lag Time (min)
Pre-Construction					
Entire Site	0.0393	70	0.857	1	19.4
Post-Construction					
Bioswale 1-2	0.0175	77	0.597	1	6.0
Bioswale 3	0.0009	75	0.667	1	6.0
Bioswale 4	0.0067	81	0.469	1	6.0
Bioswale 5	0.0104	77	0.597	1	6.0
Direct to Pond	0.0015	72	0.778	1	3.6
Direct to Wetland	0.0041	76	0.632	1	3.6

SUPERSEDED 9/13/10

See Pg 11A

Section 3.0 – Determine Composite SCS Curve Number, Initial Abstraction & Impervious %

"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area. The SCS Curve Number (CN), Initial Abstraction (Ia) and Impervious % for the pre-construction site were determined in Reference 9 – see attachment 6.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

The proposed site drainage areas as determined earlier are summarized below, with individual CN values assigned to each type of ground cover (for Group A soils). CN values are based on Reference 2, Tables 2-2a and 2-2b.

For the pre-construction condition, the SCS Curve Number (CN = 70), Initial Abstraction (Ia = 0.857) and Impervious (% = 2.6) were determined in Reference 9 – see Attachment 6.

A summary of the pre- and post-construction basin parameter values determined in the following pages, and input into the HEC-HMS model are included in the table below:

Condition	Area (sq. mi.)	Composite CN	Initial Abstraction (in)	Impervious %	Lag Time (min)
Pre-Construction					
Entire Site	0.0393	70	0.857	2.6	19.4
Post-Construction					
Bioswale 1+2 CN	0.0164	76	0.632	0	6.0
Bioswale 1+2 Imp	0.0011	98	0.041	100	6.0
Bioswale 4 CN	0.0062	80	0.500	0	6.0
Bioswale 4 Imp	0.0005	98	0.041	100	6.0
Bioswale 5 CN	0.0085	77	0.597	0	6.0
Bioswale 5 Imp	0.0010	98	0.041	100	6.0
Direct to Pond CN	0.0025	73	0.740	0	3.6
Direct to Pond Imp	0.0001	98	0.041	100	3.6
Direct to Wetland	0.0048	75	0.667	0	3.6

Bioswale 1+2 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	2.30 ac.	174.8
Lawn (Poor Coverage <50%)	68	4.55 ac.	309.4
Impervious Surface	98	2.75 ac.	269.5
Open Graded Aggregate	68	1.57 ac.	106.76
Total		11.17 ac.	860.46
Composite CN = 860.46 / 11.17 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/77 - 10)$ = 0.597 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

SUPERSEDED 9/13/10
See Pg 12A

Bioswale 1+2 (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _*1+2 CN* **Ground Cover Type**	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.30 ac.	174.8
Lawn (Poor Coverage <50%)	68	4.55 ac.	309.4
Impervious Surface not directly connected (75% x 2.75 ac. Total)	98	2.06 ac.	202.1
Open Graded Aggregate	68	1.57 ac.	106.76
Total		10.48 ac.	793.1
Composite CN = 793.1 / 10.48 = 76			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/76 - 10)$ = <u>0.632 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing to Bioswale 1+2 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_1+2 Imp**".

2.75 acres impervious x 0.25 directly connected = 0.69 ac = 0.0011 sq. mi.

Impervious % = 100%

Bioswale 3 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Lawn (Poor Coverage <50%)	68	0.45 ac.	30.6
Impervious Surface	98	0.14 ac.	13.7
Total		0.59 ac.	44.3
Composite CN = 44.3 / 0.59 = 75			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

VOID

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/75 - 10)$ = 0.667 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Rev 1 9/13/10 CAK
Bioswale 3 removed from design

Bioswale 4 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	2.51 ac.	190.8
Lawn (Poor Coverage <50%)	68	0.54 ac.	36.7
Impervious Surface	98	1.21 ac. 28.4%	118.6
Total		4.26 ac.	346.1
Composite CN = 346.1 / 4.26 = 81			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/81 - 10)$ = 0.469 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

SUPERSEDED 9/13/10
See pg 14A

Bioswale 4 (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _4 CN Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.51 ac.	190.8
Lawn (Poor Coverage <50%)	68	0.54 ac.	36.7
Impervious Surface not directly connected (75% x 1.21 ac. Total)	98	0.91 ac.	88.9
Total		3.96 ac.	316.4
Composite CN = 316.4 / 3.96 = 80			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/80 - 10)$ = 0.500 inch.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing to Bioswale 4 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_4 Imp**".

1.21 acres impervious x 0.25 directly connected = 0.30 ac = 0.0005 sq. mi.

Impervious % = 100%

Bioswale 5 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	3.35 ac.	254.6
Railroad Yard (similar to gravel)	76	0.94 ac.	71.4
Lawn (Poor Coverage <50%)	68	1.50 ac.	102
Impervious Surface	98	0.88 ac.	86.2
Total		6.67 ac.	514.2
Composite CN = 514.2 / 6.67 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/77 - 10)$ = <u>0.597 inch</u>.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

SUPERSEDED 9/13/10
See Pg 15A

Bioswale 5 (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _5 CN Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.87 ac.	218.1
Railroad Yard (similar to gravel)	76	0.94 ac.	71.4
Lawn (Poor Coverage <50%)	68	0.95 ac.	64.6
Impervious Surface not directly connected (50% x 1.32 ac. Total)	98	0.66 ac.	64.7
Total		5.42 ac.	418.8
Composite CN = 418.8 / 5.42 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/77 - 10)$ = <u>0.597 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 50% of the impervious areas contributing to Bioswale 5 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_5 Imp**".

1.32 acres impervious x 0.50 directly connected = 0.66 ac = 0.0010 sq. mi.

Impervious % = 100%

Direct to Pond (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Lawn (Poor Coverage <50%)	68	0.85 ac.	57.8
Impervious Surface	98	0.13 ac.	12.74
Total		0.98 ac.	70.54
Composite CN = 514.2 / 6.67 = 72			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/72 - 10)$ = 0.778 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

SUPERSEDES 9/13/10

See pg 16A

Direct to Pond (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _*Pond CN* Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Lawn (Poor Coverage <50%)	68	1.28 ac.	87.0
Gravel	76	0.1 ac.	7.6
Impervious Surface not directly connected (75% x 0.30 ac. Total)	98	0.23 ac.	22.5
Total		1.61 ac.	116.7
Composite CN = 116.7 / 1.61 = 73			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/73 - 10)$ = <u>0.740 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing directly to the Pond are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_Pond Imp**".

0.30 acres impervious x 0.25 directly connected = 0.08 ac = 0.0001 sq. mi.

Impervious % = 100%

Direct to Wetland (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Wetland	98	0.4 ac.	39.2
Impervious Surface	98	0.27 ac.	26.5
Vineyard / Undisturbed Area	68	1.93 ac.	131.2
Total		2.6 ac.	196.9
Composite CN = 196.9 / 2.6 = 76			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/76 - 10)$ = 0.632 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

SUPERSEDED 9/13/10

See Pg 17 A

Direct to Wetland (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _*Wetland CN* Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Wetland	98	0.4 ac.	39.2
Impervious Surface	98	0.28 ac.	27.4
Vineyard / Undisturbed Area	68	1.93 ac.	131.2
Lawn (Poor Coverage <50%)	68	0.47 ac.	32.0
Total		3.08 ac.	229.8
Composite CN = 229.8 / 3.08 = 75			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/75 - 10)$ = <u>0.667 inch</u>.

Impervious % = 0 (all impervious area not directly connected, factored in CN above)

Section 4.0 – Storage Capacity versus Elevation for Wetland Area and Pond

The bottom of the wetland is at an approximate elevation of 5 feet (It is actually slightly lower than EL 5). See B&V Drawing SS-3001 (Page 6). The relationship of Area versus Elevation for the wetland area is presented in the table below. The wetland area was measured by using AutoCAD. It should be noted that a small portion of the wetland at the east side within the project property will be filled at a later time. This area will be graded at a 4 (H) to 1 (V) slope towards the wetland. The area in the table below at Elevation 10 (1.44 acres) has the future fill area deducted to accurately model the wetland storage capacity.

Incremental storage at each water surface elevation is calculated using the average end-area method below:

Incremental Storage Volume = $\left(\frac{AreaHi + AreaLo}{2} \times (ElevHi - ElevLo)\right)$

For the volume between elevations 5.0 and 7.5:

Incremental Storage Volume = $\left(\frac{0.62 + 0.40}{2} \times (7.5 - 5.0)\right)$ = 1.28 ac-ft

Wetland Elevation – Area – Storage Summary (See Ref. 9, Pg 11)

Elevation (ft)	Wetland Area (acre)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
5.0	0.40	-	-
7.5	0.62	1.28	1.28
10.0	1.44	2.57	3.85
11.5	1.6	2.28	6.13

There is an outlet control structure proposed between the pond and wetland that will allow water to flow from the pond into the wetland when the water level in the pond is above elevation 10.0. The volume retained in the pond below elevation 10.0 prior to allowing discharge into the wetland is determined by calculating the total incremental storage provided below elevation 10.0 as shown in the table on the following page.

Retained Volume to Elevation 10.0 = 0.10 ac-ft + 0.23 ac-ft = 0.33 ac-ft

This storage volume reduces the runoff that reaches the wetland. The wetland water-surface elevation in the post-construction site condition takes this into account.

SUPERSEDED 9/13/10
See pg 18A

Section 4.0 – Storage Capacity versus Elevation for Wetland Area and Pond

The bottom of the wetland is at an approximate elevation of 5 feet (It is actually slightly lower than EL 5). See B&V Drawing SS-3001 (Page __). The relationship of Area versus Elevation for the wetland area is presented in the table below. The wetland area was measured by using AutoCAD. It should be noted that a small portion of the wetland at the east side within the project property will be filled at a later time. This area will be graded at a 4 (H) to 1 (V) slope towards the wetland. The area in the table below at Elevation 10 (1.44 acres) has the future fill area deducted to accurately model the wetland storage capacity.

Incremental storage at each water surface elevation is calculated using the average end-area method below:

$$\text{Incremental Storage Volume} = \left(\frac{AreaHi + AreaLo}{2} \times (ElevHi - ElevLo)\right)$$

For the volume between elevations 5.0 and 7.5:

$$\text{Incremental Storage Volume} = \left(\frac{0.62 + 0.40}{2} \times (7.5 - 5.0)\right) = 1.28 \text{ ac-ft}$$

Wetland Elevation – Area – Storage Summary (See Ref. 9, Pg 11)

Elevation (ft)	Wetland Area (acre)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
5.0	0.40	-	-
7.5	0.62	1.28	1.28
10.0	1.44	2.57	3.85
11.5	1.6	2.28	6.13

There is an outlet control structure proposed between the pond and wetland that will allow water to flow from the pond into the wetland when the water level in the pond is above EL 8.75. The volume retained in the pond below EL 8.75 prior to allowing discharge into the wetland is determined by calculating the total incremental storage provided below EL 8.75 as shown in the table on the following page.

Retained Volume to EL 8.75 = 0.085 ac-ft (halfway between EL 8.5 and 9.0)

This storage reduces the volume that reaches the wetland from the pond. The wetland water-surface elevation (WSEL) in the post-construction site condition takes this into account for smaller storm events. For larger storm events, the WSEL becomes equalized between the pond and wetland and flow no longer occurs from the pond to wetland. Thus the volume of runoff to the wetland does not include the volume stored in the pond.

The proposed pond will provide additional storage capacity for the stormwater runoff from the post-construction site conditions. Below is a table summarizing the relationship of Area versus Elevation for the proposed pond (areas measured using AutoCAD). Also included are columns summarizing the incremental and cumulative storage volumes provided in the pond at each elevation interval.

Pond Elevation – Area – Storage Summary

Elevation (ft)	Pond Area (acres)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
8.5	0.18	-	-
9.0	0.21	0.10	0.10
10.0	0.26	0.23	0.33
11.0	0.31	0.29	0.62
12.0	0.37	0.34	0.96
13.0	0.43	0.40	1.36
14.0	0.50	0.46	1.82
15.0	0.56	0.53	2.35

For larger storm events, the water surface elevation in the wetland will exceed the outlet control elevation in the pond, resulting in an equalized water surface elevation between the wetland and pond. Below is a table summarizing the elevation and storage volume within the wetland and pond system for larger runoff volumes.

Equalized Wetland + Pond Elevation – Area – Storage Summary

Elevation (ft)	Wetland Area (acres)	Pond Area (acres)	Incremental Wetland Storage (ac-ft)	Incremental Pond Storage (ac-ft)	Cumulative Storage (ac-ft)
5.0	0.40	-	-	-	-
7.5	0.62	-	1.28	-	1.28
8.5	0.95 *	0.18	0.78	-	2.06
9.0	1.11 *	0.21	0.52	0.10	2.68
10.0	1.44	0.26	1.28	0.23	4.19
11.0	1.55	0.31	1.50	0.29	5.98
11.5	1.6	0.34 *	0.79	0.16	6.93

* Denotes interpolated value

SUPERSEDED 9/13/10
See Pg 19A

The proposed pond will provide additional storage capacity for the stormwater runoff from the post-construction site conditions. Below is a table summarizing the relationship of Area versus Elevation for the proposed pond (areas measured using AutoCAD). Also included are columns summarizing the incremental and cumulative storage volumes provided in the pond at each elevation interval.

Pond Elevation – Area – Storage Summary

Elevation (ft)	Pond Area (acres)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
8.5	0.33	-	-
9.0	0.35	0.17	0.17
10.0	0.41	0.38	0.55
11.0	0.48	0.44	0.99
12.0	0.54	0.51	1.50
13.0	0.61	0.57	2.08

For larger storm events, the water surface elevation in the wetland will exceed the outlet control elevation in the pond, resulting in an equalized water surface elevation between the wetland and pond. Below is a table summarizing the elevation and storage volume within the wetland and pond system for larger runoff volumes.

Equalized Wetland + Pond Elevation – Area – Storage Summary

Elevation (ft)	Wetland Area (acres)	Pond Area (acres)	Incremental Wetland Storage (ac-ft)	Incremental Pond Storage (ac-ft)	Cumulative Storage (ac-ft)
5.0	0.40	-	-	-	-
7.5	0.62	-	1.28	-	1.28
8.5	0.95 *	0.33	0.78	-	2.06
9.0	1.11 *	0.35	0.52	0.17	2.75
10.0	1.44	0.41	1.28	0.38	4.41
11.0	1.55	0.48	1.50	0.44	6.35
11.5	1.6	0.51 *	0.79	0.25	7.39

* Denotes interpolated value

Section 5.0 HEC-HMS Output

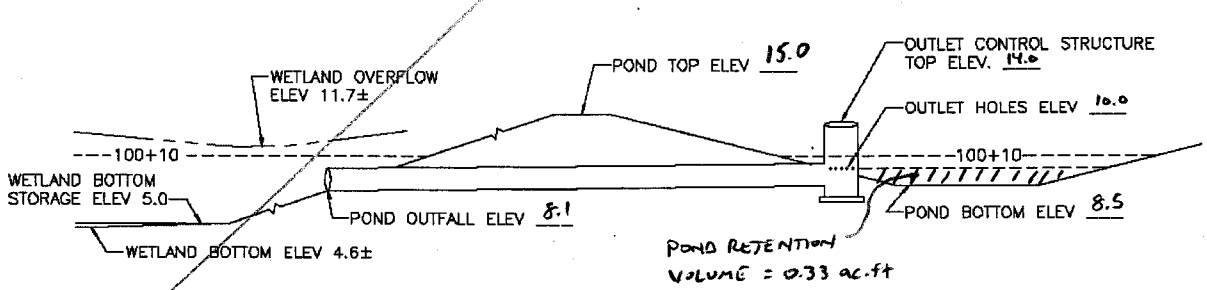
The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The initial water elevation in the wetland is specified to be at EL 5 assuming that standing water in the wetland is not higher than EL 5 when the modeled rainfall events begin. Normal water level is approximately EL 4.6 as shown on Page 6.

The total runoff volume for each storm event was calculated by running the HEC-HMS program. The table below summarizes the runoff volume produced in the pre-construction and post-construction site conditions for each storm event. The output results are included in Attachment 2.

Rainfall Event	Pre-Construction Runoff Volume	Post-Construction Runoff Volume
1-inch	0.03 ac-ft	0.14 ac-ft
10-year	1.10 ac-ft	1.84 ac-ft
100-year	2.70 ac-ft	3.91 ac-ft
100-year + 10-year	3.80 ac-ft	5.75 ac-ft

Section 6.0 – Determine WSEL within Wetland Area

The results from Sections 4.0 and 5.0 were used to determine the resulting WSEL within the wetland area for each storm event. The WSEL in the wetland is determined based on the amount of runoff that is conveyed to the wetland area. As calculated in Section 4.0, the proposed pond retains a volume of 0.33 ac-ft, therefore the amount of runoff that reaches the wetland in the post-construction condition can be reduced by 0.33 ac-ft to determine the resulting wetland WSEL. Below is a general diagram of the pond and wetland configuration, showing the retained volume in the pond below elevation 10.0.



By comparing the proposed runoff volumes discharged to the wetland against the interpolated storage capacity volumes by elevation (summarized in Section 4.0), the WSEL in the wetland is determined.

SUPERSEDED 9/13/10 See Pg 20 A

Section 5.0 HEC-HMS Output

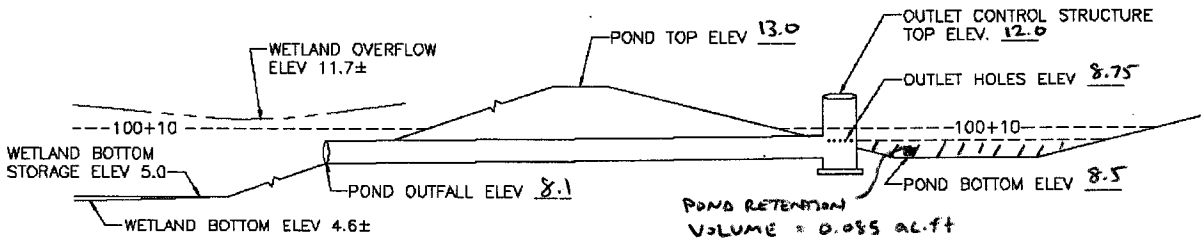
The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The initial water elevation in the wetland is specified to be at EL 5 assuming that standing water in the wetland is not higher than EL 5 when the modeled rainfall events begin. Normal water level is approximately EL 4.6 as shown on Page 6.

The total runoff volume for each storm event was calculated by running the HEC-HMS program. The table below summarizes the runoff volume produced in the pre-construction and post-construction site conditions for each storm event. The output results are included in Attachment 2.

Rainfall Event	Pre-Construction Runoff Volume	Post-Construction Runoff Volume
1-inch	0.06 ac-ft	0.24 ac-ft
10-year	1.17 ac-ft	1.98 ac-ft
100-year	2.79 ac-ft	4.05 ac-ft
100-year + 10-year	3.96 ac-ft	6.03 ac-ft

Section 6.0 – Determine WSEL within Wetland Area

The results from Sections 4.0 and 5.0 were used to determine the resulting WSEL within the wetland area for each storm event, based on the amount of runoff that is conveyed to the wetland area. Per Section 4.0, the pond retains a volume of 0.085 ac-ft for small storm events and provides greater storage when equalized with the wetland. Below is a general diagram of the pond and wetland configuration, showing the retained volume in the pond below the outlet hole elevation and the wetland / pond equalized WSEL.



By comparing the proposed runoff volumes reaching the wetland against the interpolated storage capacity volumes by elevation (per Section 4.0), the wetland WSEL is determined. For a 10-year event,

1.98 ac-ft site runoff – 0.085 ac-ft retained in pond = 1.895 ac-ft to wetland (use 1.90 ac-ft)

Determine WSEL10 (Wetland WSEL for 10-year/24-hr storm for post-construction site)

Wetland Elevation / Volume Data (from Section 4.0)

Wetland Elevation (ft)	Cumulative Wetland Storage (ac-ft)
7.5	1.28
Interpolate WSEL10	*1.51 (10-yr post- runoff to wetland)*
10.0	3.85

Interpolating for WSEL10 = $\frac{(1.51-1.28)(10.0-7.5)}{(3.85-1.28)}+7.5$ = 7.7 ft.

Using the above method for the other storm events, the resulting post-construction WSELs in the wetland are summarized in the table below. Since the pond provides 0.33 ac-ft of retention storage, up to 0.33 ac-ft of runoff volume to the pond is deducted from the total runoff volume to wetland. For example, in the 1-inch storm, a total of 0.09 ac-ft flows to the pond – see Attachment 2. Since this is less than the 0.33 ac-ft pond retention volume, this 0.09 ac-ft is retained in the pond and deducted from total runoff (0.14 ac-ft) to yield the post-construction runoff volume of 0.05 ac-ft to the wetland.

Summary of Runoff Volume & Wetland WSEL

Rainfall Event	Pre-Construction		Post-Construction	
	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)
1-inch	0.03	5.1	0.05	5.1
10-year	1.10	7.2	1.51	7.7
100-year	2.70	8.9	3.58	9.7
100-year + 10-year	3.80	10.0	5.42	10.7

Conclusion:

Based on the HEC-HMS analysis and the storage analysis of the existing wetland and proposed pond, the varying runoff volumes for each storm event will be contained on site without overflowing to adjacent properties. From B&V Drawing SS-3001, the lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.7 feet, while the maximum elevation for the 100+10 storm events is EL 10.7. This analysis does not account for storage within the bioswale system, nor infiltration that would be expected to occur which would reduce the volume of runoff that would be expected to actually reach the wetland area. Therefore this analysis can be considered conservative, relating to the overall flood storage capacity for the site.

SUPERSEDED 9/13/10
See pg 21A

Determine WSEL10 (Wetland WSEL for 10-year/24-hr storm for post-construction site)

Wetland Elevation / Volume Data (from Section 4.0)

Wetland Elevation (ft)	Cumulative Wetland Storage (ac-ft)
7.5	1.28
Interpolate WSEL10	*1.90 (10-yr post- runoff to wetland)*
10.0	3.85

Interpolating for WSEL10 = $\frac{(1.90-1.28)(10.0-7.5)}{(3.85-1.28)}+7.5$ = 8.1 ft.

Using the above method for the other storm events, the resulting post-construction WSELs in the wetland are summarized in the table below, taking into consideration the volume stored within the pond for each event. For the larger events (100-year and 100+10 events), the runoff volume results in an equalized WSEL in the wetland and pond. The runoff volume reaching the wetland is the total site runoff minus the volume provided within the pond at the equalized WSEL. For example, the 100-year site runoff is 4.05 ac-ft, with 0.47 ac-ft stored in the pond at EL 9.8. Therefore the runoff to wetland volume = 4.05 – 0.47 = 3.58 ac-ft.

Summary of Runoff Volume & Wetland WSEL

Rainfall Event	Pre-Construction		Post-Construction	
	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)	Runoff to Wetland (ac-ft)	WSEL in Wetland (ft)
1-inch	0.06	5.1	0.15	5.3
10-year	1.17	7.3	1.90	8.1
100-year	2.79	9.0	3.58	9.8
100-year + 10-year	3.96	10.1	5.11	10.8

Conclusion:

Based on the HEC-HMS analysis and the storage analysis of the existing wetland and proposed pond, the varying runoff volumes for each storm event will be contained on site without overflowing to adjacent properties. From B&V Drawing SS-3001, the lowest elevation where the stormwater in the wetland can overflow to other properties is EL 11.7 feet, while the maximum elevation for the 100+10 storm events is EL 10.8. This analysis does not account for storage within the bioswale system, nor infiltration that would be expected to occur which would reduce the volume of runoff that would be expected to actually reach the wetland area. Therefore this analysis can be considered conservative, relating to the overall flood storage capacity for the site.

Radback Tenaska Project

Project # 163994

Stormwater Analysis

CK 6/11/10

# of pages ~~18~~ 19

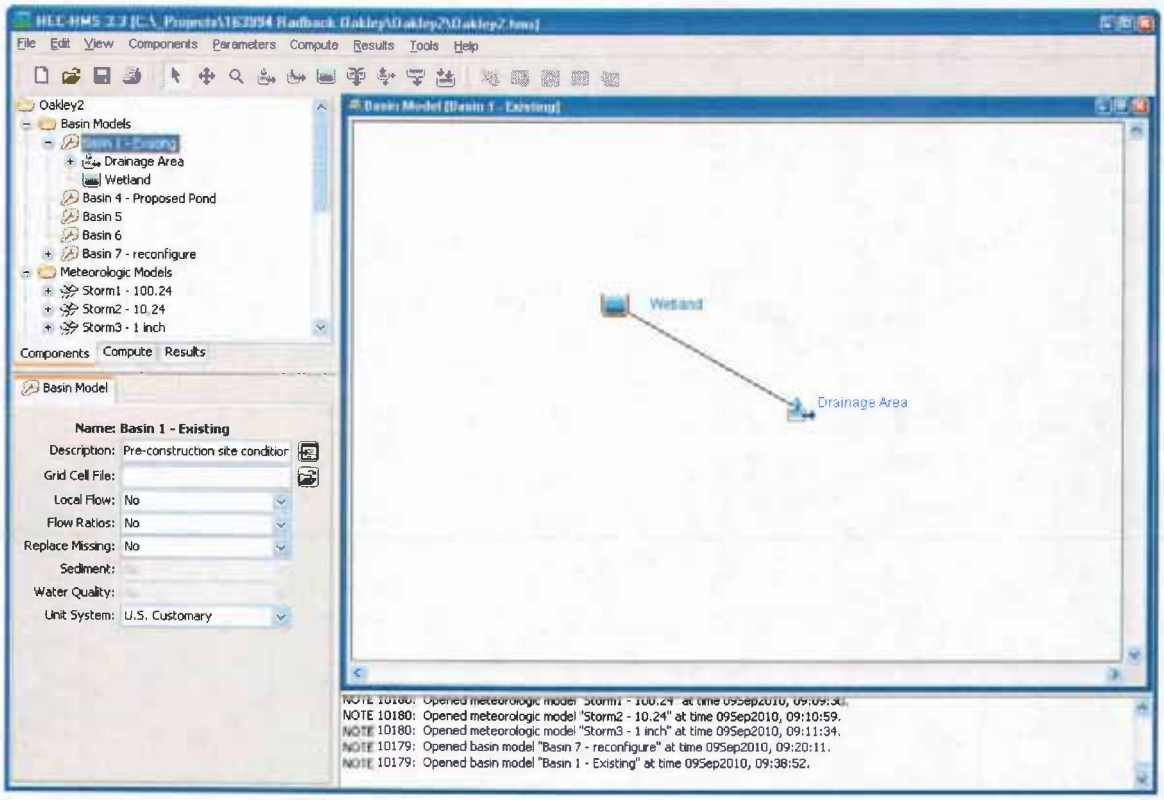
52.5406.1006

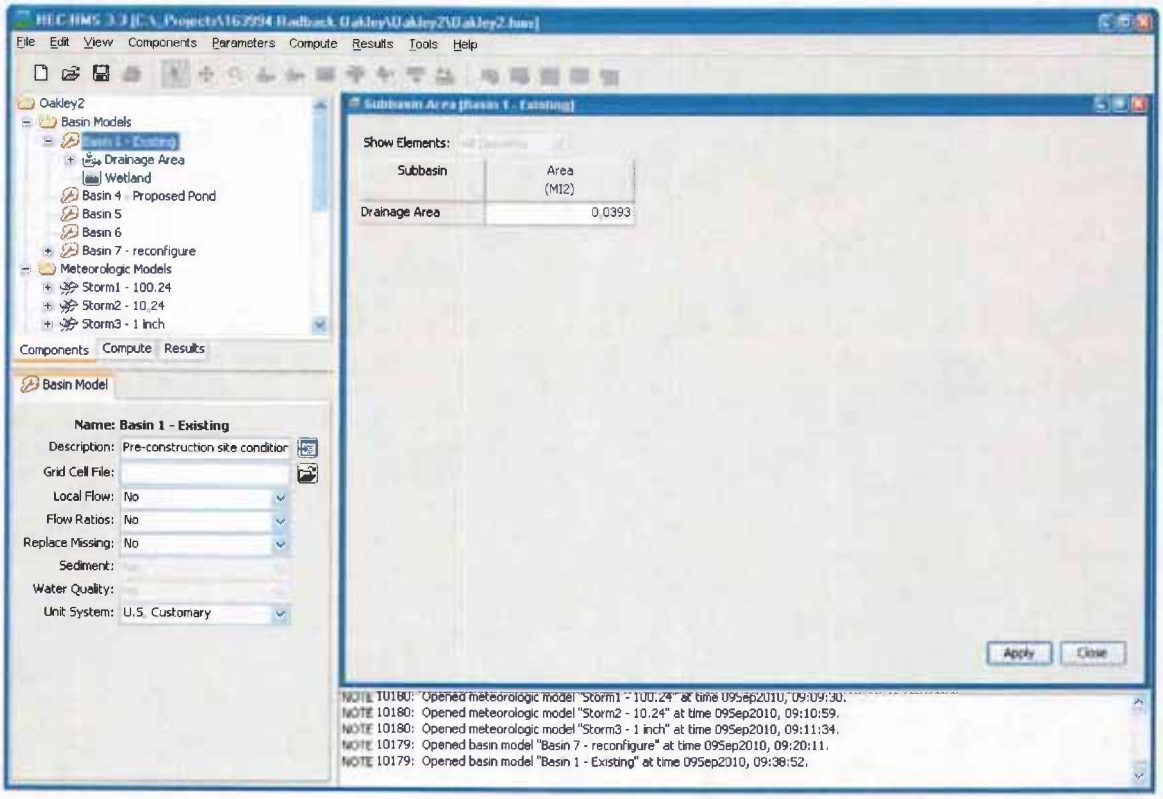
Rev 1 (all pages)
9/13/10
CAK

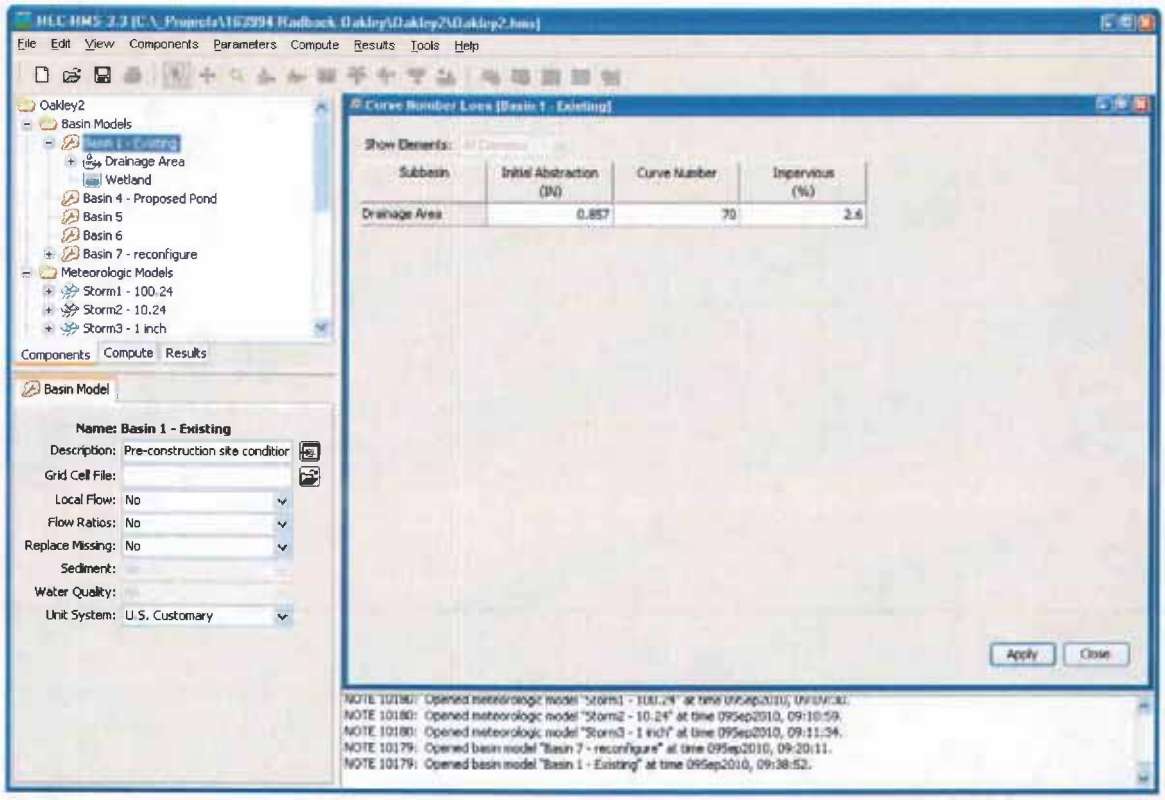
Attachment 1

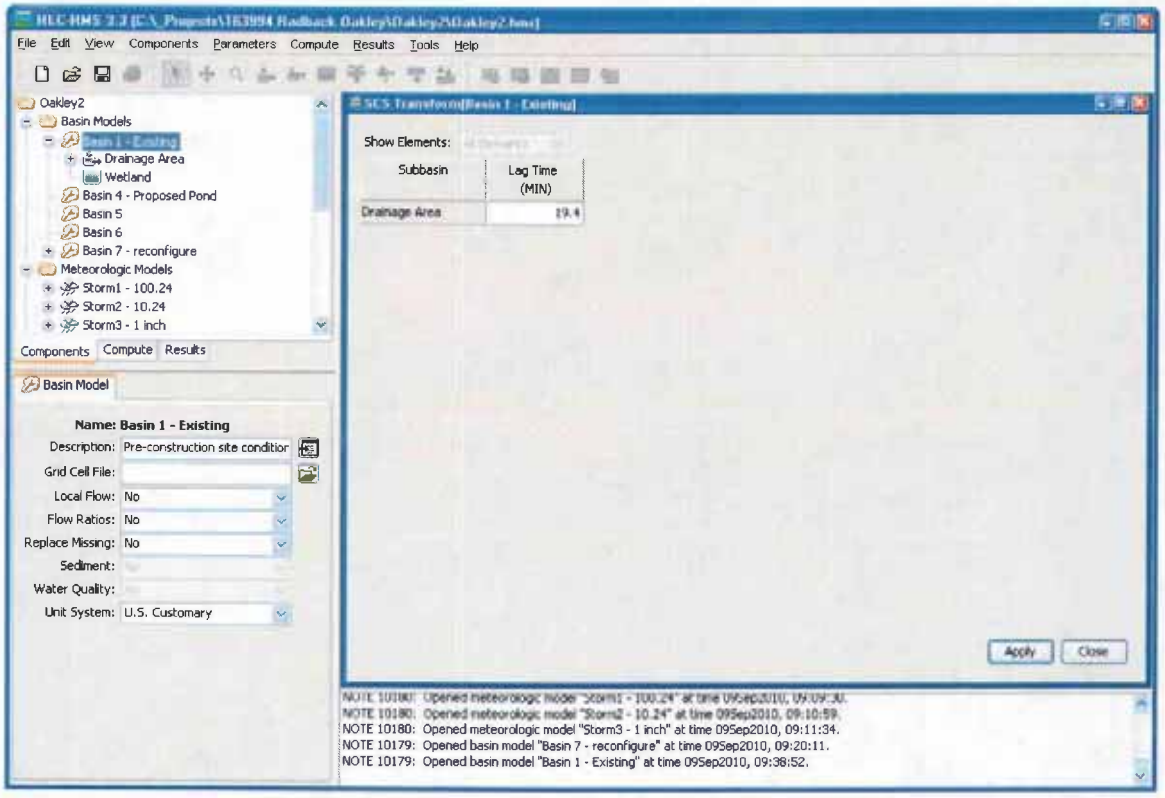
HEC-HMS Input

HEC-HMS Input – Basin Model 1 (Existing Condition)

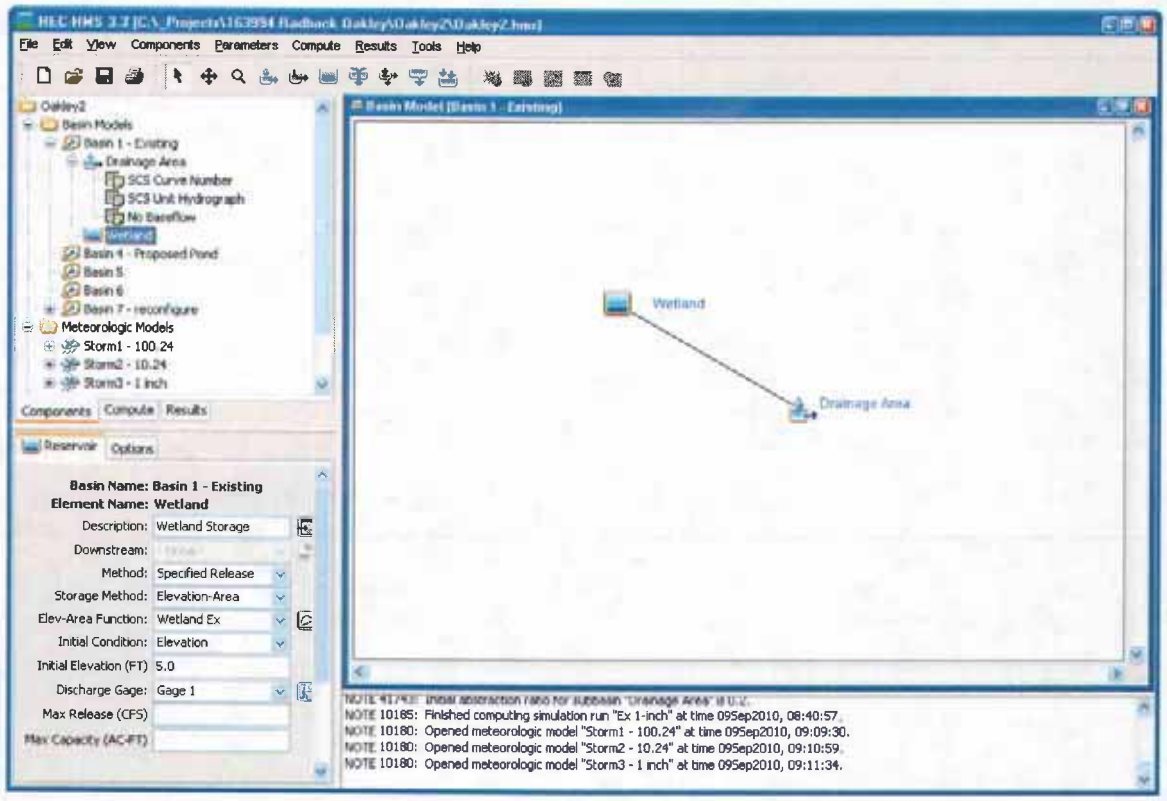


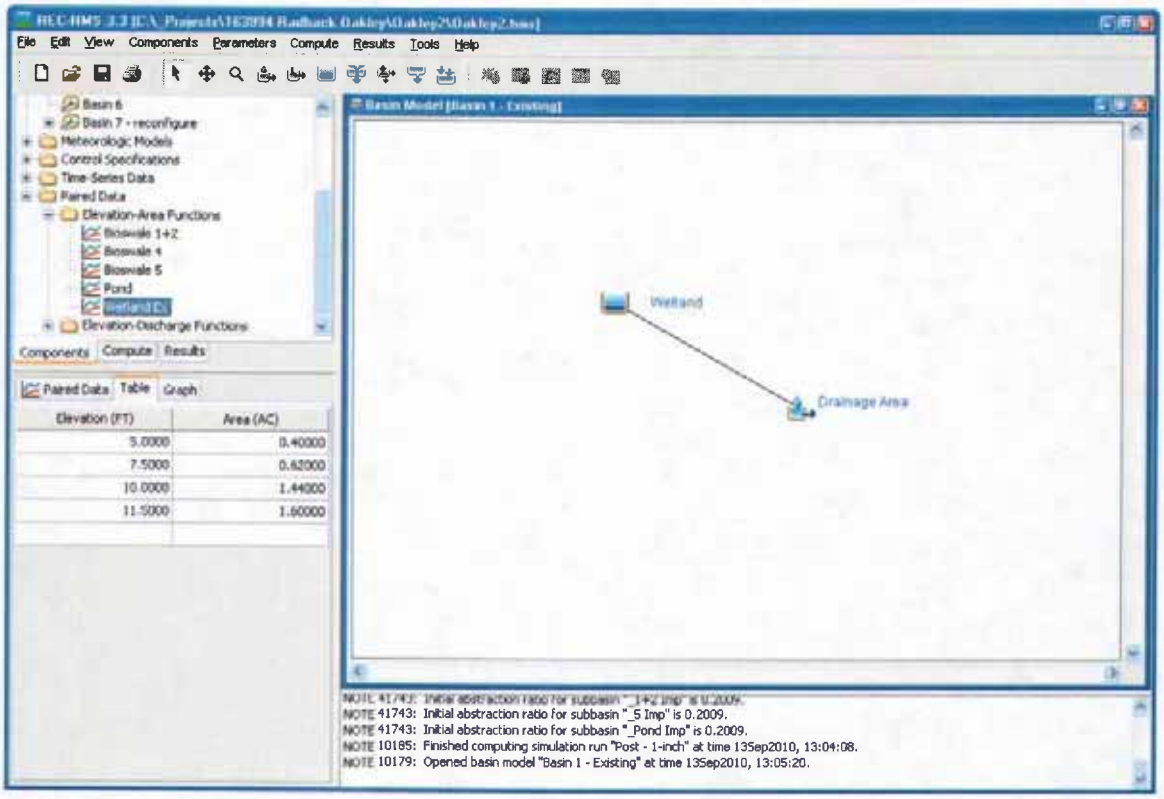



File Edit View Components Parameters Compute Results Tools Help
Oakley2
Basin Models
Drainage Area
Wetland
Basin 4 - Proposed Pond
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Components Compute Results
Basin Model
Name: Basin 1 - Existing
Description: Pre-construction site conditior
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
Curve Number Loss [Basin 1 - Existing]
Show Elements:
Subbasin
Initial Abstraction (IN)
Curve Number
Impervious (%)
Drainage Area
0.857
70
2.6
Apply
Close
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.


File Edit View Components Parameters Compute Results Tools Help
Oakley2
Basin Models
Drainage Area
Wetland
Basin 4 - Proposed Pond
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Components Compute Results
Basin Model
Name: Basin 1 - Existing
Description: Pre-construction site conditior
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
Show Elements:
Subbasin
Lag Time (MIN)
Drainage Area
19.4
Apply
Close
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.

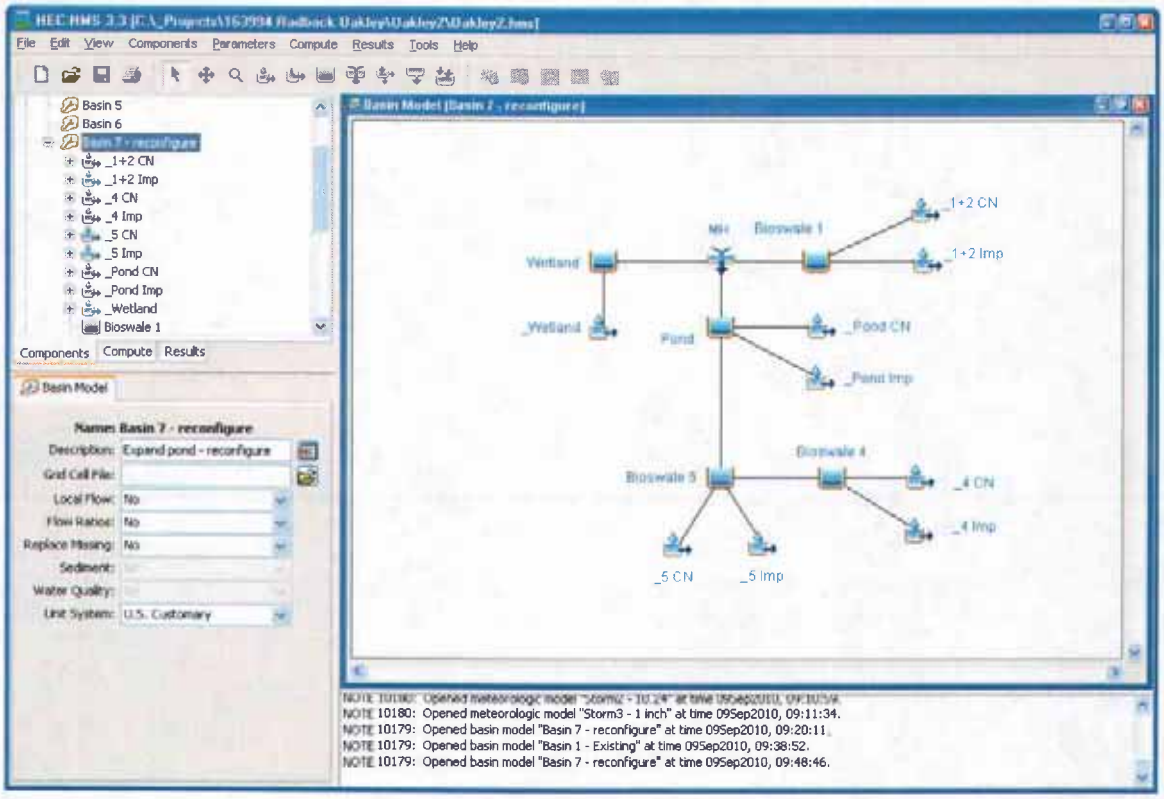
Wetland Storage Capacity Data

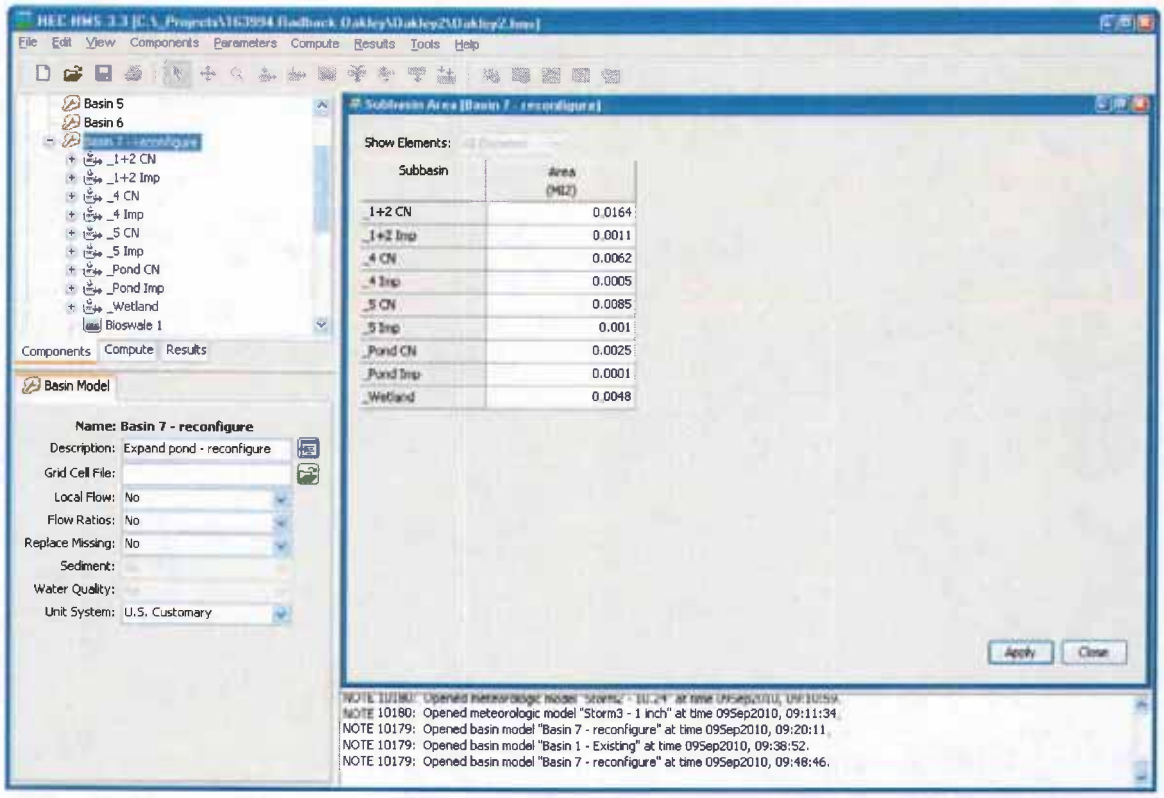




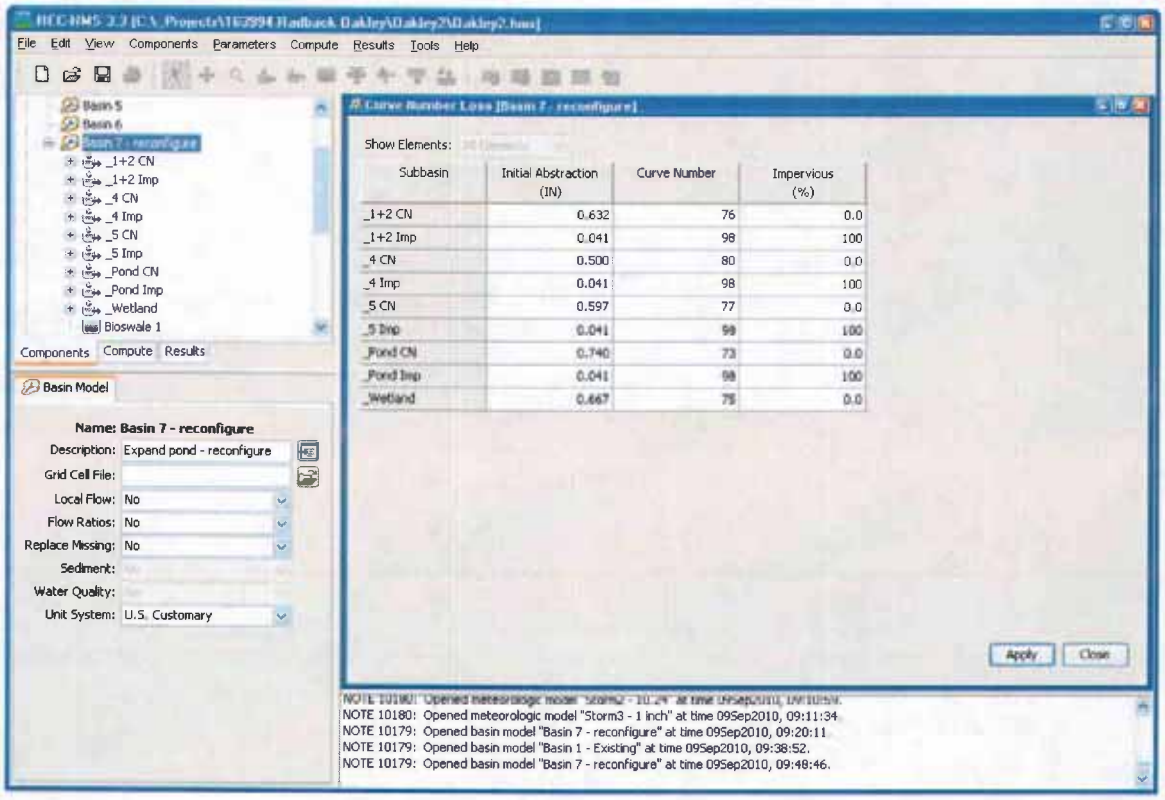
HEC-HMS Input – Basin Model 7 (Post-Construction Condition)

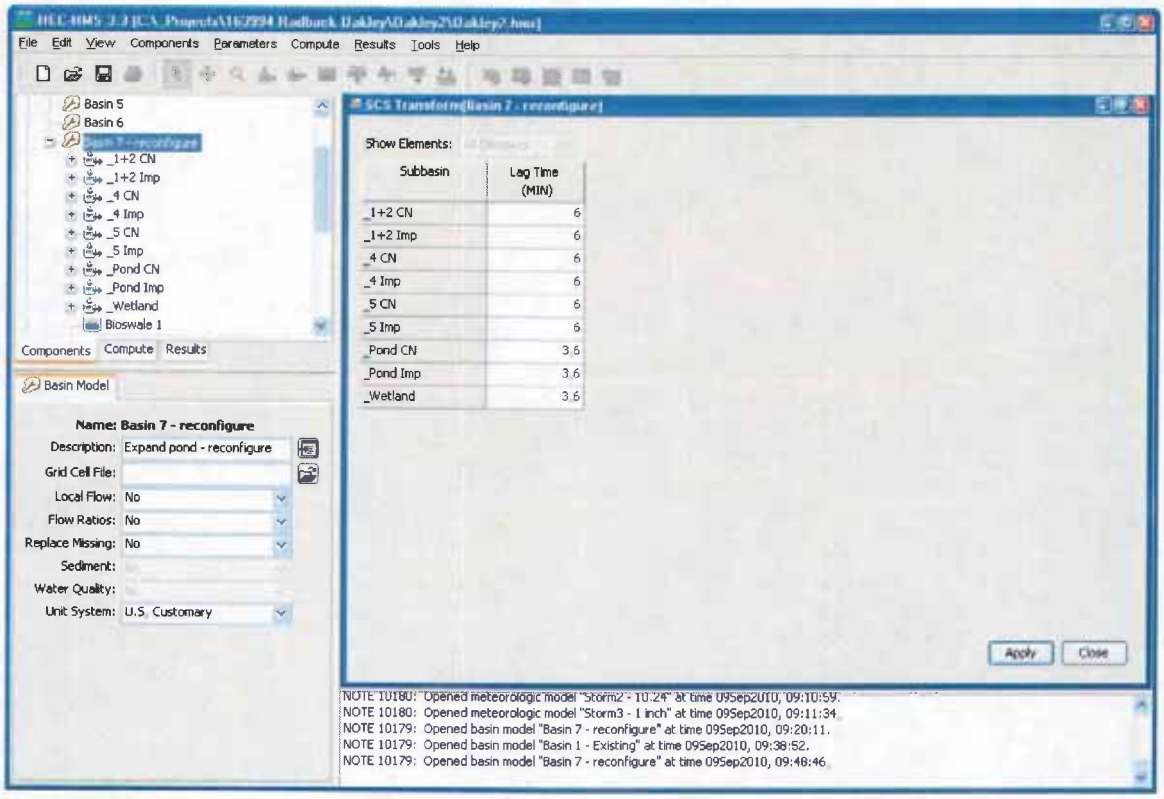
Subbasin Data



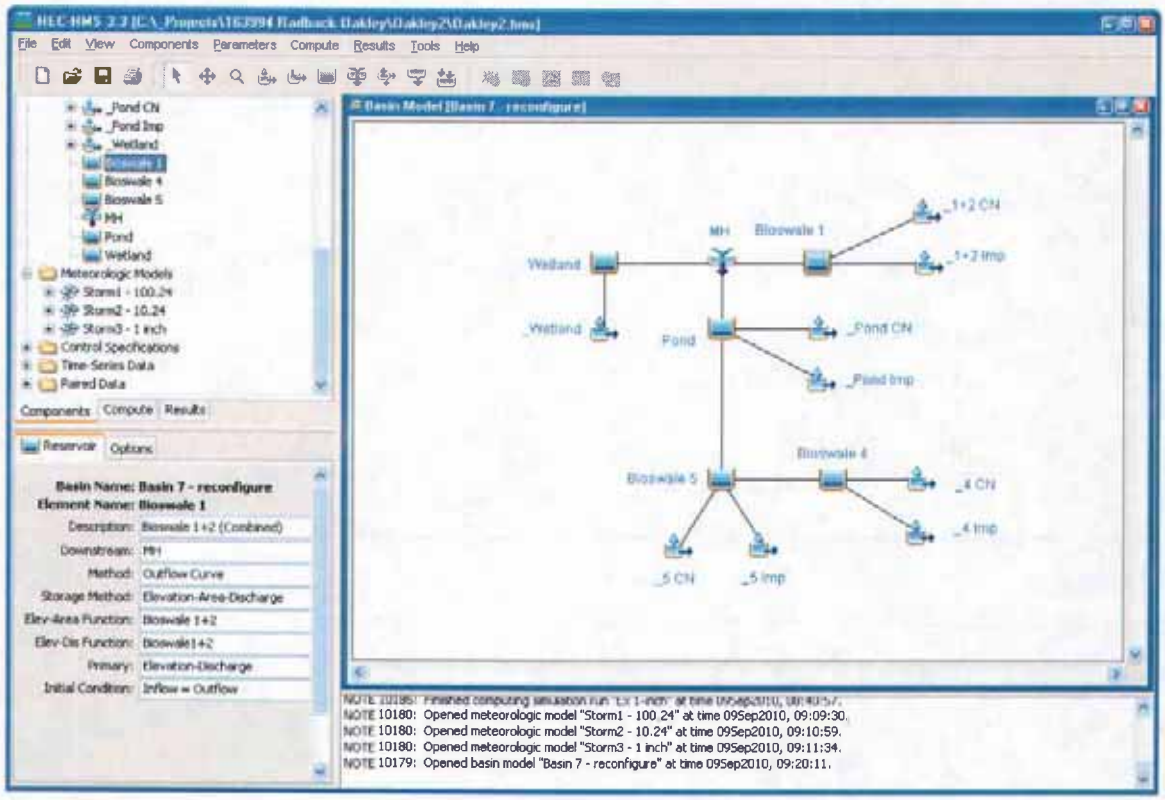


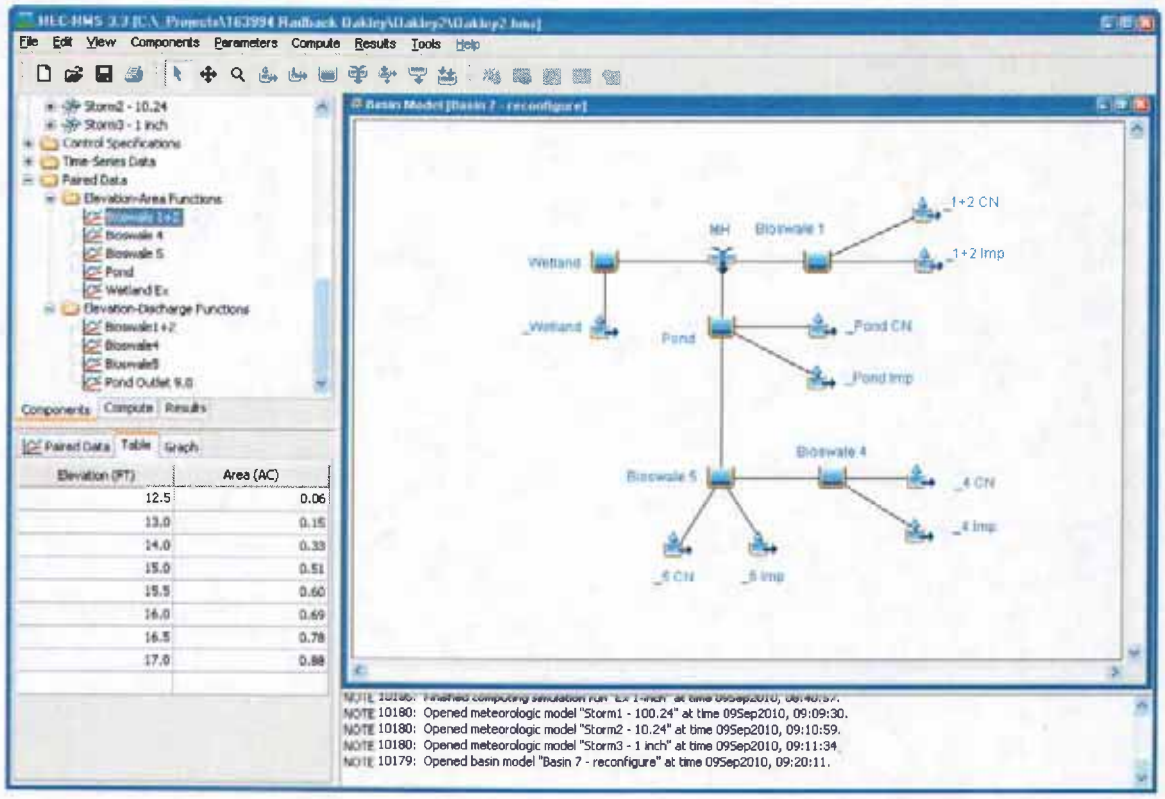
Subbasin	Area (MI2)
_1+2 CN	0.0164
_1+2 Imp	0.0011
_4 CN	0.0062
_4 Imp	0.0005
_5 CN	0.0085
_5 Imp	0.001
_Pond CN	0.0025
_Pond Imp	0.0001
_Wetland	0.0048

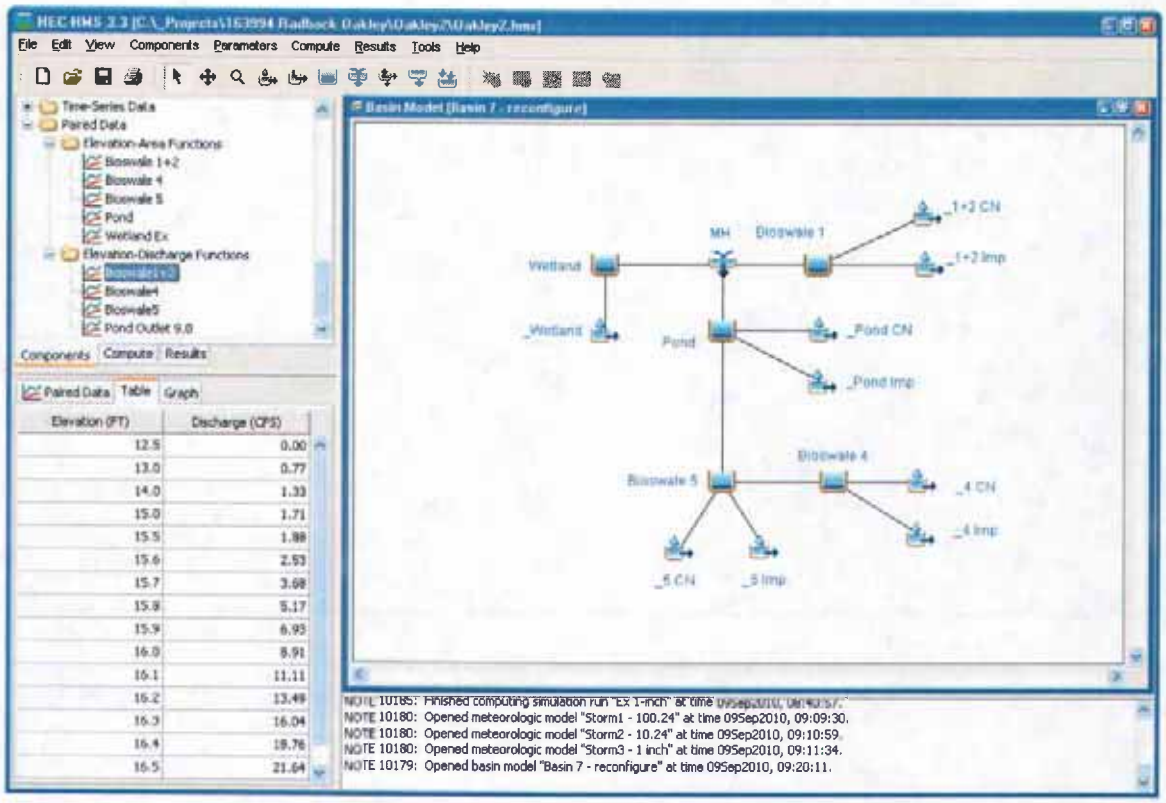

File Edit View Components Parameters Compute Results Tools Help
Basin 5
Basin 6
Basin 7 - reconfigure
_1+2 CN
_1+2 Imp
_4 CN
_4 Imp
_5 CN
_5 Imp
_Pond CN
_Pond Imp
_Wetland
Bioswale 1
Components Compute Results
Basin Model
Name: Basin 7 - reconfigure
Description: Expand pond - reconfigure
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
Curve Number Loss [Basin 7 - reconfigure]
Show Elements:
Subbasin | Initial Abstraction (IN) | Curve Number | Impervious (%)
_1+2 CN | 0.632 | 76 | 0.0
_1+2 Imp | 0.041 | 98 | 100
_4 CN | 0.500 | 80 | 0.0
_4 Imp | 0.041 | 98 | 100
_5 CN | 0.597 | 77 | 0.0
_5 Imp | 0.041 | 98 | 100
_Pond CN | 0.740 | 73 | 0.0
_Pond Imp | 0.041 | 98 | 100
_Wetland | 0.667 | 75 | 0.0
Apply
Close
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.


File Edit View Components Parameters Compute Results Tools Help
Basin 5
Basin 6
Basin 7 - reconfigure
_1+2 CN
_1+2 Imp
_4 CN
_4 Imp
_5 CN
_5 Imp
_Pond CN
_Pond Imp
_Wetland
Bioswale 1
Components Compute Results
Basin Model
Name: Basin 7 - reconfigure
Description: Expand pond - reconfigure
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
SCS Transform [Basin 7 - reconfigure]
Show Elements:
Subbasin | Lag Time (MIN)
_1+2 CN | 6
_1+2 Imp | 6
_4 CN | 6
_4 Imp | 6
_5 CN | 6
_5 Imp | 6
_Pond CN | 3.6
_Pond Imp | 3.6
_Wetland | 3.6
Apply
Close
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.

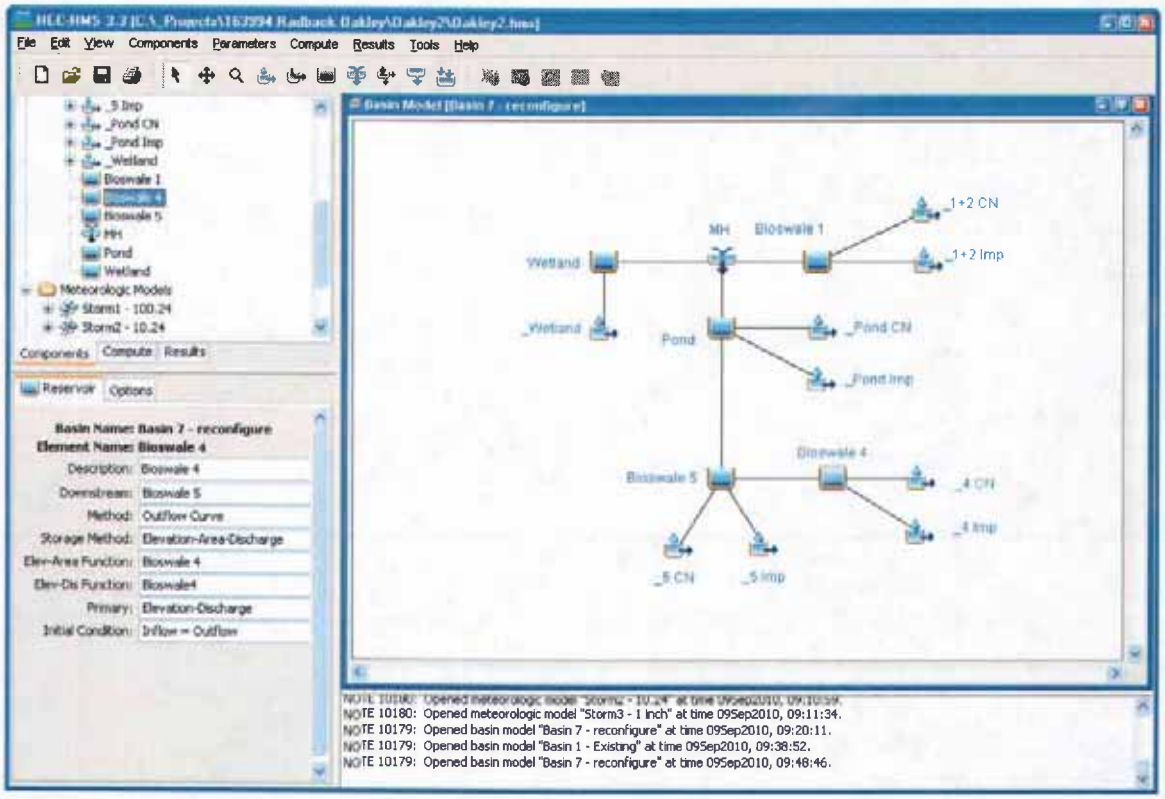
Bioswale 1 Storage Capacity & Discharge Data

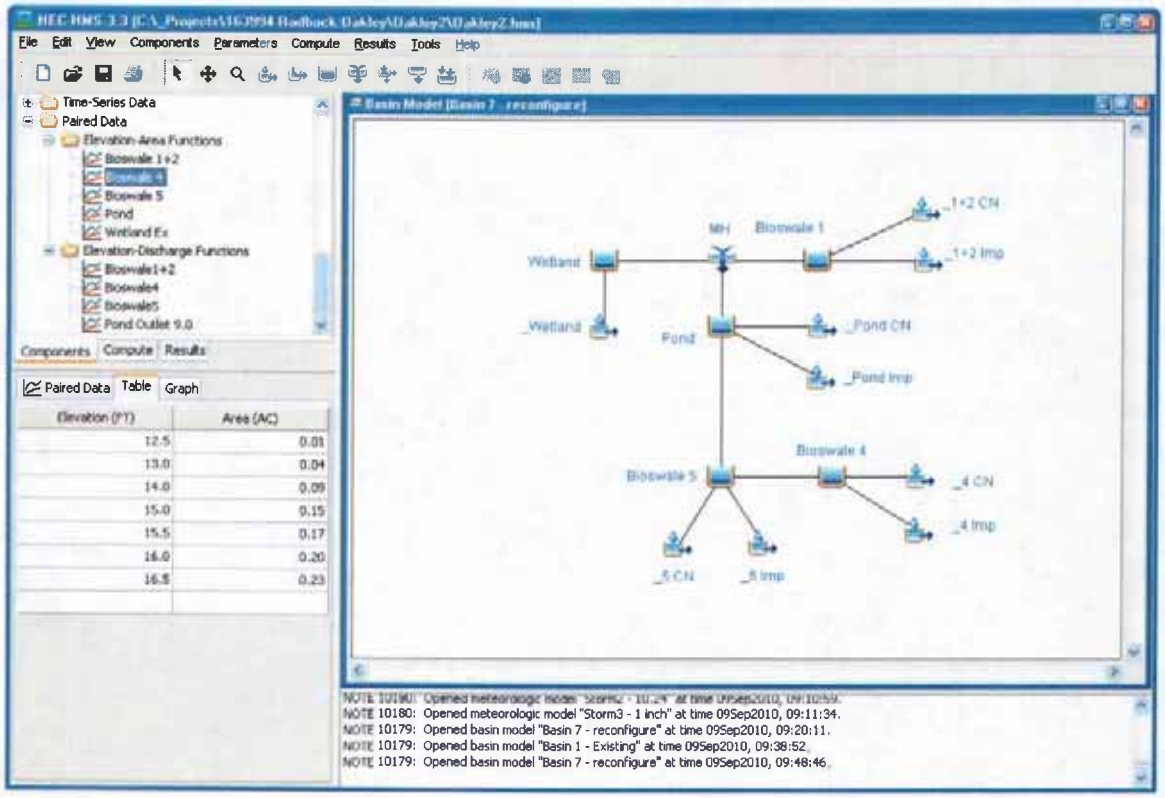


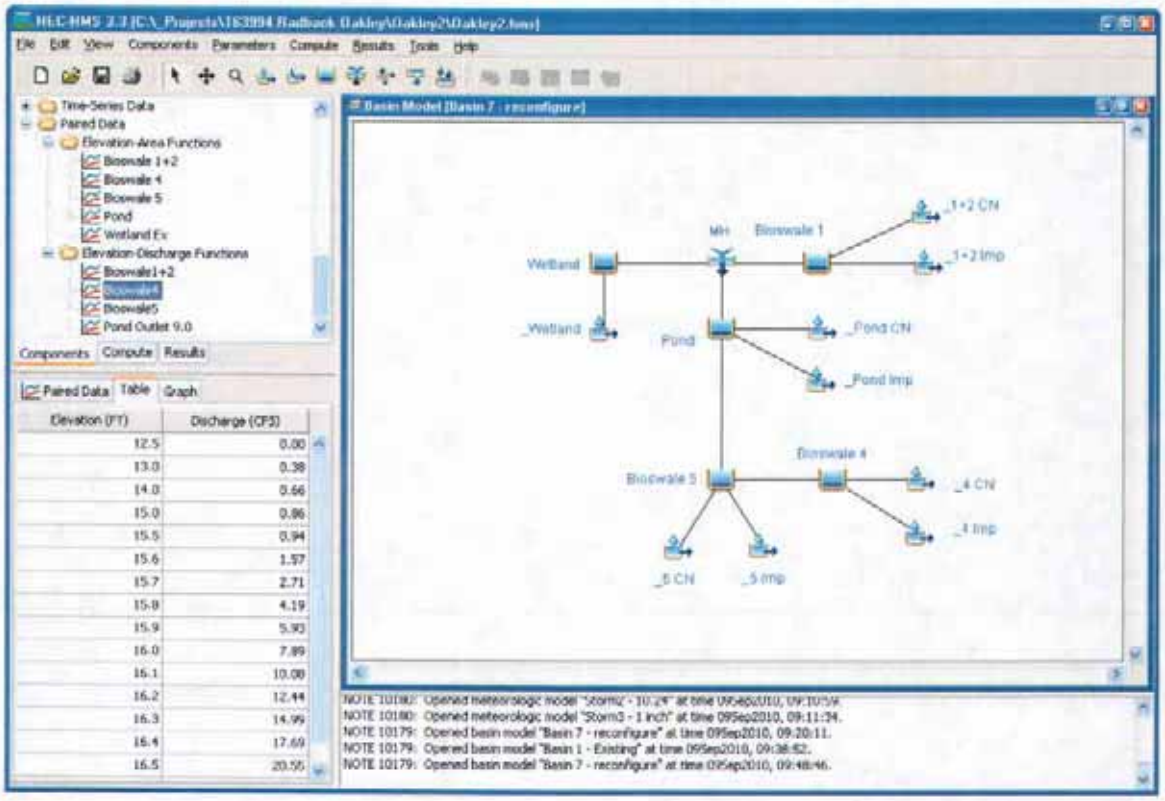



File Edit View Components Parameters Compute Results Tools Help
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Pond Outlet 9.0
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.5 0.00
13.0 0.77
14.0 1.33
15.0 1.71
15.5 1.88
15.6 2.53
15.7 3.68
15.8 5.17
15.9 6.93
16.0 8.91
16.1 11.11
16.2 13.49
16.3 16.04
16.4 18.76
16.5 21.64
Basin Model (Basin 7 - reconfigure)
_1+2 CN
MH
Bioswale 1
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10180: Opened meteorologic model "Storm1 - 100.24" at time 09Sep2010, 09:09:30.
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.

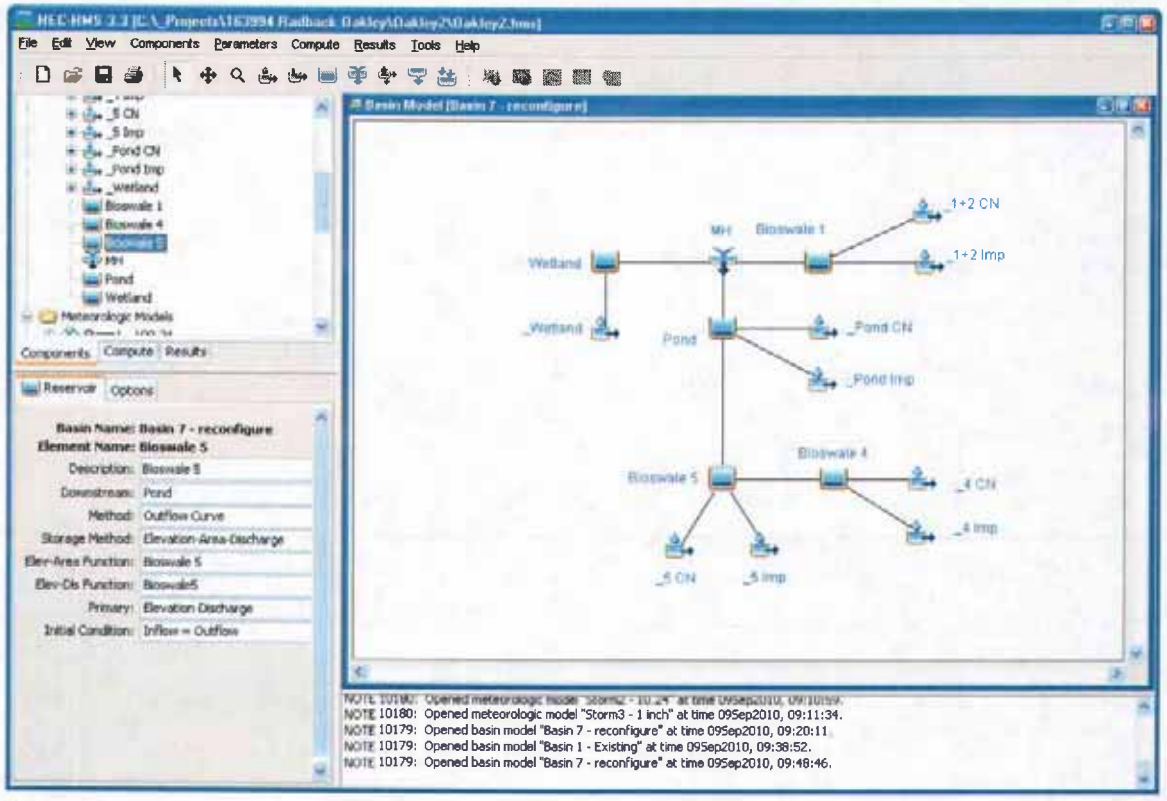
Bioswale 4 Storage Capacity & Discharge Data

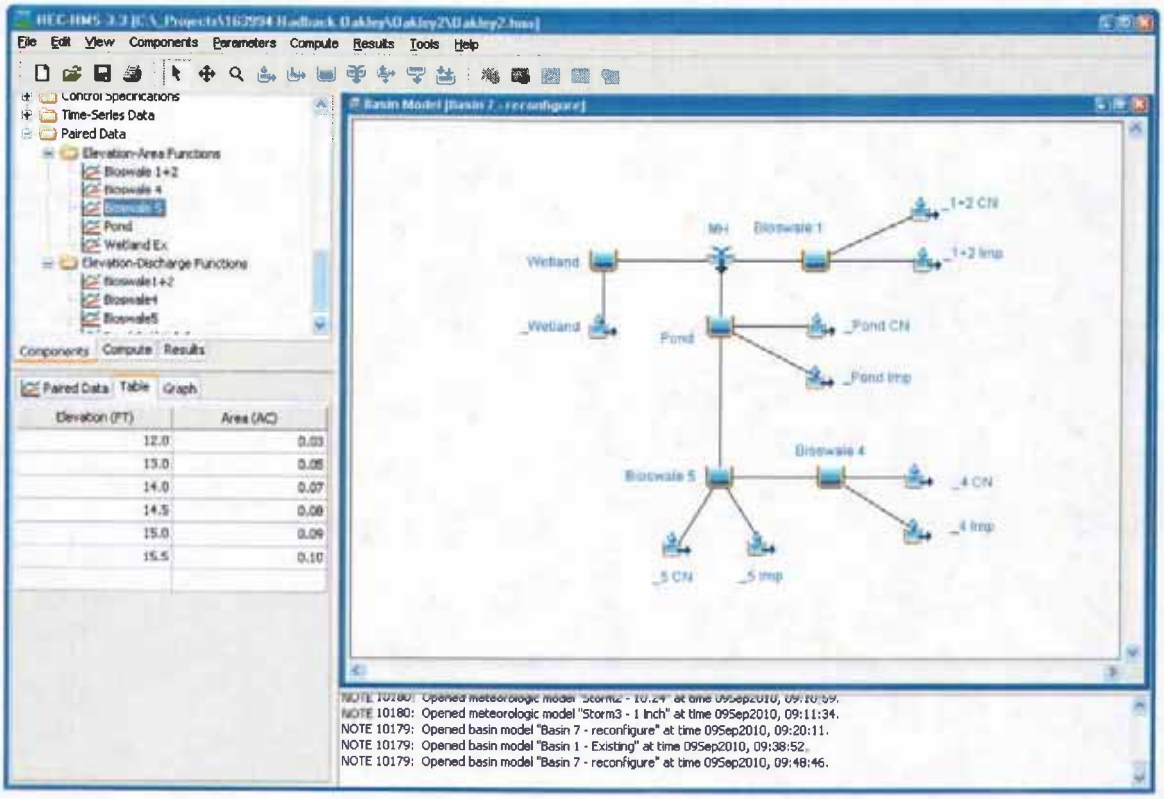


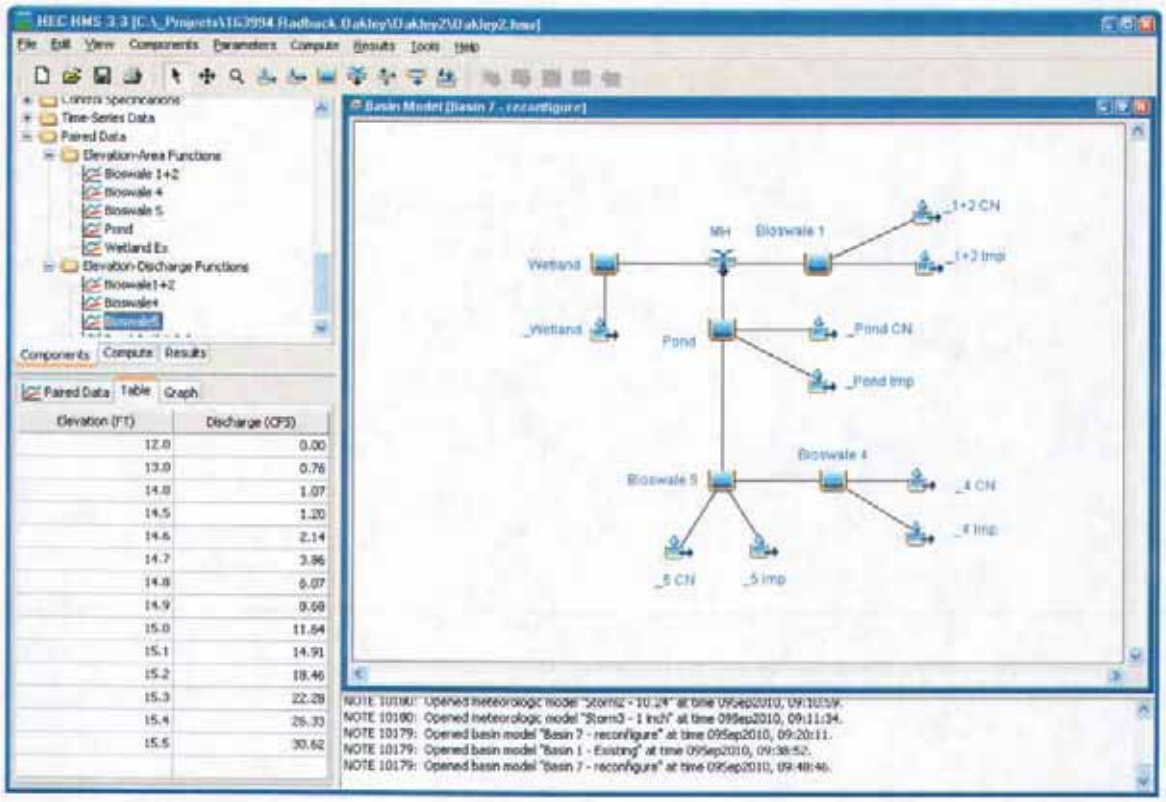



File Edit View Components Parameters Compute Results Tools Help
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Pond Outlet 9.0
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.5 0.00
13.0 0.38
14.0 0.66
15.0 0.86
15.5 0.94
15.6 1.57
15.7 2.71
15.8 4.19
15.9 5.90
16.0 7.89
16.1 10.08
16.2 12.44
16.3 14.99
16.4 17.69
16.5 20.55
Basin Model [Basin 7 - reconfigure]
Wetland
Bioswale 1
_1+2 CN
_1+2 Imp
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.

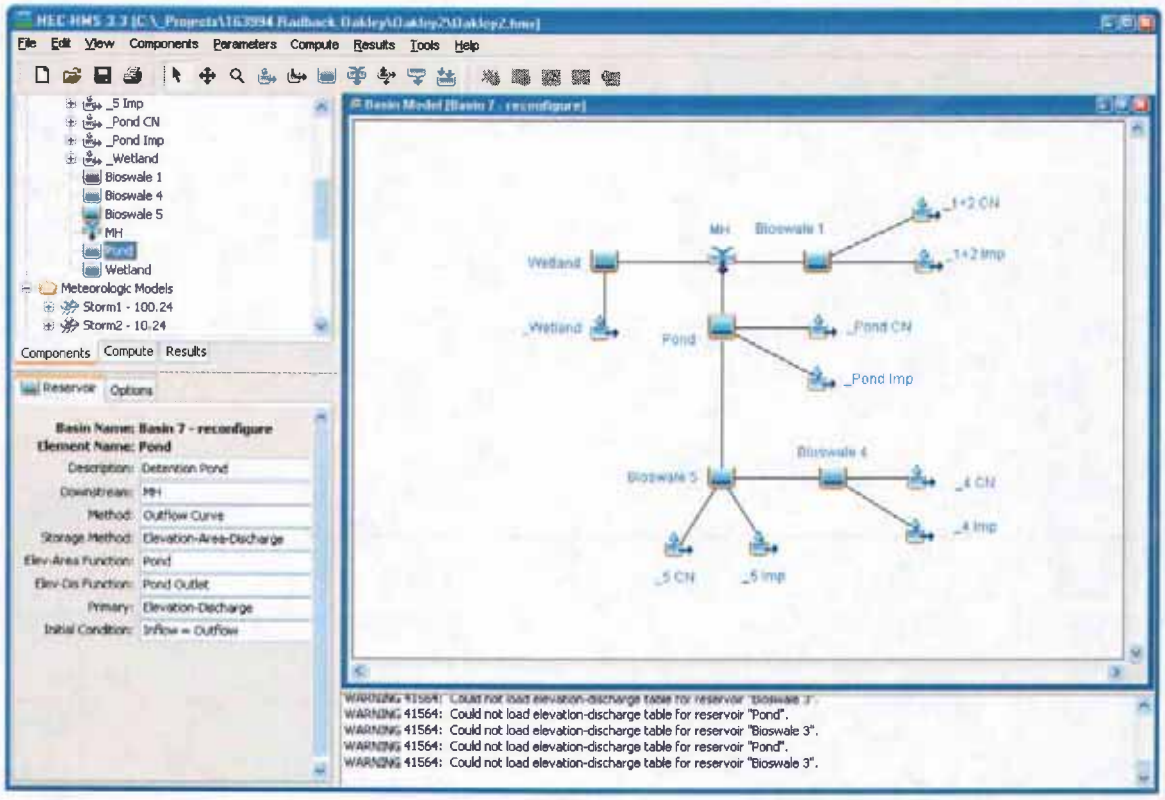
Bioswale 5 Storage Capacity & Discharge Data

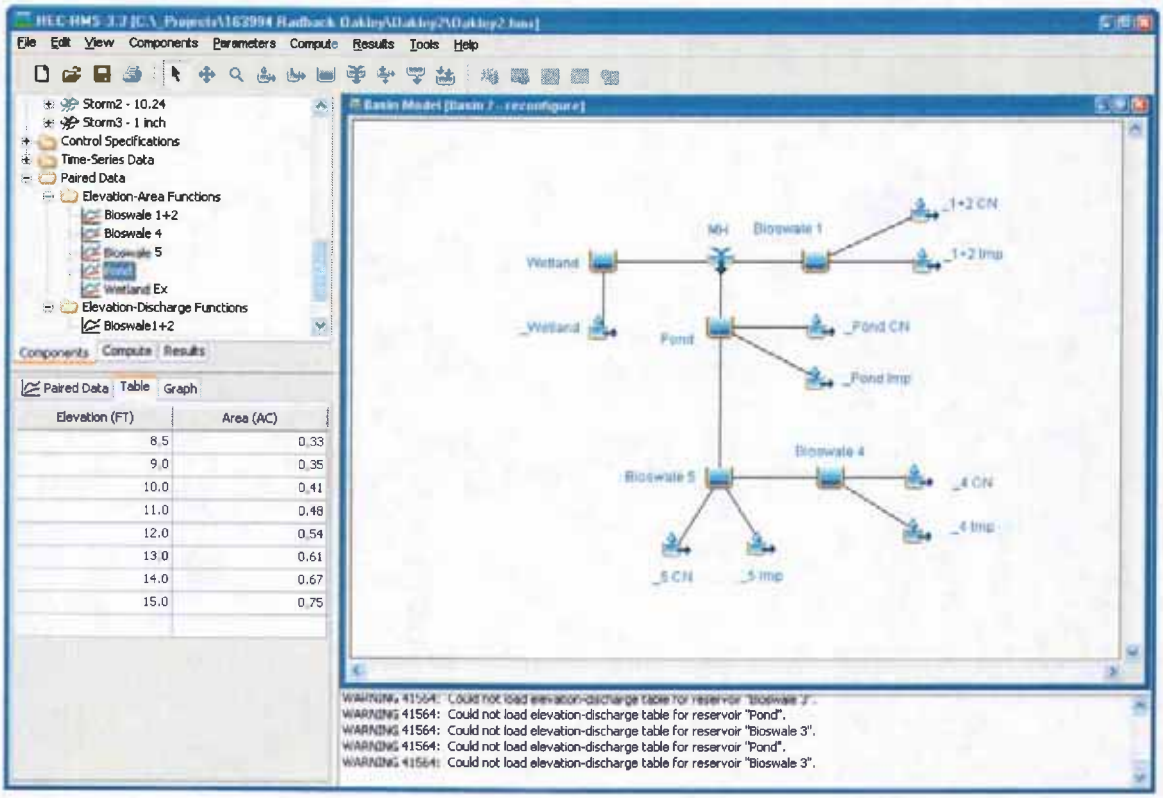


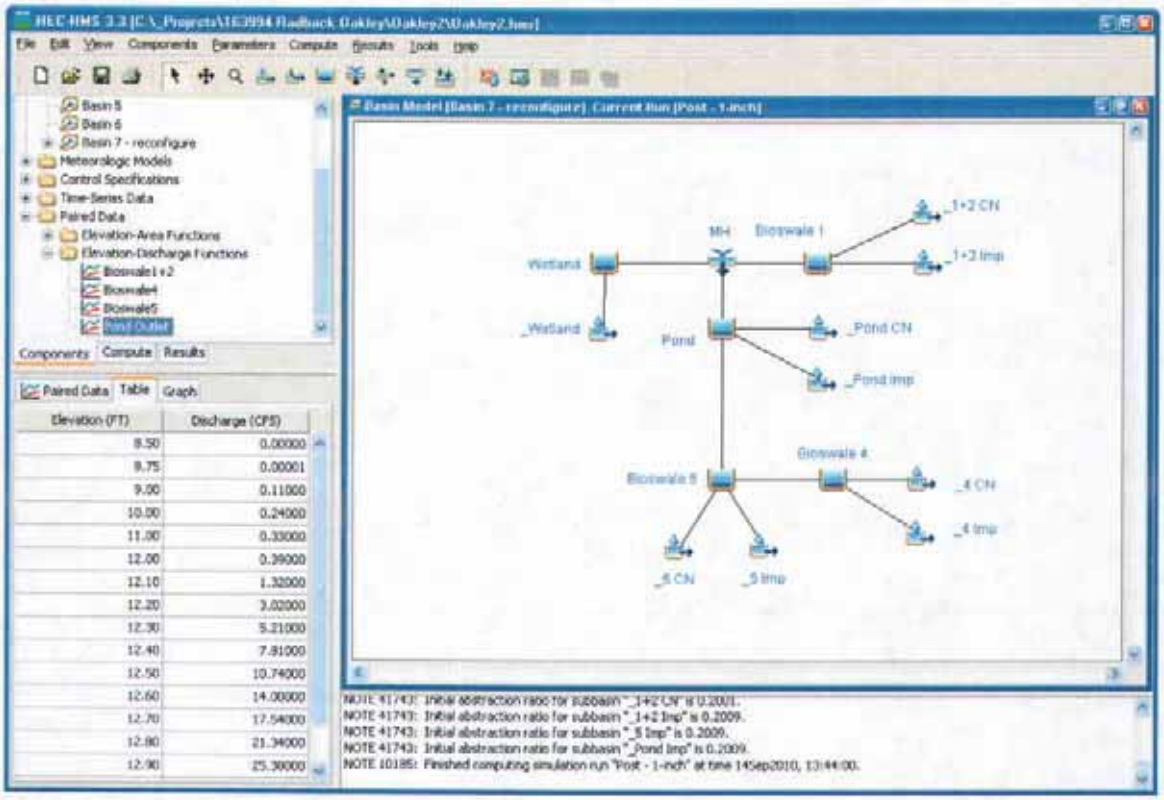



HEC-HMS 3.3 [C:_Projects\116394 Radback Oakley\Oakley2\Oakley2.hms]
File Edit View Components Parameters Compute Results Tools Help
Control Specifications
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.0 0.00
13.0 0.76
14.0 1.07
14.5 1.20
14.6 2.14
14.7 3.86
14.8 6.07
14.9 8.68
15.0 11.64
15.1 14.91
15.2 18.46
15.3 22.28
15.4 26.33
15.5 30.62
Basin Model [Basin 7 - reconfigure]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.

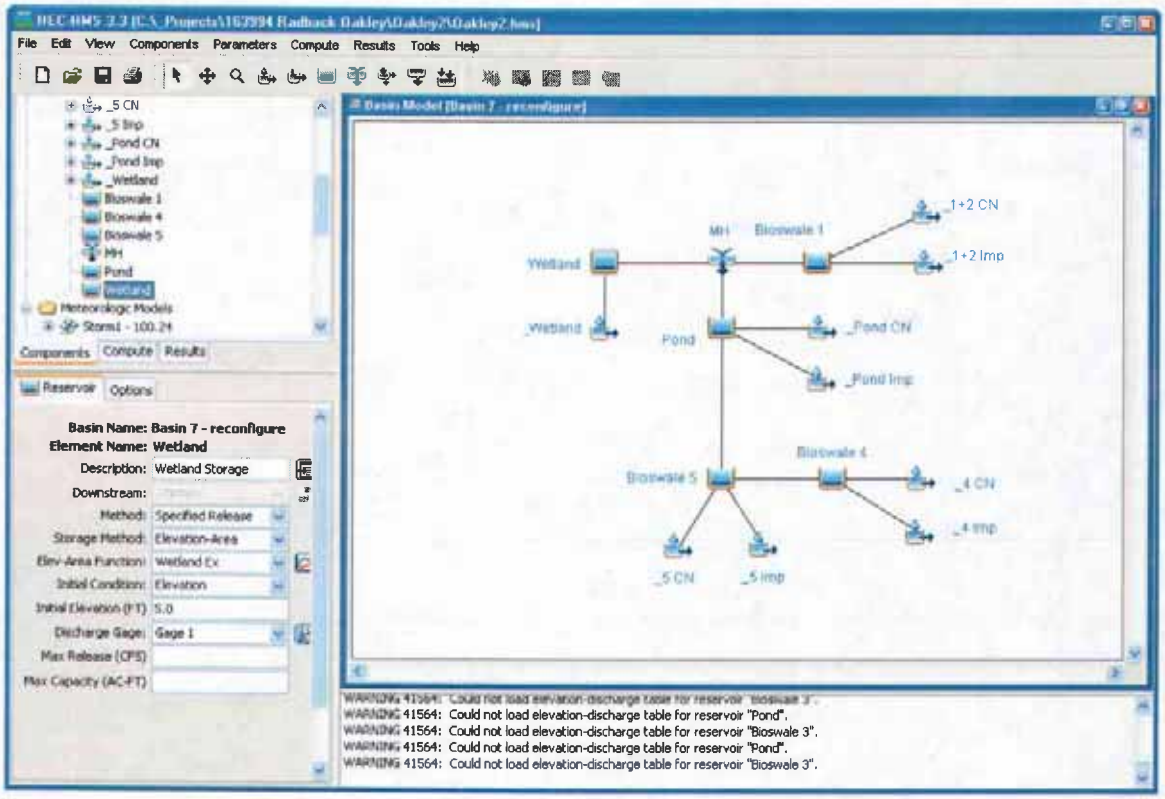
Pond Storage Capacity & Discharge Data

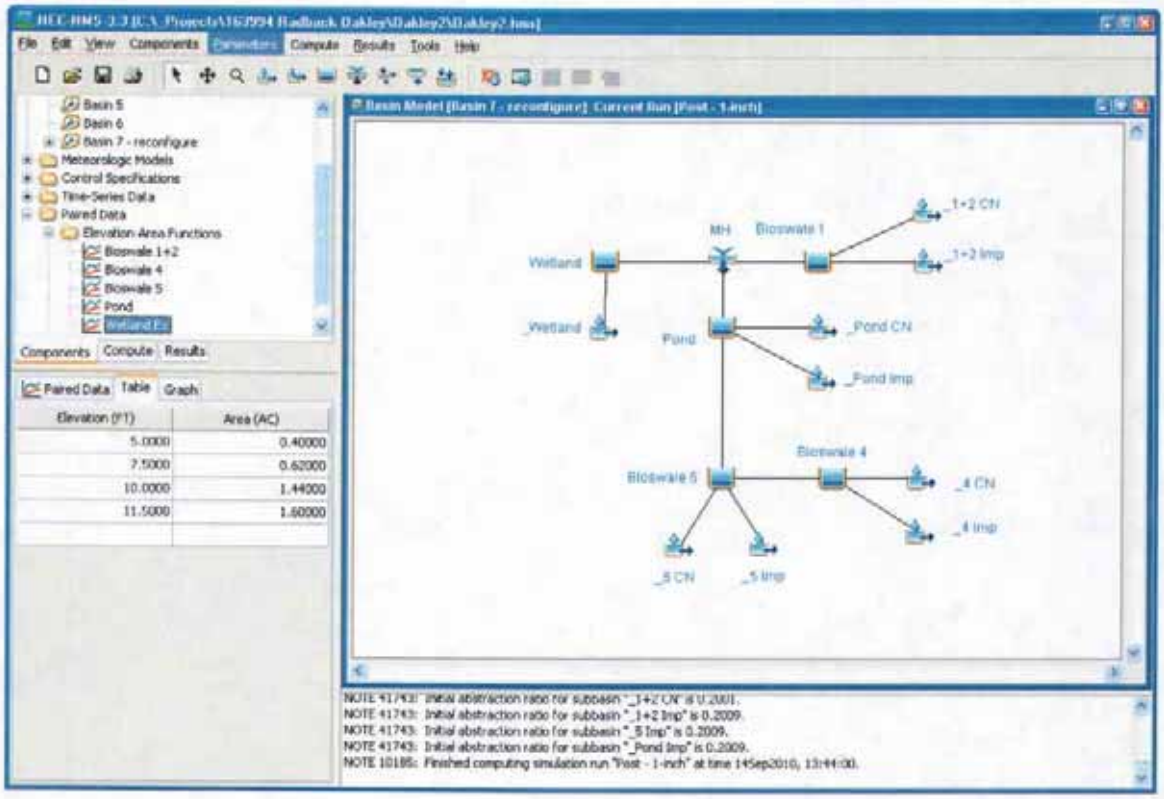


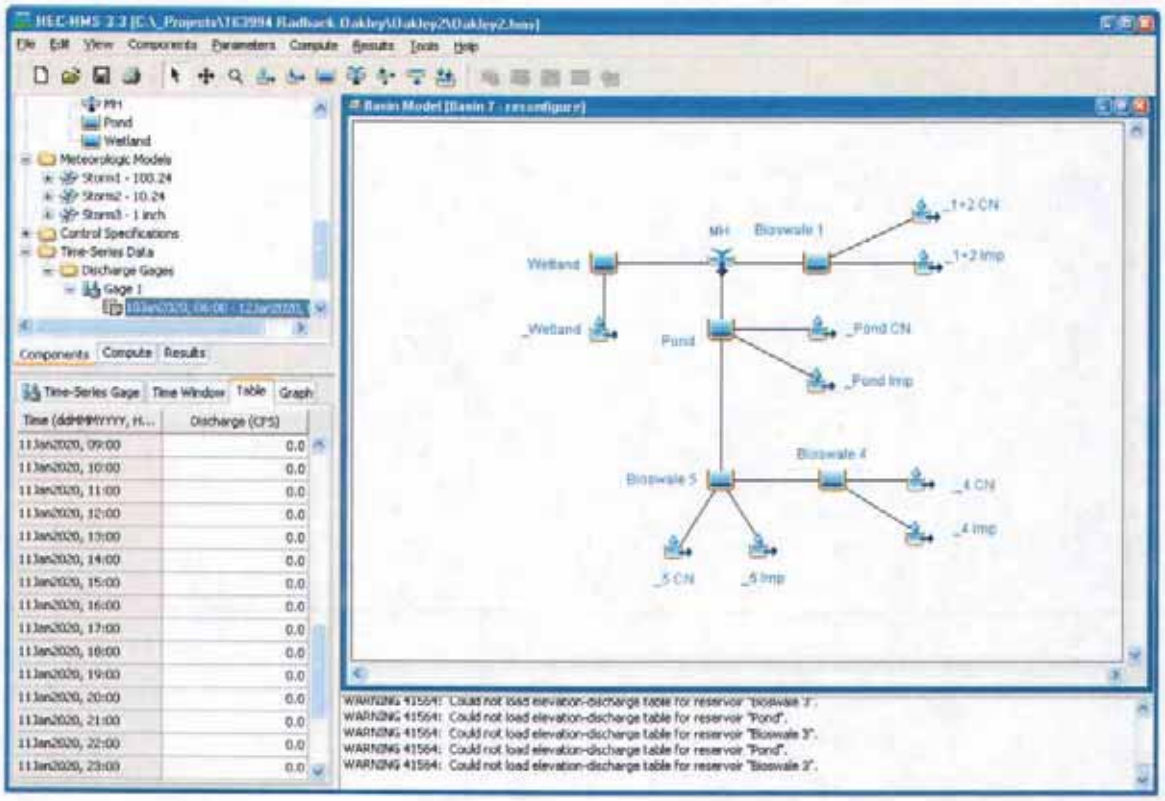



HEC-HMS 3.3 [C:_Projects\HE3934 Hadback Oakley\Oakley2\Oakley2.hms]
File Edit View Components Parameters Compute Results Tools Help
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Control Specifications
Time-Series Data
Paired Data
Elevation-Area Functions
Elevation-Discharge Functions
Bioswale1 v2
Bioswale4
Bioswale5
Pond Outlet
Components
Compute
Results
Paired Data
Table
Graph
Elevation (FT)
Discharge (CFS)
8.50 0.00000
8.75 0.00001
9.00 0.11000
10.00 0.24000
11.00 0.33000
12.00 0.39000
12.10 1.32000
12.20 3.02000
12.30 5.21000
12.40 7.81000
12.50 10.74000
12.60 14.00000
12.70 17.54000
12.80 21.34000
12.90 25.30000
Basin Model [Basin 7 - reconfigure], Current Run [Post - 1-inch]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 41743: Initial abstraction ratio for subbasin "_1+2 CN" is 0.2001.
NOTE 41743: Initial abstraction ratio for subbasin "_1+2 Imp" is 0.2009.
NOTE 41743: Initial abstraction ratio for subbasin "_5 Imp" is 0.2009.
NOTE 41743: Initial abstraction ratio for subbasin "_Pond Imp" is 0.2009.
NOTE 10185: Finished computing simulation run "Post - 1-inch" at time 14Sep2010, 13:44:00.

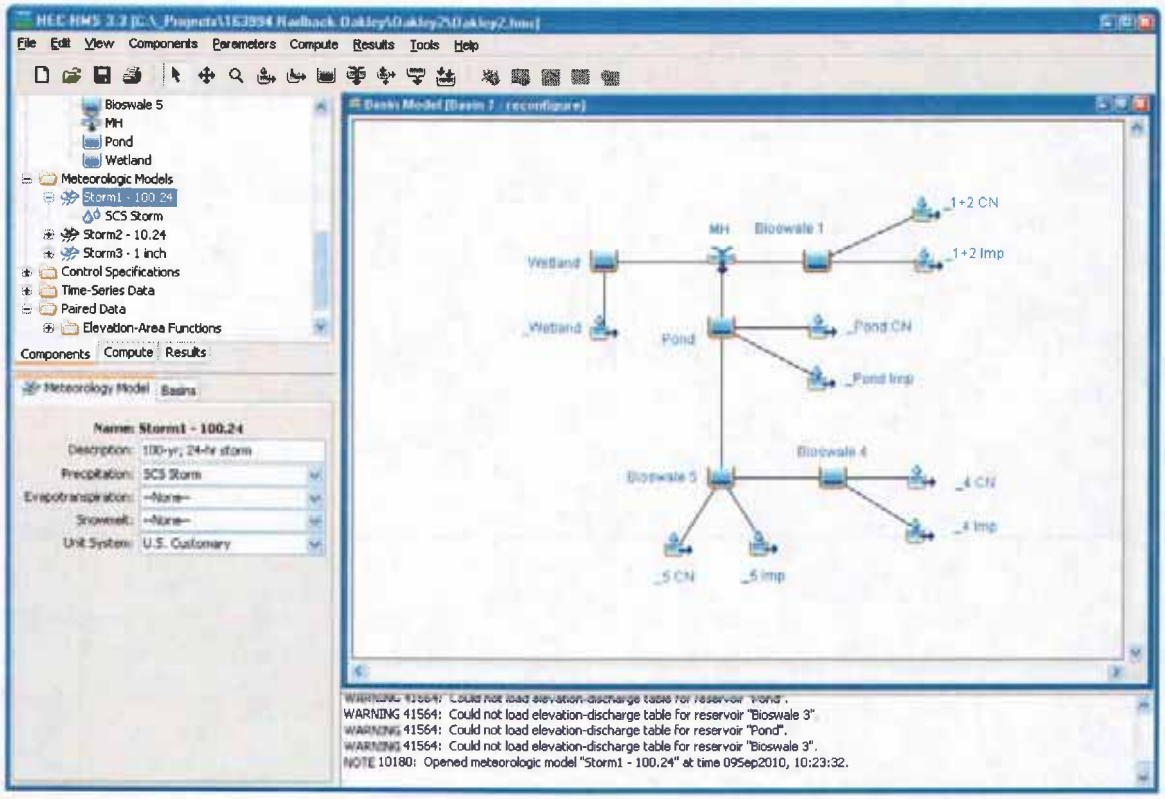
Wetland Storage Capacity Data

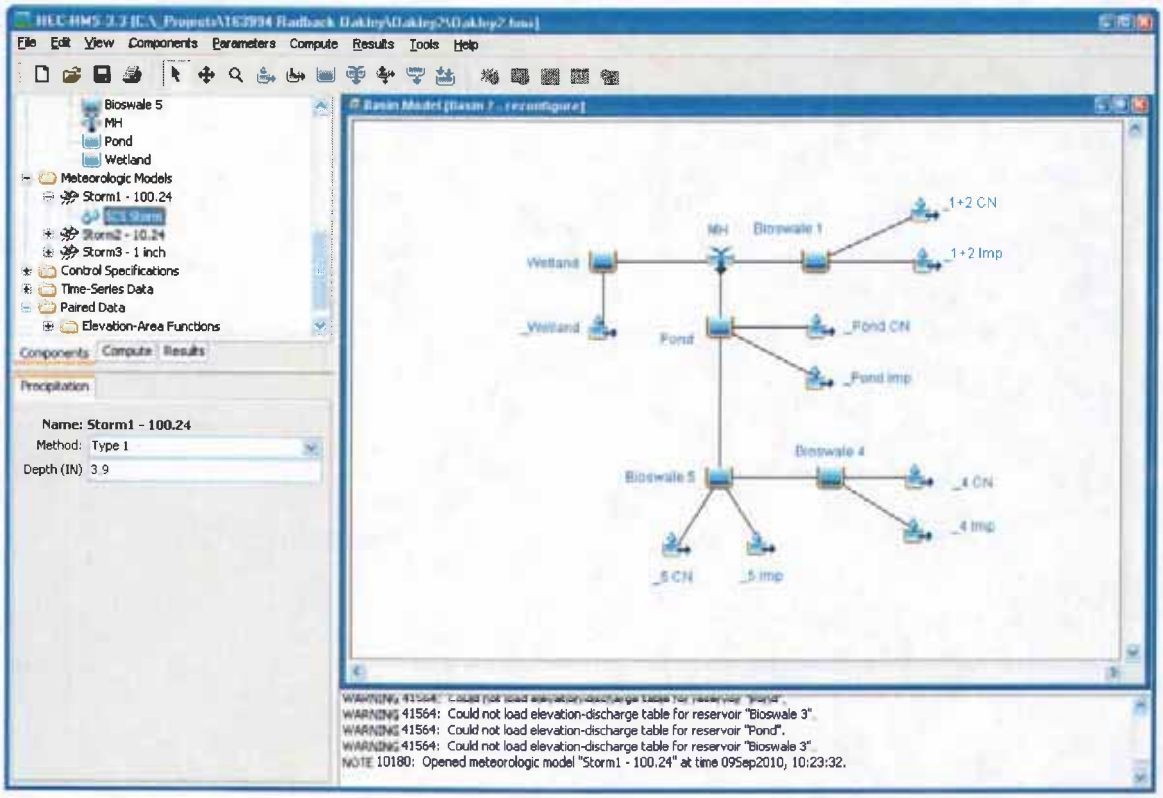




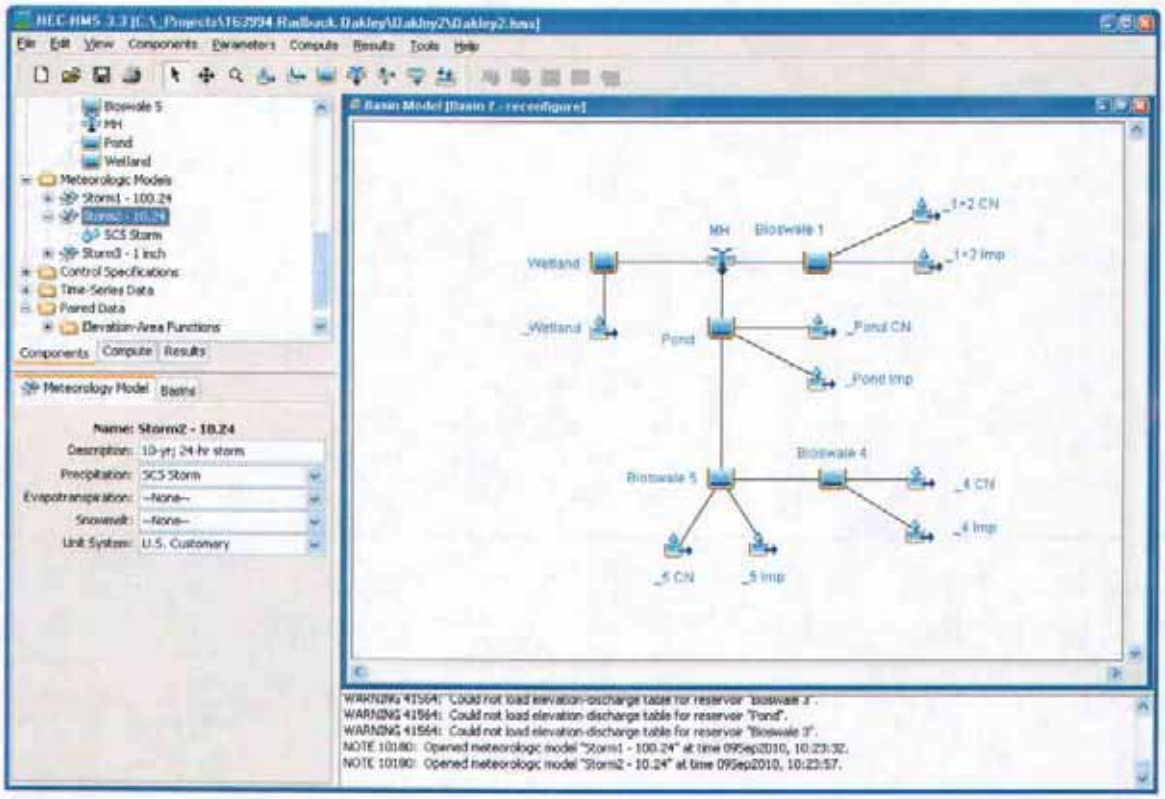

File Edit View Components Parameters Compute Results Tools Help
MH
Pond
Wetland
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Control Specifications
Time-Series Data
Discharge Gages
Gage 1
Components Compute Results
Time-Series Gage Time Window Table Graph
Time (ddMMMYYYY, H... Discharge (CFS)
11Jan2020, 09:00 0.0
11Jan2020, 10:00 0.0
11Jan2020, 11:00 0.0
11Jan2020, 12:00 0.0
11Jan2020, 13:00 0.0
11Jan2020, 14:00 0.0
11Jan2020, 15:00 0.0
11Jan2020, 16:00 0.0
11Jan2020, 17:00 0.0
11Jan2020, 18:00 0.0
11Jan2020, 19:00 0.0
11Jan2020, 20:00 0.0
11Jan2020, 21:00 0.0
11Jan2020, 22:00 0.0
11Jan2020, 23:00 0.0
Basin Model [Basin 7 - reconfigure]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
WARNING 41564: Could not load elevation-discharge table for reservoir "Pond".
WARNING 41564: Could not load elevation-discharge table for reservoir "Bioswale 3".
WARNING 41564: Could not load elevation-discharge table for reservoir "Pond".
WARNING 41564: Could not load elevation-discharge table for reservoir "Bioswale 3".

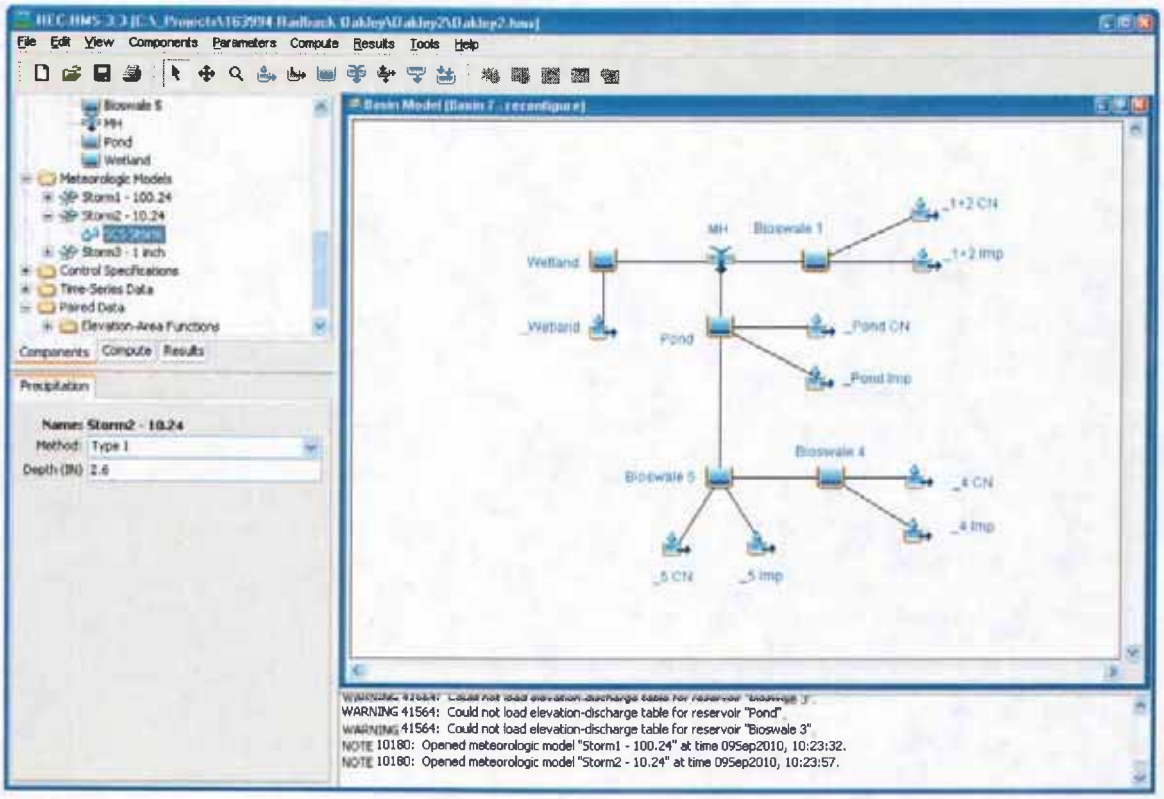
HEC-HMS Input – Meteorologic Model Storm1 – 100-year, 24-hour storm



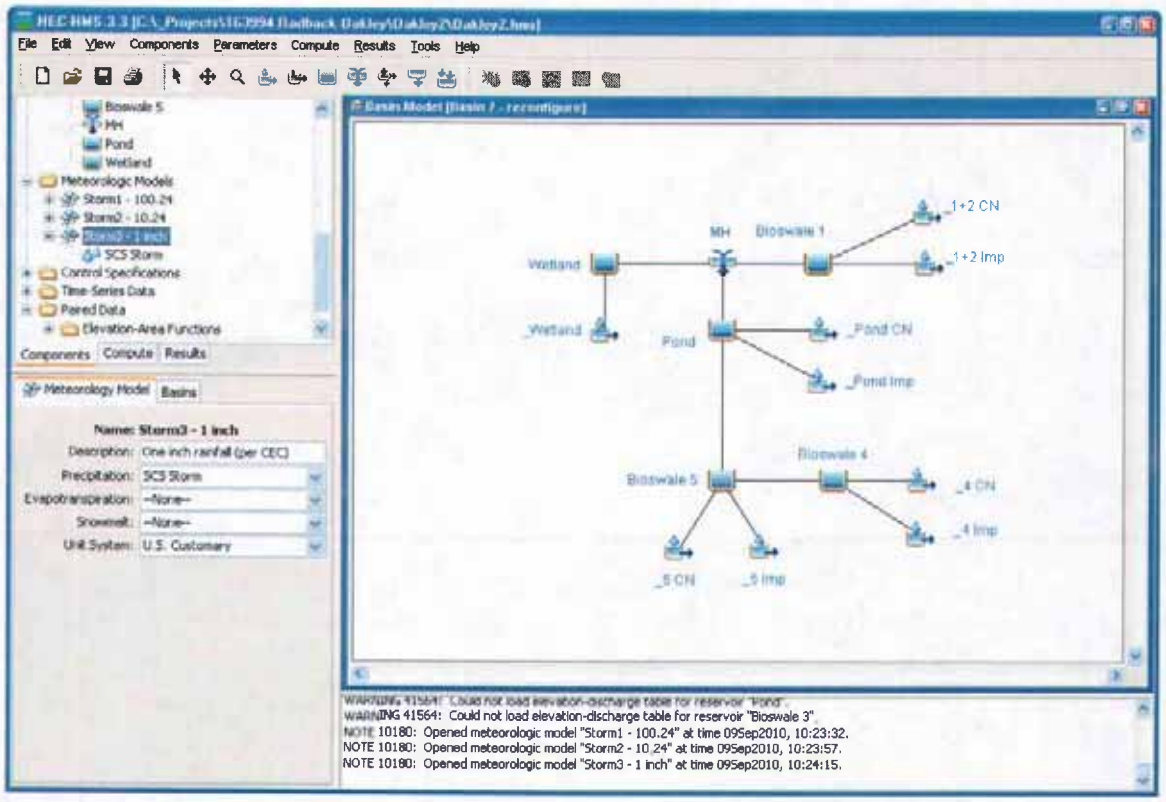


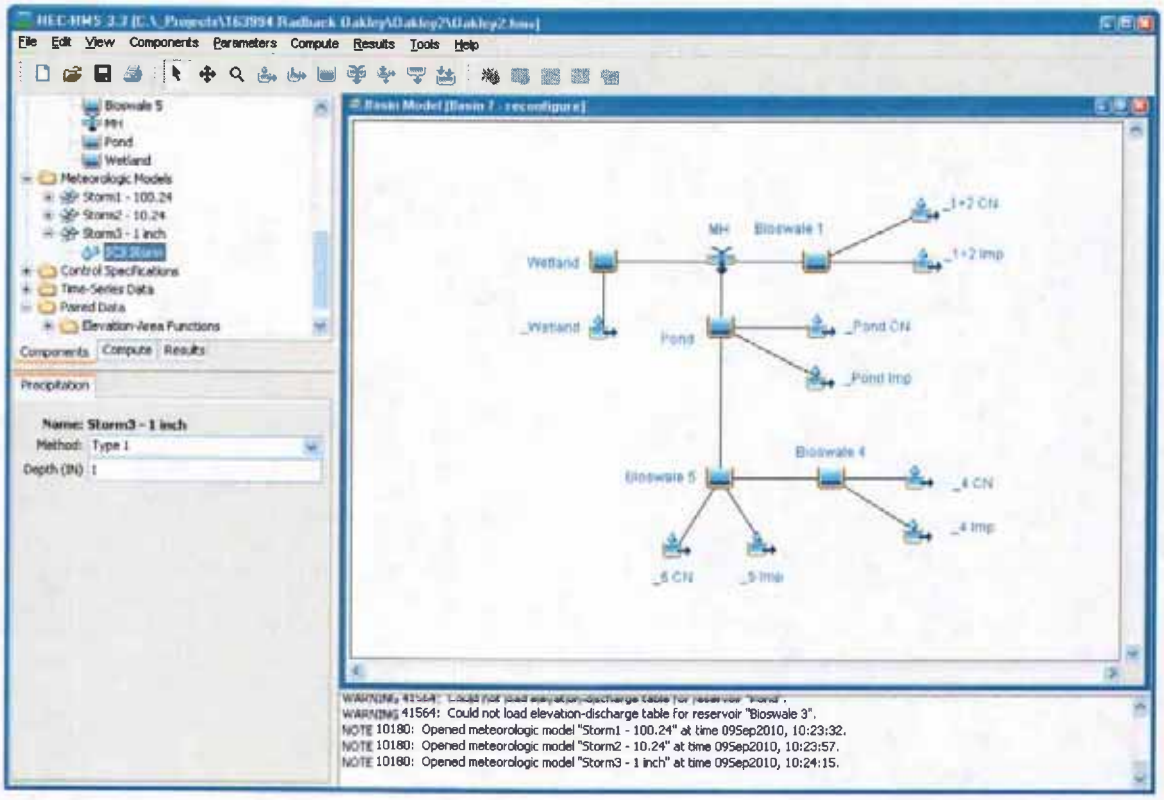
HEC-HMS Input – Meteorologic Model Storm2 – 10-year, 24-hour storm



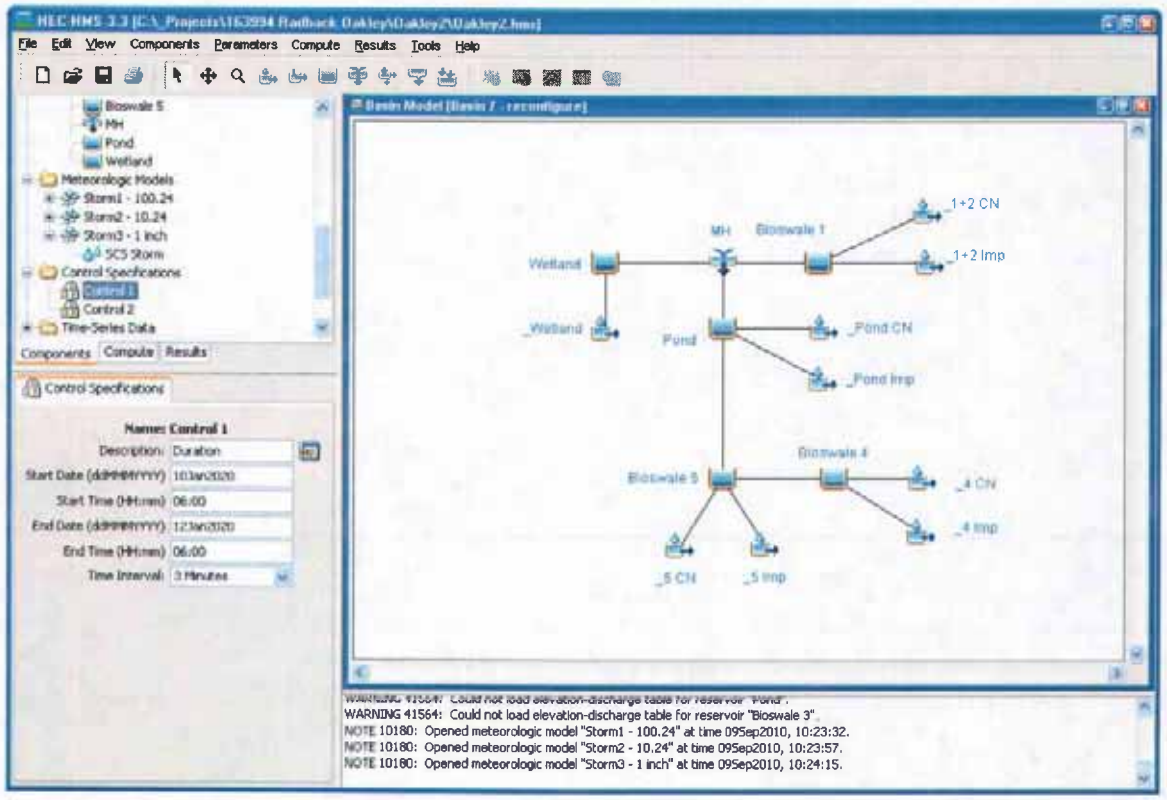


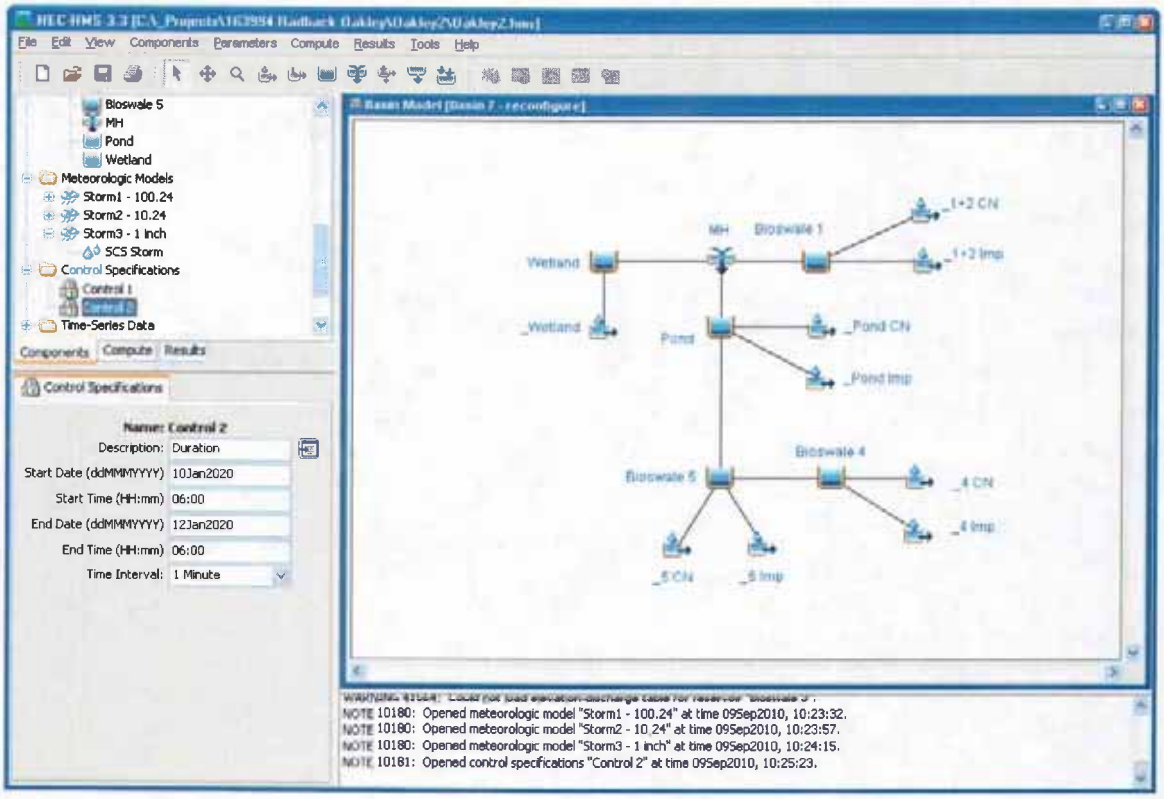
HEC-HMS Input – Meteorologic Model Storm3 – 1-inch rainfall





HEC-HMS Input – Control Data





Radback Tenaska Project Stormwater Analysis CK 6/11/10

Project # 163994 # of pages 4

52.5406.1006

Rev 1 (all pages)
9/13/10
CAK

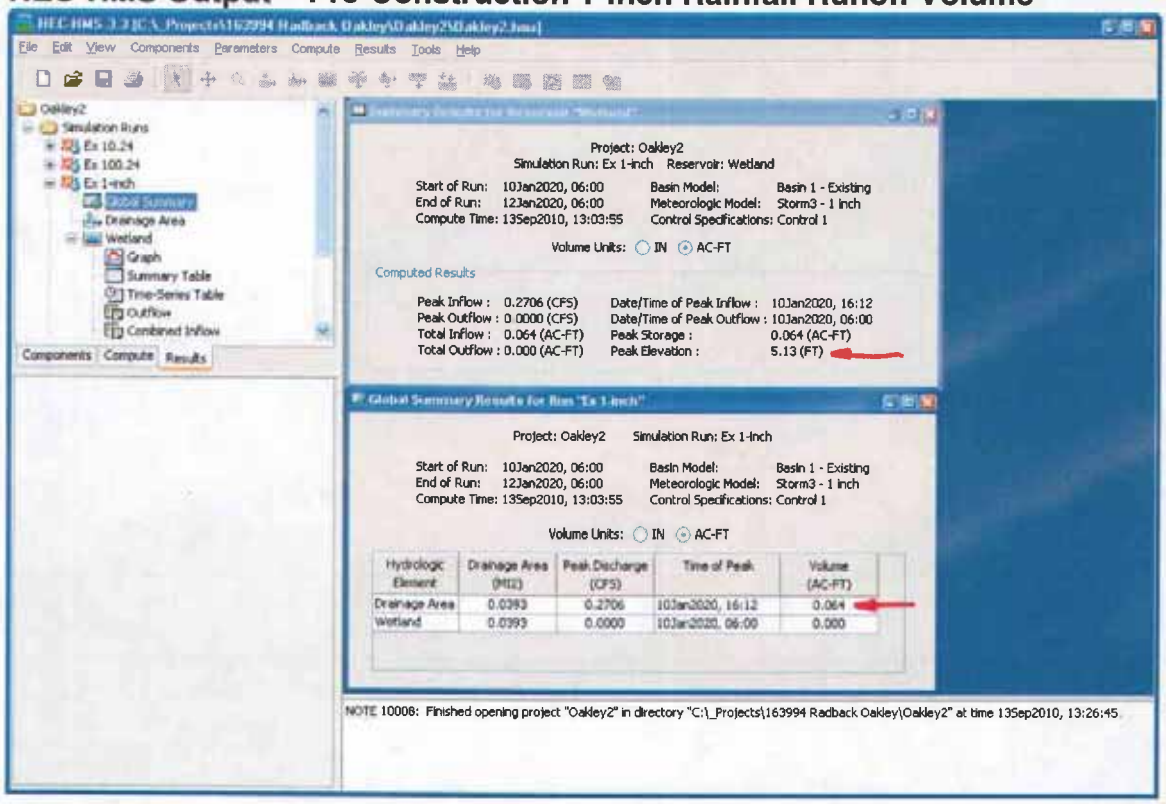
Attachment 2

HEC-HMS Output

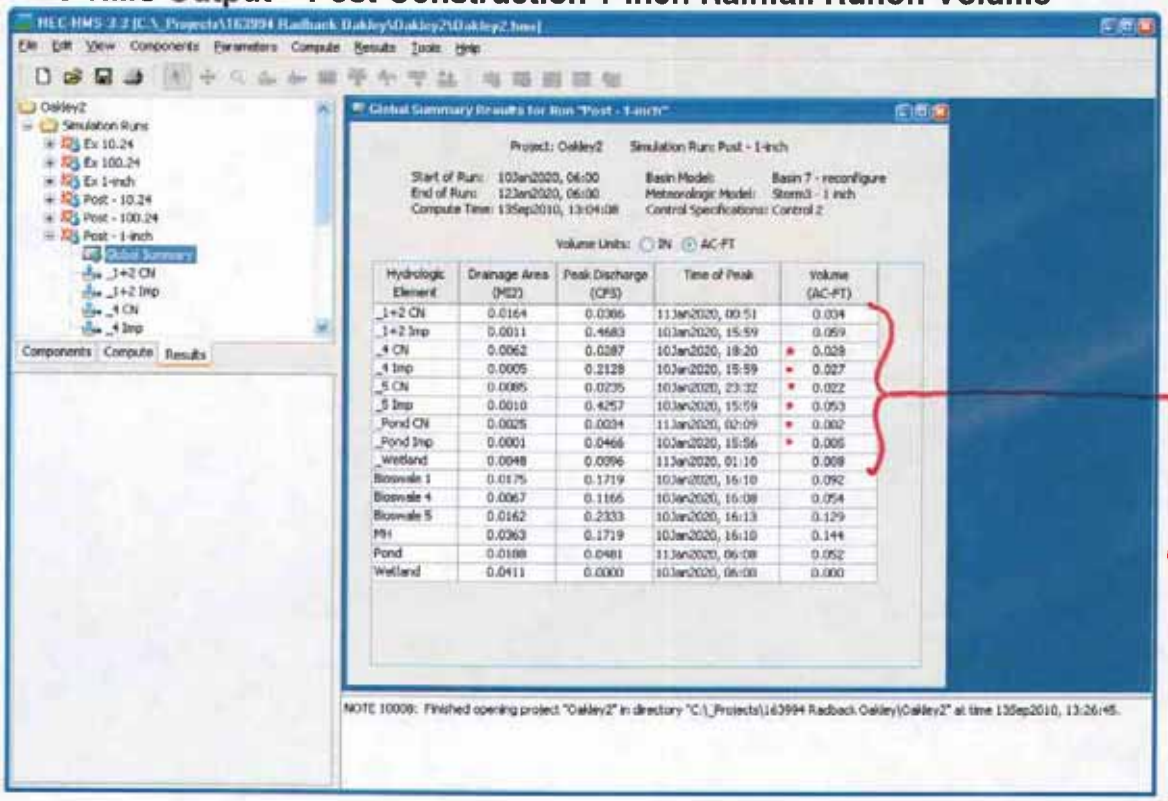
Description Key for HEC-HMS Input/Output Data

Hydrologic Element	Description
_1+2	Drainage area flowing to Bioswale 1+2
~~_3~~	~~Drainage area flowing to Bioswale 3~~
_4	Drainage area flowing to Bioswale 4
_5	Drainage area flowing to Bioswale 5
_Pond	Drainage area flowing directly to Pond
_Wetland	Drainage area flowing directly to Wetland
Bioswale 1+2	Flow from Bioswale 1+2 outlet (to MH1)
Bioswale 3	Flow from Bioswale 3 outlet (to MH2)
Bioswale 4	Flow from Bioswale 4 outlet (to MH1)
Bioswale 5	Flow from Bioswale 5 outlet (to Wetland)
MH1	Flow from Bioswales 1+2 and 4 (to Pond)
MH2	Flow from Pond and Bioswale 3 (to Wetland)
Pond	Flow from Pond Outlet (to MH2)
Wetland	Flow from Wetland (set to 0.0)

HEC-HMS Output – Pre-Construction 1-Inch Rainfall Runoff Volume



HEC-HMS Output – Post-Construction 1-Inch Rainfall Runoff Volume



0.24 ac·ft total runoff

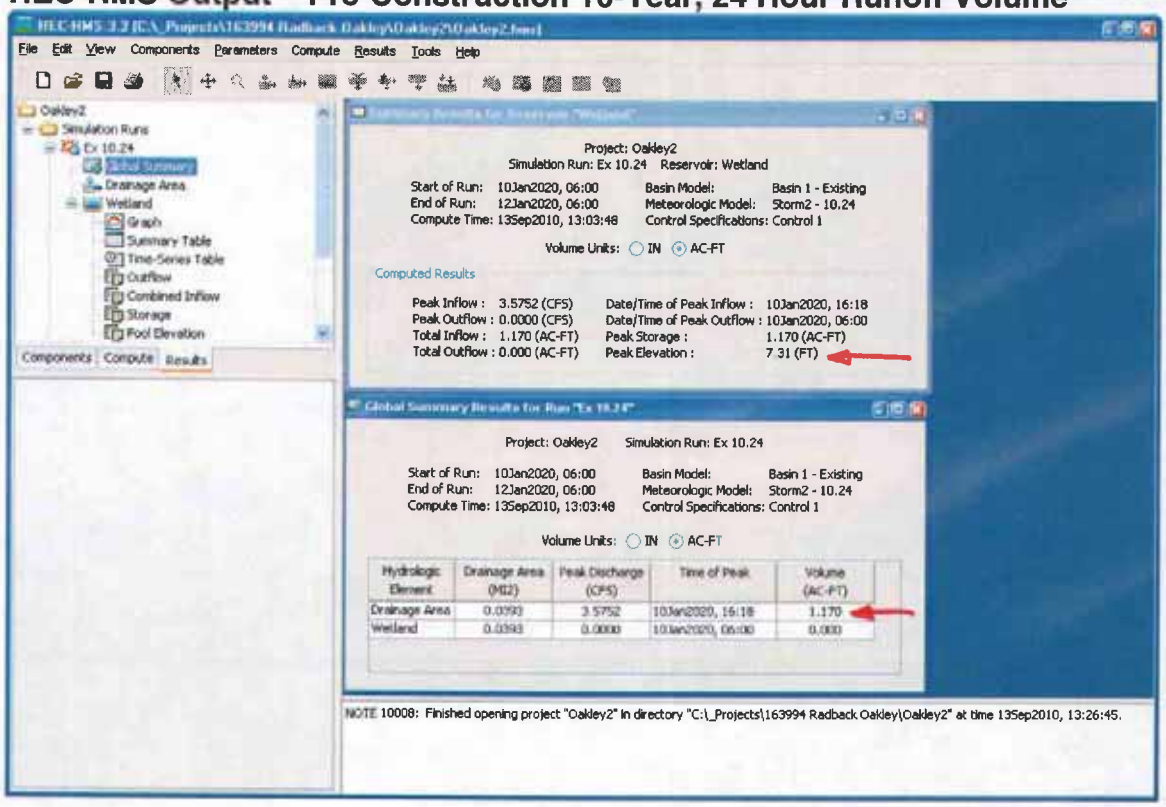
* 0.14 ac·ft to pond

0.14 > 0.085 ac·ft pond retention

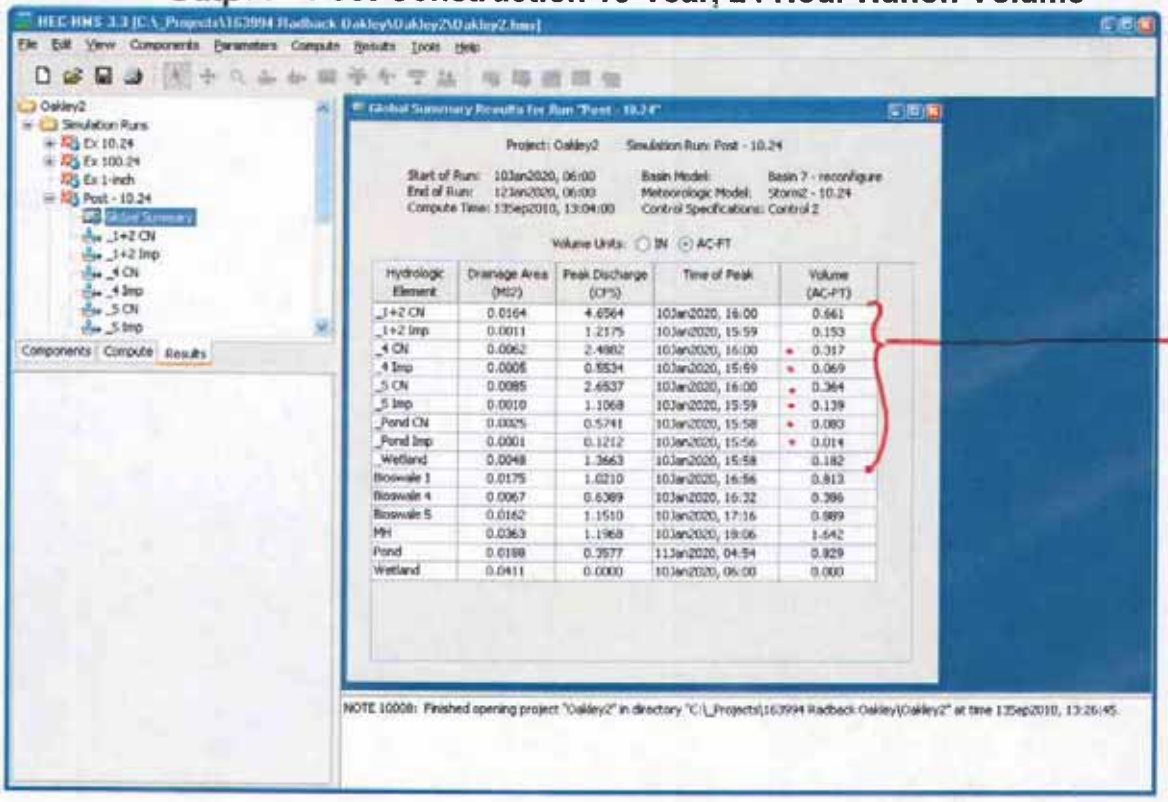
∴ total to wetland =

0.24
−0.085
0.155 ac·ft to wl

HEC-HMS Output – Pre-Construction 10-Year, 24 Hour Runoff Volume



HEC-HMS Output – Post-Construction 10-Year, 24 Hour Runoff Volume



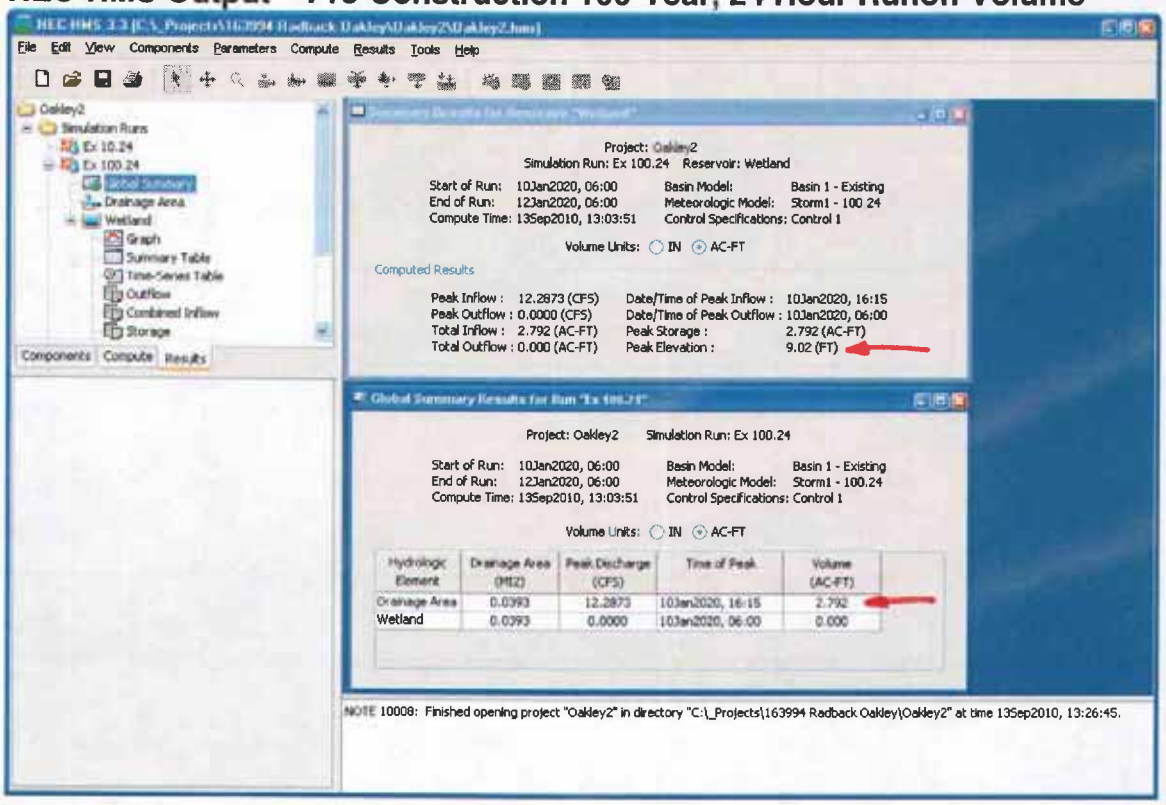
1.98 ac-ft total runoff

0.08 ac-ft pond retention

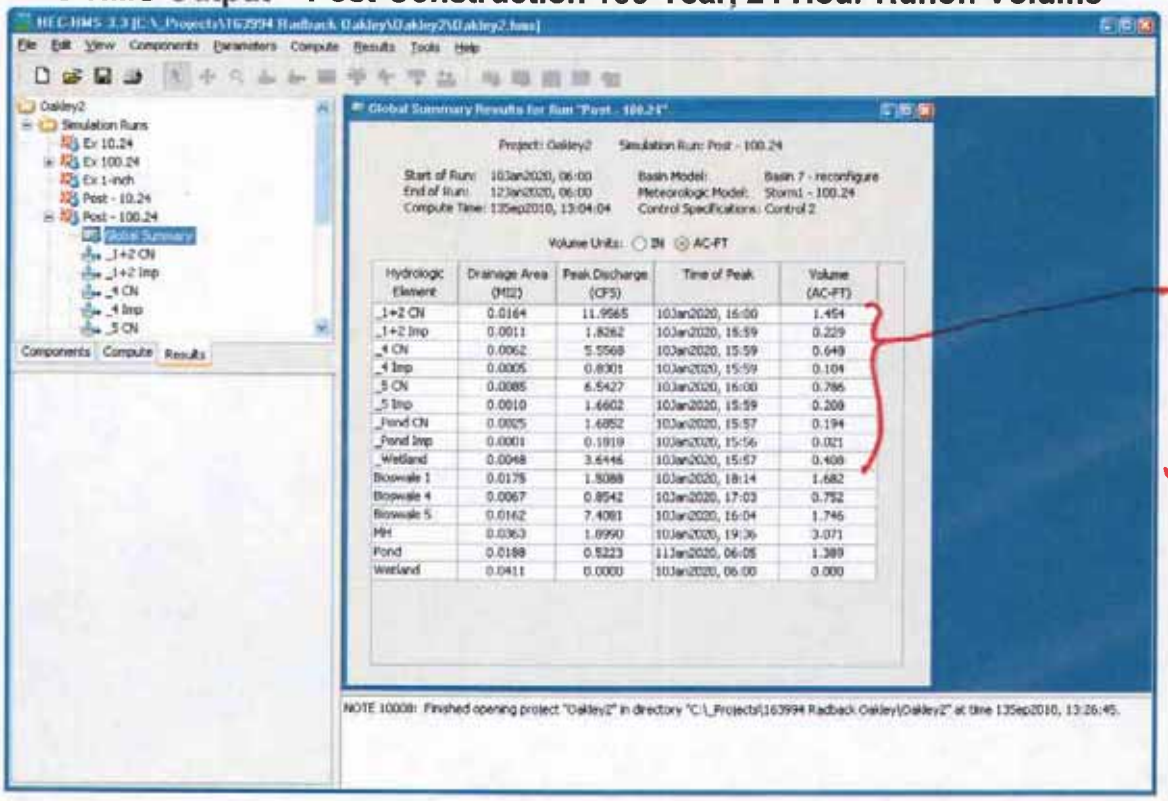
1.90 ac-ft to wetland

(pond outlet above 10-yr WSEL in wetland)

HEC-HMS Output – Pre-Construction 100-Year, 24 Hour Runoff Volume



HEC-HMS Output – Post-Construction 100-Year, 24 Hour Runoff Volume



4.05 ac-ft total runoff

at equalized WSEL 9.8 wetland ~~pond~~ storage = 3.58 ac-ft

pond storage = 0.47 ac-ft

3.58
+0.47
4.05 ac-ft ✓

Radback Tenaska Project Stormwater Analysis CK 6/11/10

Project # 163994 # of pages 5

52.5406.1006

Attachment 3

Reference 2

Select Pages

Chapter 2 Estimating Runoff

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

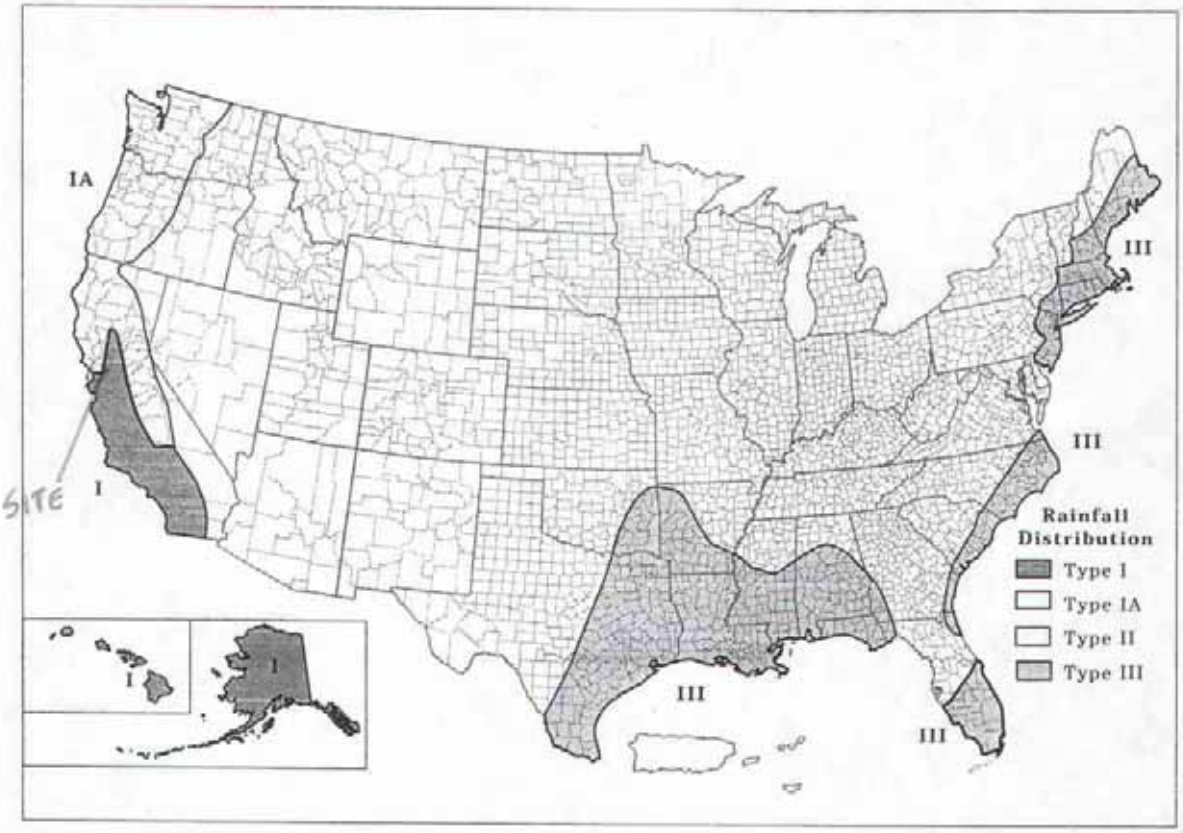
Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.
[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Radback Tenaska project Stormwater Analysis CK 6/11/10

Project # 163994

# of pages 5

Attachment 4

Reference 6

Select pages

(printed out from the Online Web Soil Survey)

Project site

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Radback Tenaska Project Stormwater Analysis CK 6/11/10

Project # 163994

# of pages 5

52.5406.1006

Attachment 5

Reference 8

Select Pages

IMP Sizing for Bioswale #1-2

Refer to Page 5, the total drainage area for bioswale #1-2 is measured to be: 491,168 ft^2 (11.28 ac). The bioswale is measured to be 1,323 feet long.

Six drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; (5) Transformer Containment; and (6) Open-Graded Aggregates (ACC Area).

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	54,900
DMA-2	Asphalt Pavement	65,113
DMA-3	Gravel Surfacing	100,200
DMA-4	Grass/Landscape	198,264
DMA-5	Transformer Containment	4,491
DMA-6	Open-Graded Aggregates	68,200

Runoff Coefficients

Dense-graded aggregate (Caltran Class 2 aggregate) will be utilized as the materials for aggregate surfacing. After being compacted, the dense-graded aggregate is estimated to have a runoff coefficient of 0.5 to 0.7. See communications with Contra Costa County Clean Water Program (Attachment 6). Use 0.6 in this calculation.

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Open Graded Aggregates" will have a runoff coefficient of 0.1. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (54{,}900 \times 1 + 65{,}113 \times 1 + 100{,}200 \times 0.6 + 198{,}264 \times 0.1 + 4{,}491 \times 0 + 68{,}200 \times 0.1)$$

$$= 206{,}779 \text{ ft}^2.$$

IMP Sizing for Bioswale #3

Refer to Page 5, the total drainage area for bioswale #3 is measured to be: 25,711 ft^2 (0.59 ac). The bioswale #3 is measured to be 187 feet long.

Three drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; and (3) Grass/Landscape.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	3,873
DMA-2	Asphalt Pavement	2,086
DMA-3	Grass/Landscape	19,752

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (3{,}873 \times 1.0 + 2{,}086 \times 1.0 + 19{,}752 \times 0.1)$$

$$= 7{,}934\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

IMP Sizing for Bioswale #4

Refer to Page 5, the total drainage area for bioswale #4 is measured to be: 190,955 ft^2 (4.38 ac). The bioswale #4 is measured to be 391 feet long.

Five drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; and (5) Transformer Containment.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	19,314
DMA-2	Asphalt Pavement	33,262
DMA-3	Gravel Surfacing	109,208
DMA-4	Grass/Landscape	23,692
DMA-5	Transformer Containment	5,479

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (19{,}314 \times 1.0 + 33{,}262 \times 1.0 + 109{,}208 \times 0.6 + 23{,}692 \times 0.1 + 5{,}479 \times 0)$$

$$= 120{,}470\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

IMP Sizing for Bioswale #5

Refer to Page 5, the total drainage area for bioswale #5 is measured to be: 290,529 ft^2 (6.67 ac) (natural gas facility included). The bioswale #5 is measured to be 385 feet long total.

Four drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; and (4) Grass/Landscape.

Including Railroad yard
PWJ 6/17/10

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	12,670
DMA-2	Asphalt Pavement	25,905
DMA-3	Gravel Surfacing	186,725
DMA-4	Grass/Landscape	65,229

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (12{,}670\text{x}1.0+25{,}905\text{x}1.0+186{,}725\text{x}0.6+89{,}695\text{x}0.1)$$

$$= 157{,}133\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Radback Tenaska Project Stormwater Analysis CK 6/11/10

Project # 163994 # of pages 4

52.5406.1006

Attachment 6

Reference 9

Select Pages

0.06 (Rev. 2) PLW 6/10/10 < (Rev 2)

Roughness coefficient n = ~~0.17~~ for "cultivated soils, residue cover ~~≥~~ 20%". (Ref. 2, Table 3-1)

Existing conditions have sparse ground coverage based on aerial photos | Rev 2

Per Ref. 2, "After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow". Use sheet flow length L = 300 feet.

1.6 (Rev 2) PLW 6/10/10 9 (Rev 2)

2-year, 24-hour rainfall P_2 = ~~2~~ inch for this site per Ref. ~~5~~ (see Page 8).

The land slope for the first 300 feet = (24.2-21.5)/300 = 0.009 ft/ft. (Refer to Page 5)

0.06 (Rev 2) 0.37 (Rev 2)

Thus, $T_{sheet} = \dfrac{0.007 \times (0.17 \times 300)^{0.8}}{2^{0.5} \times 0.009^{0.4}}$ = 0.76 hour.

1.6 (Rev 2) PLW 6/10/10

(2) Shallow Concentrated Flow

The flow length for shallow concentrated flow L = 1490-300 = 1190 feet.

The average watercourse slope = (21.5-5) / 1190 = 0.014 ft/ft. (Refer to Page 5)

Based on a slope of 0.014 ft/ft, from Ref. 2, Figure 3-1, the average velocity (V) for "unpaved" surface is found to be:

V = 1.9 ft/sec.

Thus the travel time for shallow concentrated flow is calculated to be:

$$T_{shallow} = \frac{L}{3600 \times V} = \frac{1190}{3600 \times 1.9} = 0.17 \text{ hour.}$$

In summary, the time of concentration is calculated to be:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$

(Rev 2) 0.37 = ~~0.76~~ + 0.17 + 0

= ~~0.93~~ hour.

0.54 hr (Rev 2) PLW 6/10/10

Per Ref. 4, "For ungaged watersheds, the SCS suggests that the UH (unit hydrograph) lag time may be related to the time of concentration, T_c, as: $T_{lag} = 0.6\ T_c$". See Page 7.

The SCS UH lag time (T_{lag}) is an input parameter into the HEC-HMS computer program. Thus

T_{lag} = 0.6 x ~~0.93~~ = ~~0.56~~ hour = ~~33.6~~ minutes.

0.54 = 0.324 hr = 19.4 min (Rev. 2)

PLW 6/10/10

Section 2.0 Rainfall Distribution

From Ref. 2, Figure B-2, the rainfall distribution for the site in Contra Costa County, California should be Type I distribution.

From Ref. 5, the 100-year 24-hour rainfall amount for the site is ~~4~~ 3.5 (Rev. 2) PLN 6/10/10 inches. (See Page 10)

Section 3.0 Determine the Composite SCS Curve Number

"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area.

The drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

Per Ref. 2, Table 2-2b, the curve number (CN) for "Row Crops, straight row (SR) with crop residue cover (CR)" for Group A soil is between 64 (good condition) and 71 (poor condition). Use the average curve number 68 for the vineyard area.

Per Ref. 2, Table 2-2a, the curve number for gravel area for Group A soil is 76. The ground cover in railroad yard is similar to the gravel area. Use the same curve number (76) for the railroad yard.

Treat the wetland as an impervious area since it may have standing water in it. Per Ref. 2, Table 2-2a, a curve number of 98 can be used for this area.

Thus the composite curve number (CN) for the drainage area is calculated as:

$$CN = (19.85 \times 68 + 3.96 \times 76 + 0.94 \times 76 + 0.40 \times 98) / 25.15 = 70.$$

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It

includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2)

Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 70, the initial abstraction is calculated to be:

$$I_a = 0.2 \times (1000/70 - 10) = 0.857 \text{ inch.}$$

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. The impervious area consists of the roofs of a few small buildings in the southwest portion of the drainage area. By using AutoCAD, the total roof area is measured to be 0.17 acre. Thus,

% impervious = 0.17 / 25.15 = 0.68%, say 1%.

Section 4.0 Wetland Area versus Elevation

The bottom of the wetland is at an approximate elevation of 5 feet. See B&V Drawing SS-3001 (Page 5). The relationship of Area versus Elevation for the wetland area was presented in the table below. The wetland area was measured by using AutoCAD. It should be noted that a small portion of the wetland at the east side within the project property will be filled at a later time. This area will be graded at a 4 (H) to 1 (V) slope towards the wetland. The area in the table below at Elevation 10 (1.44 acres) has already had the future fill area been deducted to accurately model the wetland storage capacity.

Elevation (ft)	Wetland Area (acre)
5.0	0.40
7.5	0.62
10.0	1.44

Section 5.0 HEC-HMS Output

The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The initial water elevation in the wetland is specified to be at

Radback Tenaska Project Stormwater Analysis CK 6/11/10

Project # 163994 # of pages 2

52.5406.1006

Attachment 7

Kantola, Craig

From: Jorge Hernandez [jhern@pw.cccounty.us]
Sent: Tuesday, May 18, 2010 8:37 PM
To: Kantola, Craig
Cc: Teri Rie; Tim Jensen
Subject: RE: Flood Control Standards - Oakley, CA
Attachments: CCCo Isohyet Map-Low Color.pdf; 025yr-Low.pdf; 050yr-Low.pdf; 100yr-Low.pdf; 005yr-Low.pdf; 010yr-Low.pdf; Supplemental Detention Basin Design Guidelines.doc

Mr. Kantola,

1. Per your request we are emailing a copy of our standard Isohyet map to determine the standard storm event.
2. For offsite conveyance of storm water runoff for an area less than 1-sqaure mile, the design storm event should be a 10-year event, however a detention/retention system should be able to store at the very least the 100-year design storm event.
3. See attached supplemental for suggested design of on-site facilities. Ultimately, the City will approve onsite facilities.
4. For the initial 100-year event, the assumption of an empty basin is acceptable, however a 10-year event after a recent 100-year occurrence should be analyzed. Additionally, the overland release of the basin should be directed north, per the current drainage pattern and not allowed to drain south to the existing inlet under the railroad crossing (bridge), which currently is outside of your parcel's drainage area and does not have the capacity to convey additional storm runoff.

If you have any additional question, you may contact me by either phone or email.

Thank you,

Jorge Hernandez
Staff Engineer

Contra Costa County
Flood Control
& Water Conservation District
255 Glacier Drive
Martinez, CA 94553-4897
Phone: (925) 313-2304
Fax: (925) 229-7955
A Division of the Public Works Department

From: Kantola, Craig [mailto:KantolaCA@bv.com]
Sent: Friday, May 14, 2010 10:21 AM
To: Jorge Hernandez
Subject: FW: Flood Control Standards - Oakley, CA

Jorge,
Good afternoon, I have left you a voice mail responding to your call from Wednesday. Any information you may be able to provide would be greatly appreciated. Please forward any design requirements for flood control in Contra Costa County

BLACK & VEATCH Building a world of difference.

CALCULATION RECORD

Client Name: Radback Energy Page 1 of 31

Project Name: Oakley Generating Station Project No.: 163994

Calculation Title: Stormwater Analysis for Wetland - Peak Flows

Calculation No./File No.: 52.5406.1007

Verification Method: ☒ Check and Review ☐ Alternate Calculations

Objective To determine the peak flow rates to the wetland area for the pre-construction and post-construction site conditions. The analysis compares pre-construction and anticipated post-construction ground conditions at the site.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

Refer to Page _____ of this calculation for additional assumptions.

This Section Used for Software-Generated Calculations

Program Name/Number: HEC-HMS Version: 3.3

Standard B&V Application Used? ☒ Yes ☐ No

If no, list approved deviation permit number below and attach approved deviation permit.

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	C Kantola SKK	17 June 2010	PLNelson	18 JUNE 2010	PLNelson	18 JUNE 2010
1	C Kantola SKK	9/14/10	PLNelson	9/20/10	PLNelson	9/20/10

Purpose

To determine the stormwater runoff peak flows entering the existing wetland at the Oakley project site for storm events including the 1-inch rainfall, 10-year/24-hour storm, and 100-year/24-hour storm events. The analyses are performed for pre-construction and post-construction ground conditions at the project site.

References

1. Black & Veatch Drawing 163994-SS-3001, Rev. 1, "Grading & Drainage - Site"
2. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
3. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, User's Manual, Version 3.3; September 2008.
4. US Army Corps of Engineers; Hydrologic Modeling System HEC-HMS, Technical Reference Manual; March 2000.
5. US Department of Commerce; NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume XI - California; 1973.
6. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
7. Mays, L. W.; Stormwater Collection Systems Design Handbook, McGraw-Hill; 2001.
8. Black & Veatch Calculation, "IMP Sizing for Plant Area", File No. 52.5406.1008 Rev 0, Same project, June, 2010
9. Black & Veatch Calculation, "Stormwater Analysis", File No. 52.5406.1003 Rev 2, Same project, June 2010
10. Black & Veatch Calculation, "Storm Sewer Pipe Design", File No. 52.5406.1005 Rev 0, Same project, April 2009
11. Black & Veatch Calculation, "Post-Construction Wetland – Volume and Water Surface Elevation", File No. 52.5406.1006 Rev 0, Same project, June 2010
12. Ferguson, Bruce K., "Introduction to Stormwater", John Wiley & Sons, 1998
13. McCuen, Richard H., "Hydrologic Analysis and Design"; Prentice Hall, 1998
14. Contra Costa County Dept. of Public Works Maps; Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973; Drawing No. B-166; December 1977; Precipitation Duration-Frequency-Depth Curves (100-yr and 10-yr); Drawing Nos. B-159 and B-162; July 1977

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)

Drainage area in acres (ac)

Attachments

1. HEC-HMS Input
2. HEC-HMS Output
3. Reference 2 – Select Pages
4. Reference 6 – Select Pages
5. Reference 8 – Select Pages
6. Reference 9 – Select Pages
7. Reference 11 – Select Pages
8. Reference 12 – Select Page
9. Reference 7 – Select Page
10. Reference 13 – Select Page

Summary

Based on the HEC-HMS analyses with current and proposed ground cover conditions, the stormwater runoff flow rates to the wetland will change due to the proposed site construction. The pre-construction (existing) models determine flows to the wetland area under undeveloped conditions. The post-construction models determine flows to the wetland area for developed conditions, considering the effects of the bioswales and detention pond for peak flow attenuation. Below is a summary table showing the pre-construction and post-construction peak flow rates determined by the HEC-HMS models.

Summary of Runoff Peak Flow Rates to Wetland

Rainfall Event	Pre-Construction Peak Flow Rate to Existing Wetland	Post-Construction Peak Flow Rate to Existing Wetland
1-inch	0.1 cfs	0.1 cfs
10-year	3.2 cfs	3.1 cfs
100-year	11.8 cfs	9.1 cfs

SUPERSEDED 9/14/10
See pg 4A

Summary

Based on the HEC-HMS analyses with current and proposed ground cover conditions, the stormwater runoff flow rates to the wetland will change due to the proposed site construction. The pre-construction (existing) models determine flows to the wetland area under undeveloped conditions. The post-construction models determine flows to the wetland area for developed conditions, considering the effects of the bioswales and detention pond for peak flow attenuation. Below is a summary table showing the pre-construction and post-construction peak flow rates determined by the HEC-HMS models.

Summary of Runoff Peak Flow Rates to Wetland

Rainfall Event	Pre-Construction Peak Flow Rate to Existing Wetland	Post-Construction Peak Flow Rate to Existing Wetland
1-inch	0.3 cfs	0.2 cfs
10-year	3.6 cfs	2.2 cfs
100-year	12.3 cfs	4.8 cfs

The peak flow rates to the wetland are reduced due to the installation of flow control devices provided within the bioswales and detention basin, for stormwater treatment. Low-flow orifices are provided to maintain hydration of the existing wetland during smaller storm events.

Hydrology Modeling – HEC-HMS

For the runoff peak flow rate analysis, the entire site was modeled as one drainage area for the pre-construction (existing) condition (Reference 9) and separated into distinct drainage areas for the post-construction (proposed) condition (bioswales, and direct runoff to pond and wetland areas). See Page 6 for the boundary delineation of these areas. The drainage areas are summarized in the table below, with measurements taken from References 8 & 9 and also using AutoCAD.

Summary of Drainage Areas (in acres & square miles)

Ground Cover Type	Existing Site Acreage*	Post-Construction Site Acreage					
		Bioswale **				Direct to Pond	Direct to Wetland
		1+2	3	4	5		
Vineyard / Undisturbed	19.85	-	-	-	-	-	1.93
Gravel	3.96	2.30	-	2.51	3.35	-	-
Railroad Yard	0.94	-	-	-	0.94	-	-
Wetland	0.40	-	-	-	-	-	0.40
Lawn (Poor Coverage <50%)	-	4.55	0.45	0.54	1.50	0.85	-
Impervious Surface ***	-	2.75	0.14	1.21	0.88	0.13	0.27 (ex. roads)
Transformer Contain ****	-	0.10	-	0.12	-	-	-
Open Graded Aggregate	-	1.57	-	-	-	-	-
Total Acres:	25.15	11.17	0.59	4.26	6.67	0.98	2.60
Total (Sq. Mi.):	**0.0393**	**0.0175**	**0.0009**	**0.0067**	**0.0104**	**0.0015**	**0.0041**
		0.0411 sq. mi. (Total Post-Construction)					

* Existing site acreage as determined in BV Calc 52.5406.1003 (Ref 9)
** Post-construction areas as determined in BV Calc 52.5406.1008 (Ref 8)
*** Impervious surface computed as sum of Equipment/Roofs + Pavement (from Calc 52.5406.1002)
**** Transformer Containment area does not drain to Bioswales and is not included in total areas listed.

The stormwater runoff to the wetland for various storms was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

SUPERSEDED 9/14/10
See Pg 5A

Hydrology Modeling – HEC-HMS

For the runoff peak flow rate analysis, the entire site was modeled as one drainage area for the pre-construction (existing) condition (Reference 9) and separated into distinct drainage areas for the post-construction (proposed) condition (bioswales, and direct runoff to pond and wetland areas). See Page 6 for the boundary delineation of these areas. The drainage areas are summarized in the table below, with measurements taken from References 8 & 9 and also using AutoCAD.

Summary of Drainage Areas (in acres & square miles)

Ground Cover Type	Existing Site Acreage*	Post-Construction Site Acreage					
		Bioswale **				Direct to Pond	Direct to Wetland
		1+2	3	4	5		
Vineyard / Undisturbed	19.85	-	REMOVED IN REVISION 1	-	-	-	1.93
Gravel	3.96	2.30		2.51	2.87	0.1	-
Railroad Yard	0.94	-		-	0.94	-	-
Wetland	0.40	-		-	-	-	0.40
Lawn (Poor Coverage <50%)	-	4.55		0.54	0.95	1.28	0.47
Impervious Surface ***	-	2.75		1.21	1.32	0.30	0.28 (ex. roads)
Transformer Contain ****	-	0.10		0.12	-	-	-
Open Graded Aggregate	-	1.57		-	-	-	-
Total Acres:	25.15	11.17		4.26	6.08	1.68	3.08
Total (Sq. Mi.):	**0.0393**	**0.0175**	**0**	**0.0067**	**0.0095**	**0.0026**	**0.0048**
		0.0411 sq. mi. (Total Post-Construction)					

* Existing site acreage as determined in BV Calc 52.5406.1003 (Ref 9)
** Post-construction areas as determined in BV Calc 52.5406.1008 (Ref 8)
*** Impervious surface computed as sum of Equipment/Roofs + Pavement (from Calc 52.5406.1002)
**** Transformer Containment area does not drain to Bioswales and is not included in total areas listed.

The stormwater runoff to the wetland for various storms was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

BIOSWALE #3

WETLAND

POND

BIOSWALE #5

BIOSWALE #1

BIOSWALE #4

DRAINAGE AREA FOR EA. BIOSWALE (TYP)

CONSERVATION EASEMENT

SLOPE TO MATCH BRIDGEHEAD ROAD

BRIDGEHEAD ROAD

CL BIOSWALE

SEE NOTE 7 (TYP)

SEE NOTE 8

MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION

N 2193000

N 2192750

N 2192500

N 2192250

N 2192000

E 6201500

E 6201750

E 6202000

E 6202250

E 6202500

E 6202750

ALL BACKCIRCLED CHANGES PER ECN-N-S-00XX

OPEN
05/27/10

2'-0"

ABBRE

APPROX
ASPH
AVG
BND
BLDG
B/MH
BOC
BOD
BOP
BU
C
CB
CD
CHDPE

CL
CLR
CMH
CND
CONC
CO
CS
CW
DB
DBC
DET
DIA
DIP
DWG
DWP
EC
ECC
EF
EHH
EL
EMH
EW
FC
FDN
FF
FRP
GR
HDM
HDPE
HP
HYD
ID
INV
JBX
L
LP

1 S3000

× 326.5

BM-1

TR-1

N

1. COORDINATE NGVD 29 D. THE FLAGPO DATUM ELEV PHOTOGRAPI ASSOCIATES.
2. NEW GRADE INDICATE FI
3. ALL CUT AN NOTED OTHI
4. SEE DWG S AND OUTLET
5. TOP OF CO EL 18.0. FI
6. CL OF ALL
7. TREES TO F
8. TEMPORARY CONSTRUCTI

Void 9/14/10 SUPERSEDED SEE PL 6a CAK

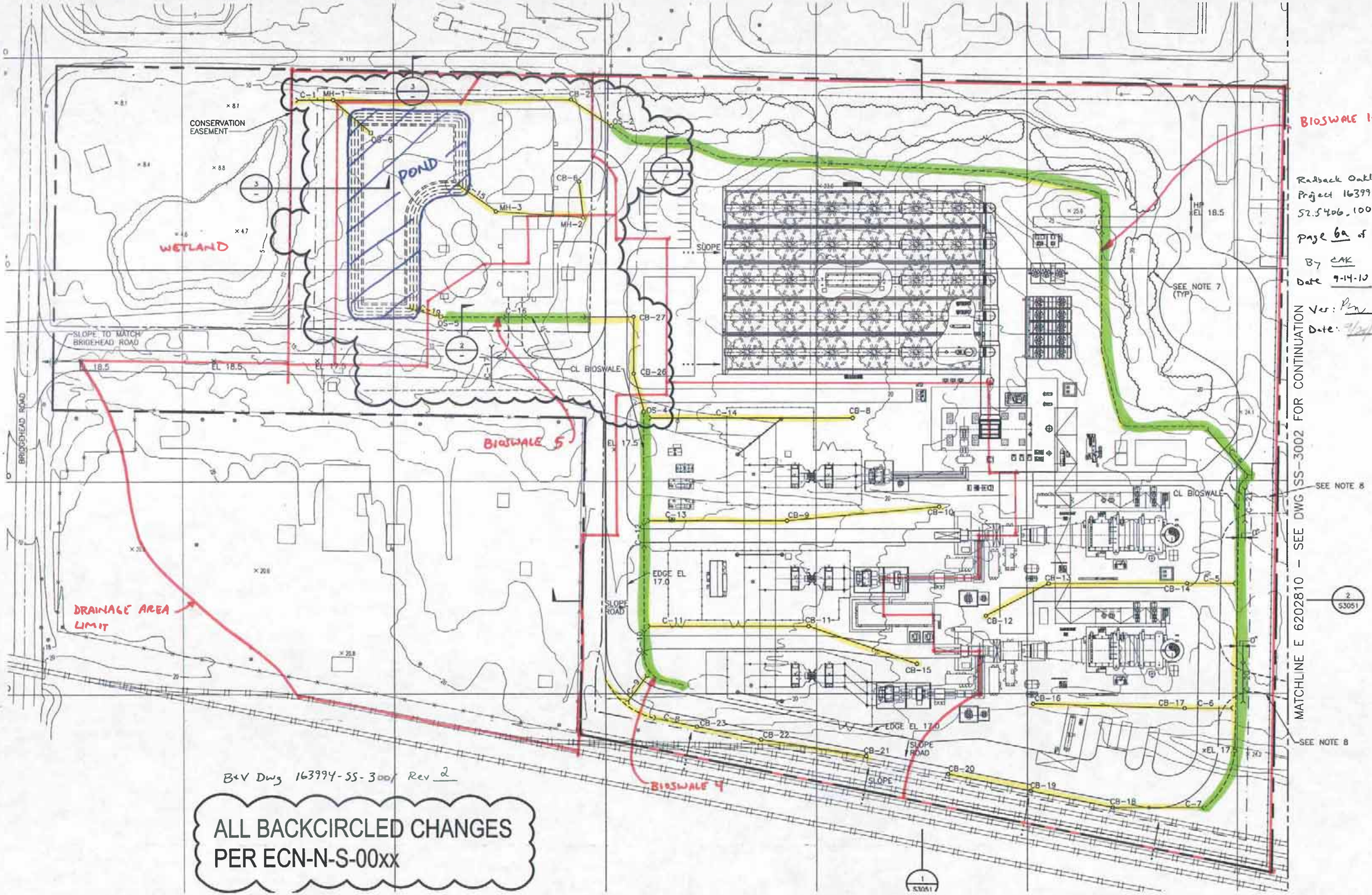
Redbank Oakley Project # 163994 Stormwater Analysis

File 52.5946.1007

page 6 of 31

By CK
Date 6/17/10
Ver: pnv
Date: 6/18/10

Bdc Dwg 163994-SS-3001 Rev 1



ALL BACKCIRCLED CHANGES PER ECN-N-S-00xx

Section 1.0 – Determine the Time of Concentration (Tc) and Lag Time

For the pre-construction condition, the time of concentration of 0.54 hours (32.4 minutes) and lag time of 19.4 minutes were determined in Reference 9 – see Attachment 6.

For the post-construction condition, the peak flow from the plant area to the wetland will be most impacted by the peak runoff from the area draining through Bioswale 5. This is due to the proximity of Bioswale 5 to the wetland and the runoff conditions from Bioswale 5 being similar to the remainder of the plant. Bioswales 1+2 and 4 are routed through the detention pond (which significantly reduces the peak flows through the outlet control structure) while the drainage area for Bioswale 3 is relatively small and therefore contributes little flow.

Therefore the Tc and Lag Time for the area draining to Bioswale 5 will be determined and applied to the model for all bioswale area drainage (Bioswales 1-5). Using the same Lag Time for each bioswale area within the model will result in a conservative peak flow determination from the plant area, since all areas into the bioswales are modeled to peak concurrently.

Bioswale 5 (Post-Construction condition)
Time of concentration (T_c) can be calculated as:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$ (Ref. 4, Eq. 6-11)

Where:

T_{sheet} = travel time in sheet flow to drainage basin;
$T_{shallow}$ = travel time in shallow concentrated flow;
$T_{channel}$ = travel time in open channels.

The flow path from the hydraulically most distant point of this drainage area to the outlet structure for Bioswale 5 is identified as shown on Page 8. The total flow length is measured to be approximately 900 feet (using AutoCAD).

(1) Sheet Flow
Sheet flow travel time can be calculated as:

$$T_{sheet} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}}$$ (Ref. 2, Eq. 3-3)

Where:

n = roughness coefficient;
L = flow length (ft);
P_2 = 2-year, 24-hour rainfall (in);
s = land slope (ft/ft).

BIOSWALE #3

VOID 9-14-10
Supersedes
see PS 8a
CAK

POND

BIOSWALE #1

BIOSWALE #5

TC FLOW PATH

DRAINAGE AREA FOR EA. BIOSWALE (TYP)

BIOSWALE #4

ALL BACKCIRCLED CHANGES
PER ECN-N-S-00XX

OPEN
05/27/10

Radback Oakley
Project # 163994
Stormwater Analysis
File 52.5406.1007
Page 8 of 31
By: C. Kantola
6/17/10
Ver: PLN
Date: 8/18/10

MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION

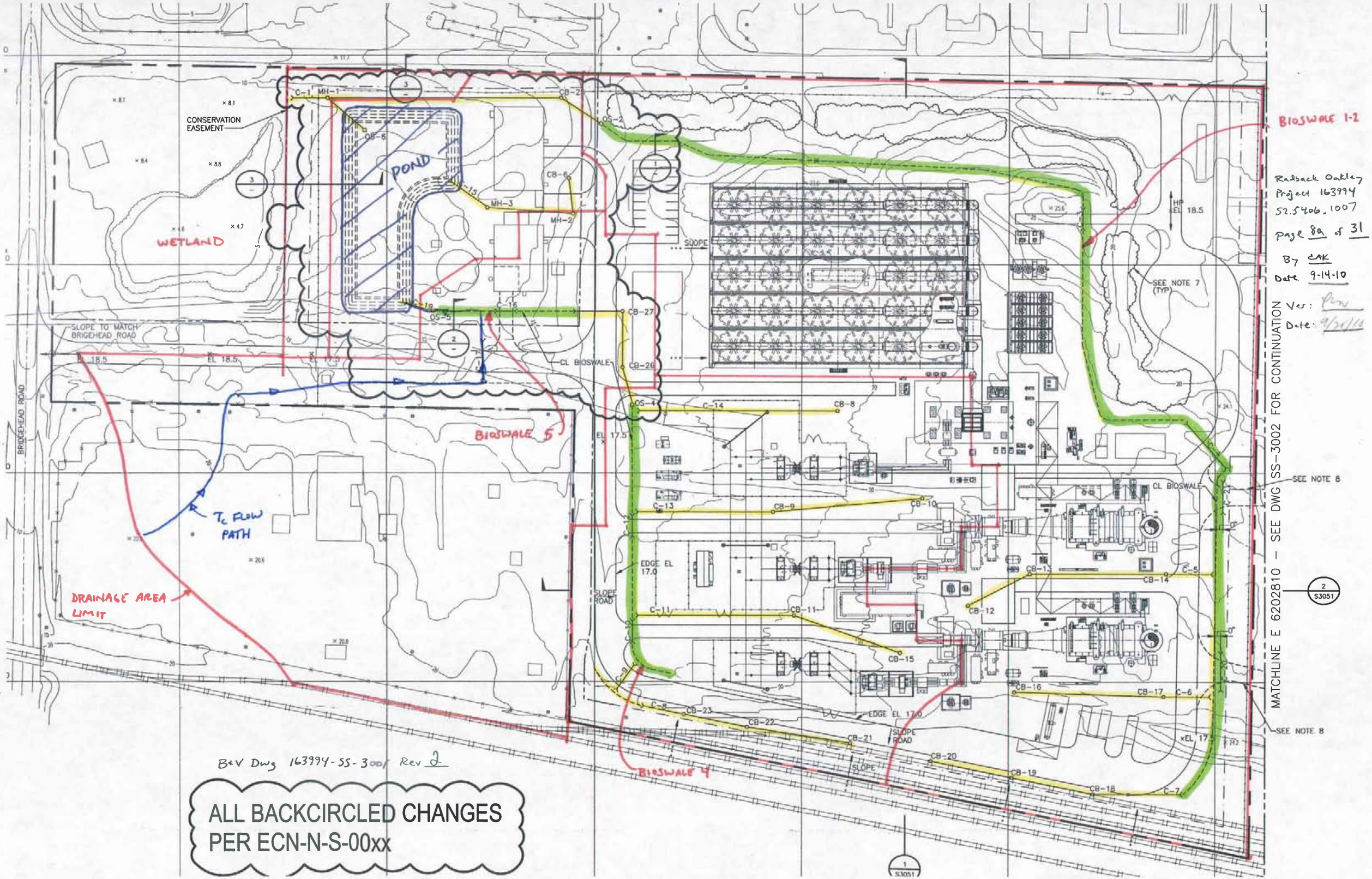
ABBRE

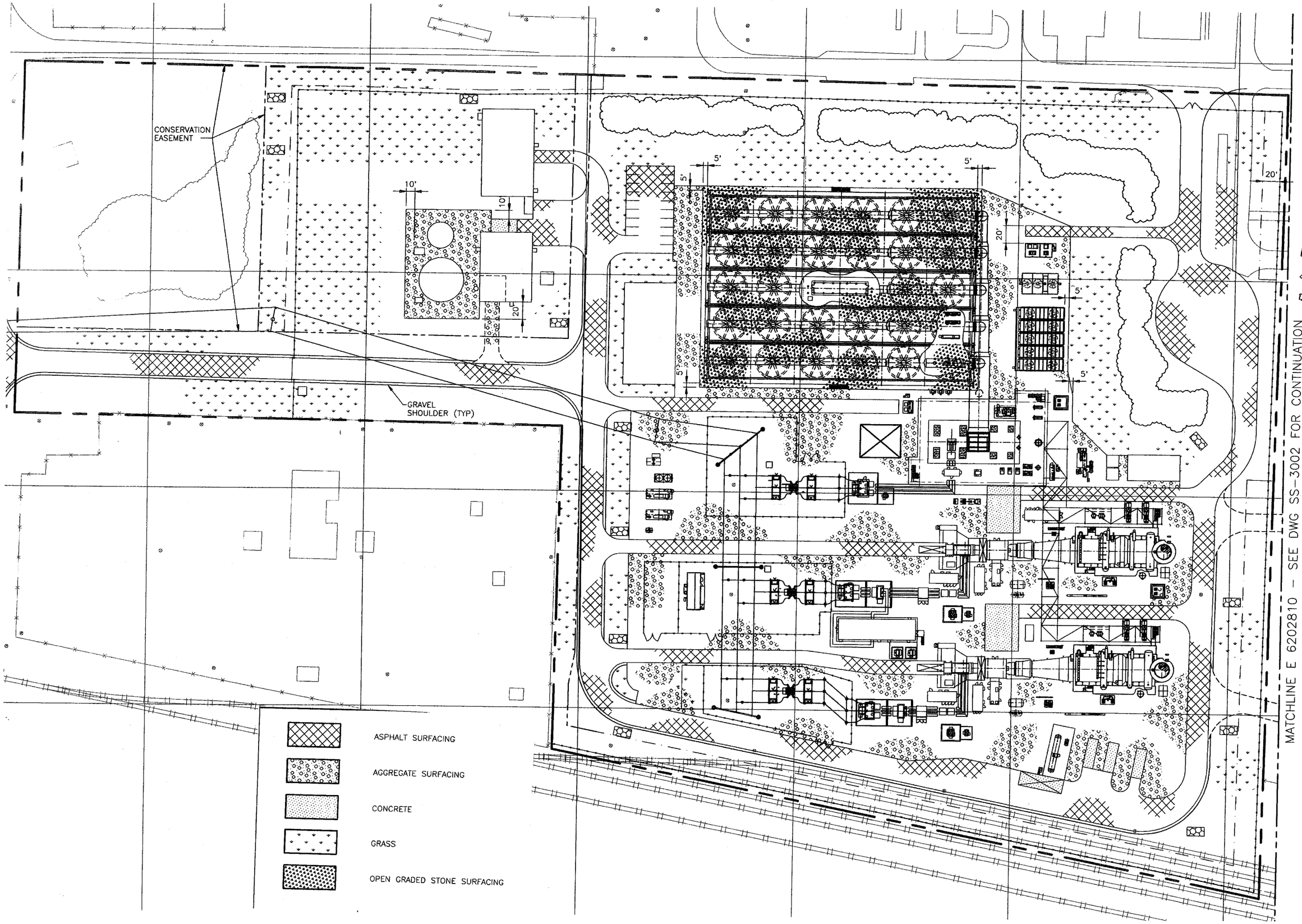
APPROX
ASPH
AVG
BND
BLDG
B/MH
BOC
BOD
BOP
BU
C
CB
CD
CHDPE

CL
CLR
CMH
CND
CONC
CO
CS
CW
DB
DBC
DET
DIA
DIP
DWG
DWP
EC
ECC
EF
EHH
EL
EMH
EW
FC
FDN
FF
FRP
GR
HDM
HDPE
HP
HYD
ID
INV
JBX
L
LP

N

1. COORDINATE NGVD 29 D THE FLAGPO DATUM ELEV PHOTOGRAPH ASSOCIATES.
2. NEW GRADE INDICATE FI
3. ALL CUT AN NOTED OTH
4. SEE DWG S AND OUTLET
5. TOP OF CO EL 18.0. FI
6. CL OF ALL
7. TREES TO F
8. TEMPORARY CONSTRUCTI


CONSERVATION EASEMENT
WETLAND
POND
BIOSWALE 1-2
BIOSWALE 5
BIOSWALE 4
SLOPE TO MATCH BRIGEHEAD ROAD
BRIDGEHEAD ROAD
T_c FLOW PATH
DRAINAGE AREA LIMIT
CL BIOSWALE
SLOPE
SLOPE ROAD
EDGE EL 17.0
SEE NOTE 7 (TYP)
SEE NOTE 8
MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION
Radback Oakley
Project 163994
52.5406.1007
Page 8a of 31
By CAK
Date 9-14-10
Ver: Rev
Date: 9/21/10
B&V Dwg 163994-SS-3001 Rev 2
ALL BACKCIRCLED CHANGES
PER ECN-N-S-00xx



Radbaele Oakley
Project 163994
52.5406.

BY: C. Kantola
Date: 9-14-10
Chk: Pl
Date: 9/20/10

Note: This page is a portion of B&V Drawing 163994-SS-3201 REV. 0

Roughness coefficient n = 0.011 for "smooth surfaces (gravel)". (Ref. 2, Table 3-1)

Per Ref. 2, "After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow". Therefore sheet flow length will be limited to a maximum of 300 feet. BV Drawing SS-3001 and AutoCAD data show that the ground slope for sheet flow can be separated into two sections, each approximately 120 feet long. L = 120 ft.

2-year, 24-hour rainfall P_2 = 1.6 inch for this site per Ref. 5 (see Page 10).

The land slope for the first sheet flow section is from EL 20.80 to the 20.0 contour. This slope is (20.8-20.0)/120 = 0.0067 ft/ft

Thus, $T_{sheet} = \dfrac{0.007 \times (0.011 \times 120)^{0.8}}{1.6^{0.5} \times 0.0067^{0.4}}$ = 0.051 hour = 3.1 minutes for sheet flow 1.

The land slope for the second sheet flow section is from EL 20.0 to EL 17.7 at the edge of the access road (data from AutoCAD). This slope is (20.0-17.7)/120 = 0.0192 ft/ft

Thus, $T_{sheet} = \dfrac{0.007 \times (0.011 \times 120)^{0.8}}{1.6^{0.5} \times 0.0192^{0.4}}$ = 0.034 hour = 2.0 minutes for sheet flow 2.

The sum of sheet flow travel times is: T_{sheet} = 3.1 min + 2.0 min = <u>5.1 minutes</u>

(2) Shallow Concentrated Flow
From AutoCAD, the flow length for shallow concentrated flow is measured as L = 365 feet from EL 17.7 to the top of bioswale 5 at EL 14.5.

The average watercourse slope = (17.7-14.5) / 365 = 0.0088 ft/ft.

Based on a slope of 0.0088 ft/ft, from Ref. 2, Figure 3-1, the average velocity (V) for "unpaved" surface is found to be: V = 1.5 ft/sec.

Thus the travel time for shallow concentrated flow is calculated to be:

$$T_{shallow} = \frac{L}{3600 \times V} = \frac{365}{3600 \times 1.5} = 0.07 \text{ hour} = \underline{4.2 \text{ minutes}}.$$

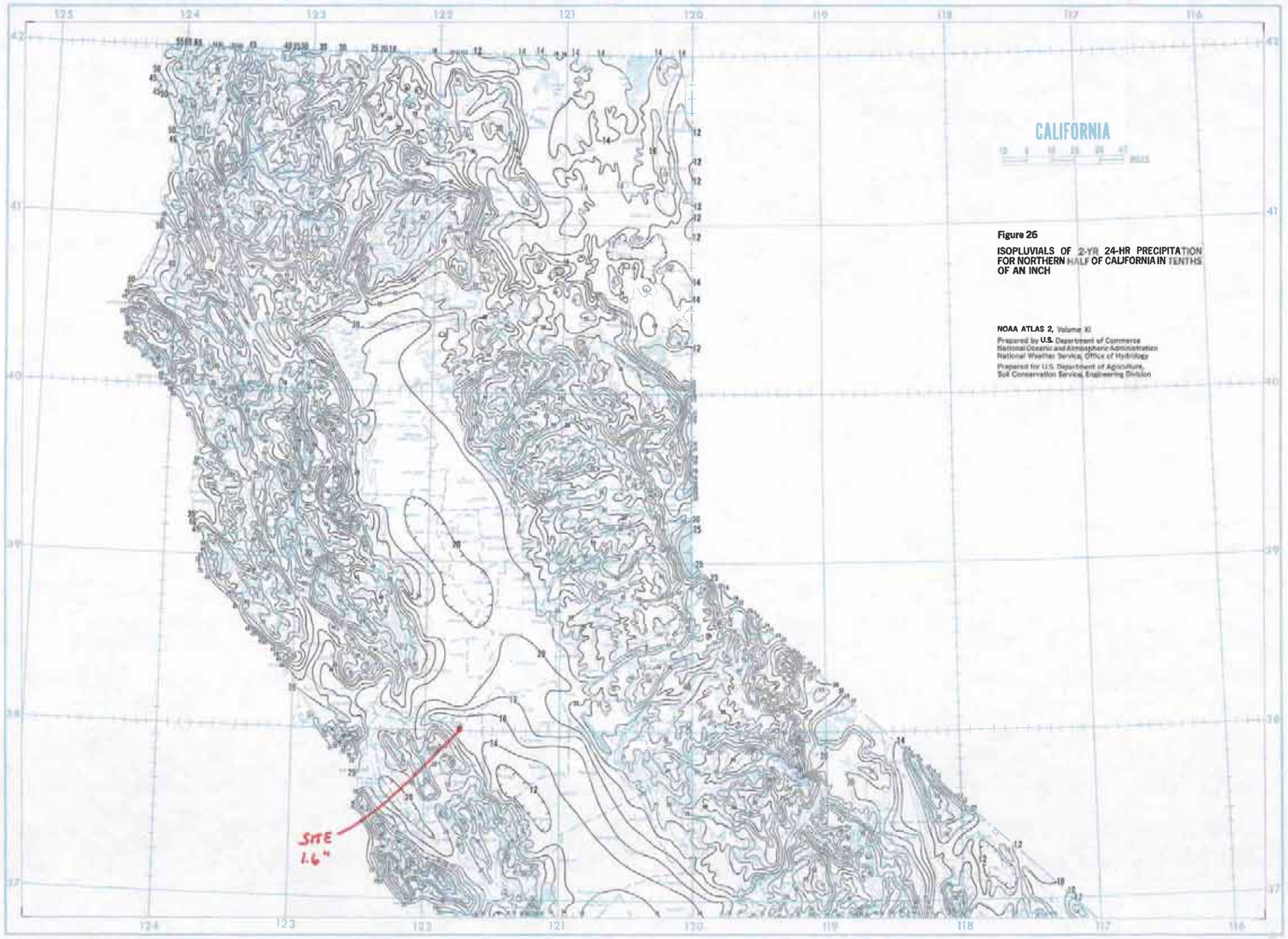


Figure 26

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

~~Rev 2~~ Radback ~~Fonsta~~ Oakley Project
Stormwater Analysis

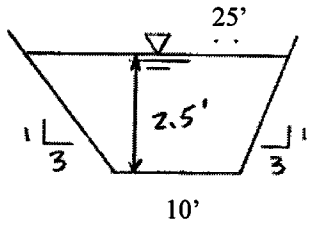
Project # 163994
page ~~X~~ ~~of 35~~ 10 of 31
52.5406 . ~~005~~
.1007

Note:
This page is from Ref. ~~X~~ 5

CK 6/17/10
Ver: PLN
Date: 6/18/10

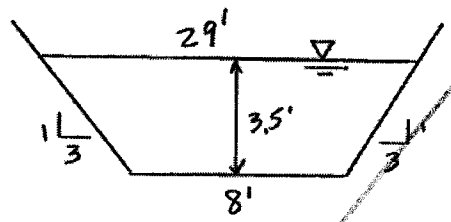
(3) Open Channel Flow

Calculate open channel flow within the bioswales. There are two differing bioswale cross-sections in Bioswale 5 and Individual travel times for each section are calculated below. From Reference 8, the bioswale cross-sections are shown below:



Section 2

DWG SS-3001



Section 2A

DWG SS-3001

Travel time for each portion of open channel flow is calculated by

T_t (hours) = $\frac{L}{3600 \times V}$ where L = length of flow path (feet) and V = flow velocity (ft/sec)

Length of flow path is measured from the site grading plan (Refer to Page 8)

For open channel flow, V is based on Manning's equation where V = $\frac{1.49}{n} \times R^{2/3} \times \sqrt{s}$

R is the hydraulic radius, defined as R = $\frac{Area}{WettedPerimeter}$

For Bioswale 5 / Section 2 (a trapezoidal channel):

Area, A (trapezoidal channel) = (10 ft + 25 ft)/2 x 2.5 ft = 43.75 sf

Wetted Perimeter, P (trapezoidal channel) = 10 ft + 2 x $\sqrt{(2.5^2 + (2.5 \times 3)^2)}$ = 25.8 ft

Hydraulic Radius, R = A / P = 43.75 sf / 25.8 ft = 1.7 ft

The bioswale can be described as an earthen channel, straight & uniform with short grass and few weeds. This corresponds to a Manning's 'n' = 0.027 (Refer to Reference 7).

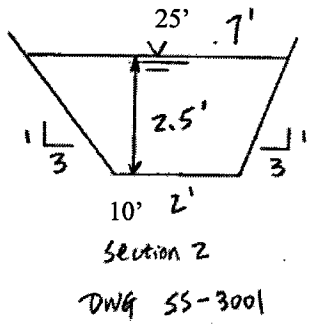
The swale from C16 to the point the swale turns north has a length L = 175 ft and grade from EL 12.0 to 11.5, the slope is calculated as (12.0 – 11.5) / 175 = 0.0029 ft/ft

The resulting full-flow velocity in the swale is V = $\frac{1.49}{0.027} \times 1.7^{2/3} \times \sqrt{0.0029}$ = 4.2 ft/s

Superseded 9/14/10
See Pg 11A

(3) Open Channel Flow

Calculate open channel flow within the bioswales. The cross-section and travel time for Bioswale 5 are calculated below. From Reference 8, the bioswale cross-section is shown below:



Travel time for the portion of open channel flow is calculated by

T_t (hours) = $\frac{L}{3600 \times V}$ where L = length of flow path (feet) and V = flow velocity (ft/sec)

Length of flow path is measured from the site grading plan (Refer to Page 8)

For open channel flow, V is based on Manning's equation where V = $\frac{1.49}{n} \times R^{2/3} \times \sqrt{s}$

R is the hydraulic radius, defined as R = $\frac{Area}{WettedPerimeter}$

For Bioswale 5 / Section 2 (a trapezoidal channel):

Area, A (trapezoidal channel) = (10 ft + 25 ft)/2 x 2.5 ft = 43.75 sf

Wetted Perimeter, P (trapezoidal channel) = 10 ft + 2 x $\sqrt{\left(2.5^2 + (2.5 \times 3)^2\right)}$ = 25.8 ft

Hydraulic Radius, R = A / P = 43.75 sf / 25.8 ft = 1.7 ft

The bioswale can be described as an earthen channel, straight & uniform with short grass and few weeds. This corresponds to a Manning's 'n' = 0.027 (Refer to Reference 7).

The swale from C16 to the basin has a length L = 75 ft and grade from EL 12.0 to 11.8, the slope is calculated as (12.0 – 11.8) / 75 = 0.0027 ft/ft

The resulting full-flow velocity in the swale is V = $\frac{1.49}{0.027} \times 1.7^{2/3} \times \sqrt{0.0027}$ = 4.1 ft/s

Thus the travel time for open channel flow in this swale section is calculated to be:

$$T_{open} = \frac{L}{3600 \times V} = \frac{175}{3600 \times 4.2} = 0.011 \text{ hour} = 0.7 \text{ minutes}$$

For Bioswale 5 / Section 2a (a trapezoidal channel):

Area, A (trapezoidal channel) = (8 ft + 29 ft)/2 x 3.5 ft = 64.75 sf

Wetted Perimeter, P (trapezoidal channel) = 8 ft + 2 x $\sqrt{\left(3.5^2 + (3.5 \times 3)^2\right)}$ = 30.1 ft

Hydraulic Radius, R = A / P = 64.75 sf / 30.1 ft = 2.15 ft

Manning's 'n' = 0.027 as noted above.

The swale from the point the swale turns north to OS-5 a length L = 120 ft and grade from EL 11.5 to 11.0, the slope is calculated as (11.5 – 11.0) / 120 = 0.0042 ft/ft

The resulting full-flow velocity in the swale is V = $\frac{1.49}{0.027} \times 2.15^{2/3} \times \sqrt{0.0042}$ = 6.0 ft/s

Thus the travel time for open channel flow in this swale section is calculated to be:

$$T_{open} = \frac{L}{3600 \times V} = \frac{120}{3600 \times 6.0} = 0.006 \text{ hour} = 0.4 \text{ minutes}$$

The sum of open channel flow travel times is: T_{open} = 0.4 min + 0.7 min = <u>1.1 minutes</u>

In summary, the time of concentration is calculated to be:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$ = 5.1 min + 4.2 min + 1.1 min = <u>10.4 minutes</u>.

Per Ref. 4, "For ungaged watersheds, the SCS suggests that the UH (unit hydrograph) lag time may be related to the time of concentration, T_c, as: $T_{lag} = 0.6\ T_c$". See Page 13.
The SCS UH lag time (T_{lag}) is an input parameter into the HEC-HMS computer program.
Thus T_{lag} = 0.6 x 10.4 = 6.2 minutes; (use 6 minutes in model for Bioswale areas).

The areas draining directly to the pond and wetland areas have significantly different runoff characteristics than the main plant, therefore a different Lag Time is used in the model. Since the drainage areas are small, the times of concentration will be very short. Per Reference 10, use a minimum starting Tc in drainage basin of 0.1 hr.

Thus model input for the direct runoff to the pond and wetland areas can be determined:

Tc = 0.1 hr = 6 minutes and T_{lag} = 0.6 x 6 = 3.6 minutes

Superseded 9/14/10
See Pg 12A

Thus the travel time for open channel flow in this swale section is calculated to be:

$$T_{open} = \frac{L}{3600 \times V} = \frac{75}{3600 \times 4.1} = 0.005 \text{ hour} = 0.3 \text{ minutes}$$

In summary, the time of concentration is calculated to be:

$T_c = T_{sheet} + T_{shallow} + T_{channel}$ = 5.1 min + 4.2 min + 0.3 min= 9.6 minutes.

Per Ref. 4, "For ungaged watersheds, the SCS suggests that the UH (unit hydrograph) lag time may be related to the time of concentration, T_c, as: $T_{lag} = 0.6\ T_c$". See Page 13.
The SCS UH lag time (T_{lag}) is an input parameter into the HEC-HMS computer program.
Thus T_{lag} = 0.6 x 9.6 = 5.8 minutes; (use 6 minutes in model for Bioswale areas).

The areas draining directly to the pond and wetland areas have significantly different runoff characteristics than the main plant, therefore a different Lag Time is used in the model. Since the drainage areas are small, the times of concentration will be very short. Per Reference 10, use a minimum starting Tc in drainage basin of 0.1 hr.

Thus model input for the direct runoff to the pond and wetland areas can be determined:

Tc = 0.1 hr = 6 minutes and T_{lag} = 0.6 x 6 = 3.6 minutes

Radback Tenaska project project # 163394 Stormwater Analysis 13 of 31
52.5406.~~1003~~ .1007 page ~~7~~ of ~~53~~

UH can be found from the dimensionless form, which is included in HEC-HMS, by multiplication.

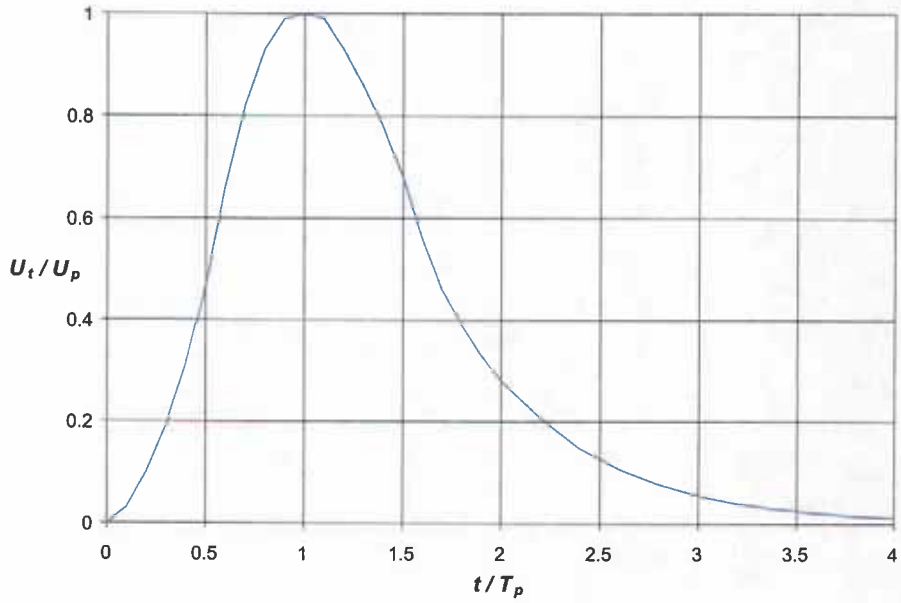


Figure 6-2. SCS unit hydrograph

Estimating the SCS UH Model Parameters

The SCS UH lag can be estimated via calibration, using procedures described in Chapter 9, for gaged headwater subwatersheds.

For ungaged watersheds, the SCS suggests that the UH lag time may be related to time of concentration, t_c, as:

$$t_{lag} = 0.6\, t_c \qquad (6\text{-}10)$$

Time of concentration is a quasi-physically based parameter that can be estimated as

$$t_c = t_{sheet} + t_{shallow} + t_{channel} \qquad (6\text{-}11)$$

where t_{sheet} = sum of travel time in sheet flow segments over the watershed land surface; $t_{shallow}$ = sum of travel time in shallow flow segments, down streets, in gutters, or in shallow rills and rivulets; and $t_{channel}$ = sum of travel time in channel segments.

NOTE: THIS PAGE IS FROM REF. 4.

Identify open channels where cross section information is available. Obtain cross sections from field surveys, maps, or aerial photographs. For these channels, estimate velocity by Manning's equation:

$$V = \frac{CR^{2/3}S^{1/2}}{n} \qquad (6\text{-}12)$$

where V = average velocity; R = the hydraulic radius (defined as the ratio of channel cross-section area to wetted perimeter); S = slope of the energy grade

Section 2.0 – Rainfall Distribution

From Ref. 2, Figure B-2, the rainfall distribution for the site in Contra Costa County, California should be Type I distribution.

From Ref. 14, the 24-hour rainfall amounts for the site are: (See Pages 15 & 16)

Storm Event	100-year	10-year	Small event*
Rainfall	3.9 in.	2.6 in.	1.0 in.

* A smaller "typical" rain event of 0.75-1.0 inch was requested to be modeled by CEC

Section 3.0 – Determine Composite SCS Curve Number, Initial Abstraction & Impervious %

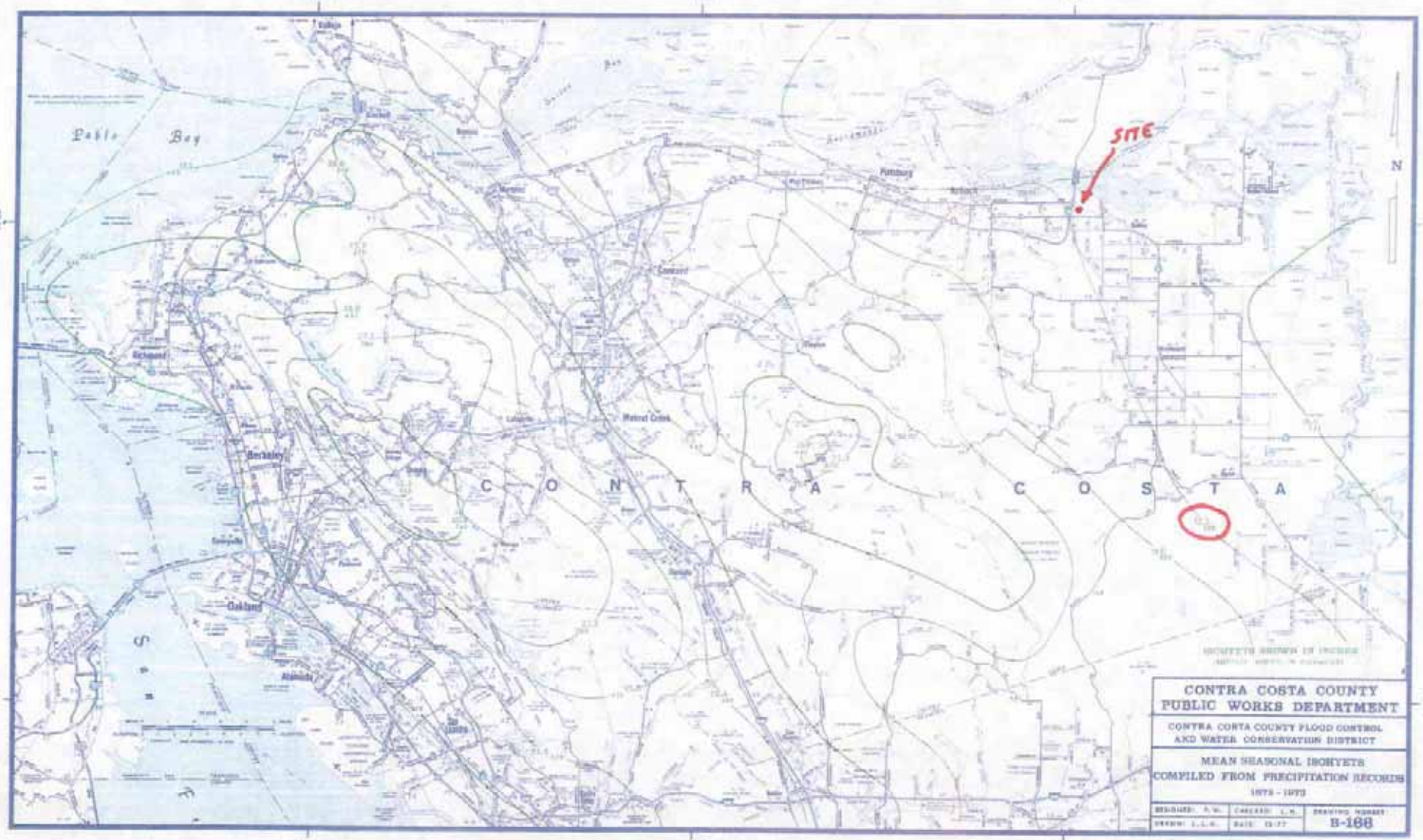
"SCS Curve Number" method was used in the HEC-HMS computer program to calculate the loss rate for the drainage area. The SCS Curve Number (CN), Initial Abstraction (Ia) and Impervious % for the pre-construction site were determined in Reference 9 – see attachment 5.

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". See Attachment 4. Per Ref. 2, this type of soil can be classified as Hydrologic Soil Group A soil.

The proposed site drainage areas as determined earlier are summarized below, with individual CN values assigned to each type of ground cover (for Group A soils). CN values are based on Reference 2, Tables 2-2a and 2-2b.

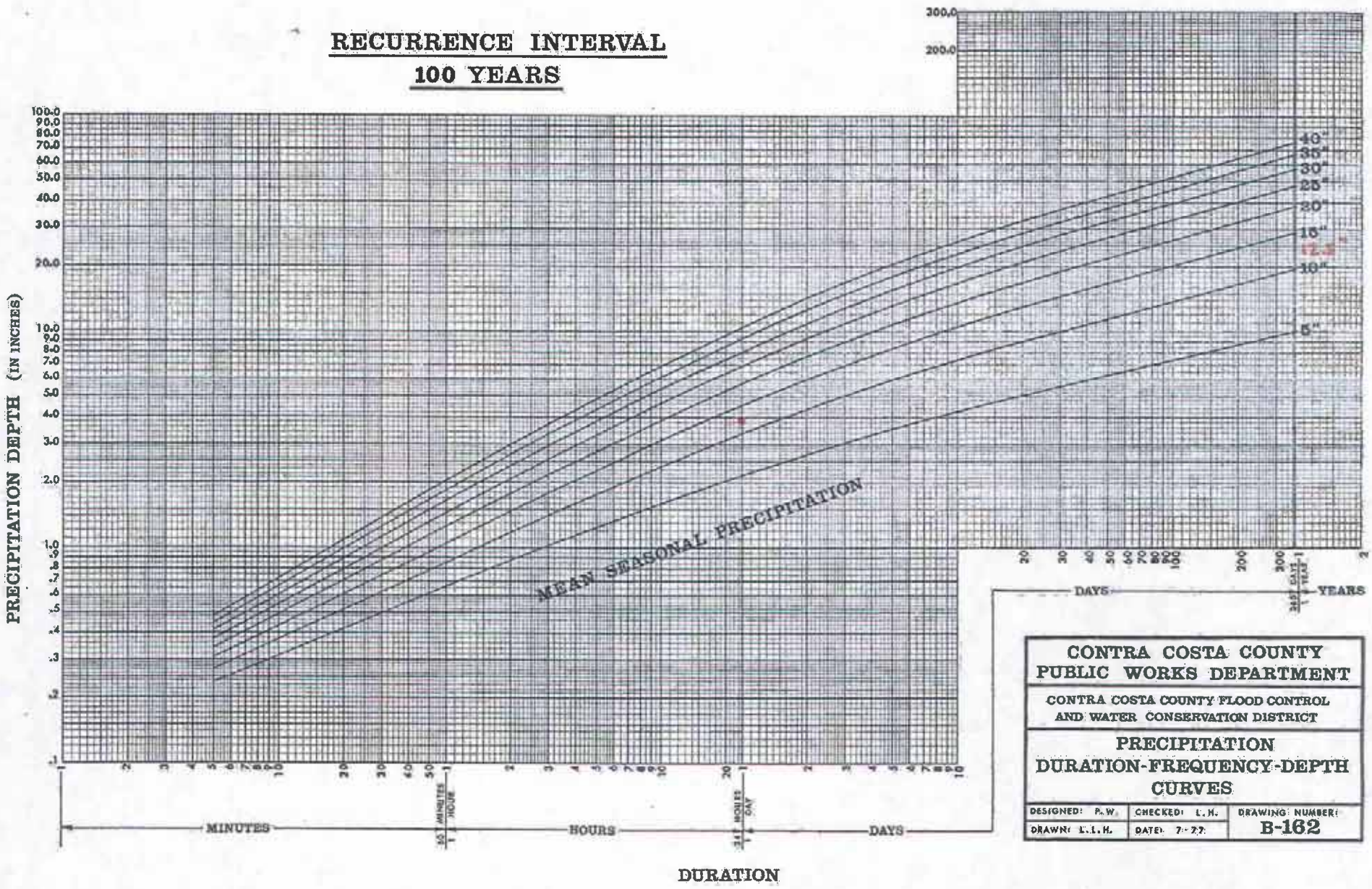
For the pre-construction condition, the SCS Curve Number (CN = 70), Initial Abstraction (Ia = 0.857) and Impervious (% = ~~1~~) were determined in Reference 9 – see Attachment 6.

2.6%
Rev 1 9/14/10 CAK



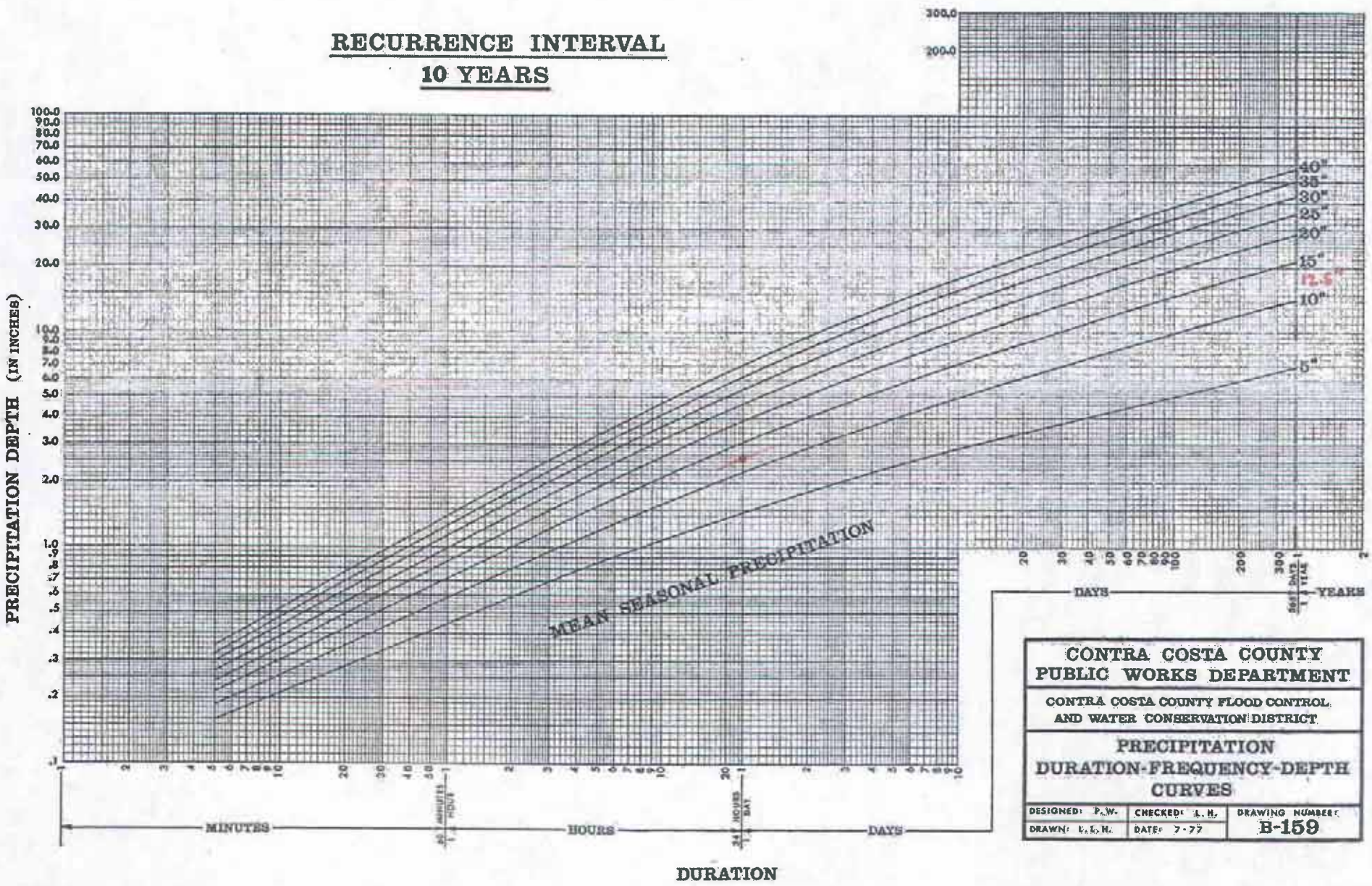
Radback Oakley Project #163994 (FROM REF. 14)
52.5406.1007 Page 15 of 31 ✓ Pm 6/18/10

MSP = 12.5"



MSP = 12.5" (DWG B-166)

24-HR = 3.9" (ABOVE)



RADBACK OAKLEY PROJECT #163994

52.5406.1007 Page 16 of 31

(FROM REF. 14) ✓ Pm 6/14/10

MSP = 12.5" (DWG B-166)

24-HR = 2.6" (ABOVE)

Bioswale 1+2 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	2.30 ac.	174.8
Lawn (Poor Coverage <50%)	68	4.55 ac.	309.4
Impervious Surface	98	2.75 ac.	269.5
Open Graded Aggregate	68	1.57 ac.	106.76
Total		11.17 ac.	860.46
Composite CN = 860.46 / 11.17 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/77 - 10)$ = 0.597 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Superseded 9/14/10
See Pg 17A

Bioswale 1+2 (Post-Construction): Curve Number (CN) and Impervious Area

HMS Subbasin: _*1+2 CN* Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.30 ac.	174.8
Lawn (Poor Coverage <50%)	68	4.55 ac.	309.4
Impervious Surface not directly connected (75% x 2.75 ac. Total)	98	2.06 ac.	202.1
Open Graded Aggregate	68	1.57 ac.	106.76
Total		10.48 ac.	793.1
Composite CN = 793.1 / 10.48 = 76			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/76 - 10)$ = <u>0.632 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing to Bioswale 1+2 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_1+2 Imp**".

2.75 acres impervious x 0.25 directly connected = 0.69 ac = 0.0011 sq. mi.

Impervious % = 100%

Bioswale 3 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Lawn (Poor Coverage <50%)	68	0.45 ac.	30.6
Impervious Surface	98	0.14 ac.	13.7
Total		0.59 ac.	44.3
Composite CN = 44.3 / 0.59 = 75			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

VOID

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/75 - 10)$ = 0.667 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Removed ~~Superseded~~ 9/14/10

Bioswale 4 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	2.51 ac.	190.8
Lawn (Poor Coverage <50%)	68	0.54 ac.	36.7
Impervious Surface	98	1.21 ac.	118.6
Total		4.26 ac.	346.1
Composite CN = 346.1 / 4.26 = 81			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/81 - 10)$ = 0.469 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Superseded 9/14/10
See pg 19A

Bioswale 4 (Post-Construction): Curve Number (CN) and Impervious Area)

HMS Subbasin: _4 CN Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.51 ac.	190.8
Lawn (Poor Coverage <50%)	68	0.54 ac.	36.7
Impervious Surface not directly connected (75% x 1.21 ac. Total)	98	0.91 ac.	88.9
Total		3.96 ac.	316.4
Composite CN = 316.4 / 3.96 = 80			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/80 - 10)$ = 0.500 inch.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing to Bioswale 4 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_4 Imp**".

1.21 acres impervious x 0.25 directly connected = 0.30 ac = 0.0005 sq. mi.

Impervious % = 100%

Bioswale 5 (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Gravel	76	3.35 ac.	254.6
Railroad Yard (similar to gravel)	76	0.94 ac.	71.4
Lawn (Poor Coverage <50%)	68	1.50 ac.	102
Impervious Surface	98	0.88 ac.	86.2
Total		6.67 ac.	514.2
Composite CN = 514.2 / 6.67 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000 / 77 - 10)$ = 0.597 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Superseded 9/14/10
See pg 20A

Bioswale 5 (Post-Construction): Curve Number (CN) and Impervious Area)

HMS Subbasin: _5 *CN* Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Gravel	76	2.87 ac.	218.1
Railroad Yard (similar to gravel)	76	0.94 ac.	71.4
Lawn (Poor Coverage <50%)	68	0.95 ac.	64.6
Impervious Surface not directly connected (50% x 1.32 ac. Total)	98	0.66 ac.	64.7
Total		5.42 ac.	418.8
Composite CN = 418.8 / 5.42 = 77			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/77 - 10)$ = <u>0.597 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 50% of the impervious areas contributing to Bioswale 5 are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_5 Imp**".

1.32 acres impervious x 0.50 directly connected = 0.66 ac = 0.0010 sq. mi.

Impervious % = 100%

Direct to Pond (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Lawn (Poor Coverage <50%)	68	0.85 ac.	57.8
Impervious Surface	98	0.13 ac.	12.74
Total		0.98 ac.	70.54
Composite CN = 514.2 / 6.67 = 72			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/72 - 10)$ = 0.778 inch.

The "SCS Curve Number" method also requires the input of "% impervious" in the computer program. Reference 3 states that "the composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area". As computed above, the impervious areas are factored into the CN for the drainage area and therefore the value for Impervious % would not include those areas. An allocation of 1% impervious area is input into the model to allow for a small increase in impervious areas during final design.

Superseded 9/14/10
See pg 21A

Direct to Pond (Post-Construction): Curve Number (CN) and Impervious Area)

HMS Subbasin: _*Pond CN* Ground Cover Type	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Lawn (Poor Coverage <50%)	68	1.28 ac.	87.0
Gravel	76	0.1 ac.	7.6
Impervious Surface not directly connected (75% x 0.30 ac. Total)	98	0.23 ac.	22.5
Total		1.61 ac.	116.7
Composite CN = 116.7 / 1.61 = 73			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/73 - 10)$ = <u>0.740 inch</u>.

Impervious % = 0 (all directly connected impervious modeled separately, see below)

A separate subbasin was created to model the area of impervious surface that could be considered directly connected to the storm drainage system. Upon review of the surfacing plan for the site, it is estimated that 25% of the impervious areas contributing directly to the Pond are located sufficiently close to storm catch basins and swales to be considered directly connected. This area is modeled as subbasin "**_Pond Imp**".

0.30 acres impervious x 0.25 directly connected = 0.08 ac = 0.0001 sq. mi.

Impervious % = 100%

Direct to Wetland (Post-Construction)

Ground Cover Type	SCS CN (Group A Soil)	Proposed Site Acreage, A	CN x A
Wetland	98	0.4 ac.	39.2
Impervious Surface	98	0.27 ac.	26.5
Vineyard / Undisturbed Area	68	1.93 ac.	131.2
Total		2.6 ac.	196.9
Composite CN = 196.9 / 2.6 = 76			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on a composite CN of 77, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/76 - 10)$ = 0.632 inch.

Impervious % = 1% (Consistent with other drainage areas)

A summary of the pre- and post-construction basin parameter values determined above and input into the HEC-HMS model are included in the table below:

Condition	Area (sq. mi.)	Composite CN	Initial Abstraction (in)	Impervious %	Lag Time (min)
Pre-Construction					
Entire Site	0.0393	70	0.857	1	19.4
Post-Construction					
Bioswale 1-2	0.0175	77	0.597	1	6.0
Bioswale 3	0.0009	75	0.667	1	6.0
Bioswale 4	0.0067	81	0.469	1	6.0
Bioswale 5	0.0104	77	0.597	1	6.0
Direct to Pond	0.0015	72	0.778	1	3.6
Direct to Wetland	0.0041	76	0.632	1	3.6

Direct to Wetland (Post-Construction): Curve Number (CN) and Impervious Area)

HMS Subbasin: _*Wetland CN* **Ground Cover Type**	**SCS CN (Group A Soil)**	**Proposed Site Acreage, A**	**CN x A**
Wetland	98	0.4 ac.	39.2
Impervious Surface	98	0.28 ac.	27.4
Vineyard / Undisturbed Area	68	1.93 ac.	131.2
Lawn (Poor Coverage <50%)	68	0.47 ac.	32.0
Total		3.08 ac.	229.8
Composite CN = 229.8 / 3.08 = 75			

The "SCS Curve Number" method also requires the input of initial abstraction (initial loss) in the computer program. The initial abstraction accounts for all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration (Ref. 2).

The initial abstraction (I_a) can be estimated to be:

$I_a = 0.2\ S$ (Ref. 2, Eq. 2-2) Where: $S = \frac{1000}{CN} - 10$ (Ref. 2, Eq. 2-4)

Based on the composite CN, the initial abstraction is calculated to be:

$I_a = 0.2 \times (1000/75 - 10)$ = 0.667 inch.

Impervious % = 0 (all impervious area not directly connected, factored in CN above)

Summary table for pre- and post-construction basin parameter values (HEC-HMS input):

Condition	**Area (sq. mi.)**	**Composite CN**	**Ia (in)**	**Imperv %**	**Lag Time (min)**
Pre: Entire Site	0.0393	70	0.857	2.6	19.4
Post: Bioswale 1+2 CN	0.0164	76	0.632	0	6.0
Post: Bioswale 1+2 Imp	0.0011	98	0.041	100	6.0
Post: Bioswale 4 CN	0.0062	80	0.500	0	6.0
Post: Bioswale 4 Imp	0.0005	98	0.041	100	6.0
Post: Bioswale 5 CN	0.0085	77	0.597	0	6.0
Post: Bioswale 5 Imp	0.0010	98	0.041	100	6.0
Post: Direct to Pond CN	0.0025	73	0.740	0	3.6
Post: Direct to Pond Imp	0.0001	98	0.041	100	3.6
Post: Direct to Wetland	0.0048	75	0.667	0	3.6

Section 4.0 – Elevation versus Area and Outflow Rate

The proposed pond and each bioswale provide volumetric storage for runoff and also ~~has~~ have an outlet control structure to limit flows entering the wetland area. The relationship of Elevation versus Area and Elevation versus Discharge Flow Rate are used within the HEC-HMS model to accurately determine flow rates within the system. For the bioswales, areal measurements are based on the length of swale multiplied by the width of the swale. The swale width at each elevation is based on the bottom width plus the width with 3H:1V side slopes for each depth (each 1-foot of depth increases the width by 6 feet (3 feet on each side)).

For example, Bioswale 1-2 is 1,323 feet long, 2 foot wide at EL 12.5 and 3H:1V slopes.

Area at EL 12.5 = 1,323 ft x 2 ft = 2646 sf (0.06 ac)

Area at EL 13.0 = 1,323 ft x [2 ft + (3 H:V x 0.5' depth x 2 (slope on both sides)]
= 1,323 x 5 ft wide = 6,615 sf (0.15 ac)

Using the above method, Elevation vs Area tables are determined and included for each Bioswale in the following pages. Each table includes the elevation and area up to one foot above the rim of the control structure. This is to consider the effects of flow into the structure when water levels exceed the rim elevation.

For purposes of determining elevation versus discharge rate, the rim of the outlet structure is modeled as a weir. Using the weir equation $Q = C \times L \times H^{3/2}$ the flow rate at each elevation can be determined by considering the head (H) above the weir (rim elevation). The length of the weir is the circumference of the outlet structure which is dependent on the diameter of pipe selected for the standpipe. L = Circumference = π x diameter.

Thus for Bioswale 1-2, the elevation – discharge table can be determined:

Rim EL = 15.5 (per Reference 9)

Discharge at 0.1' intervals can be determined:

At EL 15.6, H = 15.6 – 15.5 = 0.1 ft
L = π x 24" (diameter) * 1 ft / 12 in = 6.28 ft
C = 3.1 (per Reference 12)

Discharge at EL 15.6 $Q = 3.1 \times 6.28 \times 0.1^{3/2} = 0.62$ cfs

Discharge at EL 15.7 $Q = 3.1 \times 6.28 \times 0.2^{3/2} = 1.74$ cfs

Using the above method, Elevation vs Discharge tables are determined and included for each Bioswale in the following pages. Note that any orifices placed within the vertical barrel of the standpipe will allow discharge prior to peaking over the rim elevation. For the purposes of this calculation the peak flow is determined without allowing orifice flow, to be conservative and maximize peak flows in the system.

Superseded 9/14/10 See pg 23A

Section 4.0 – Elevation versus Area and Outflow Rate

The proposed pond and each bioswale provide volumetric storage for runoff and also have an outlet control structure to control flows discharging to the wetland area. The relationship of Elevation vs. Area and Elevation vs. Discharge Rate are used within the HEC-HMS model to accurately model flow rates within the system. For the bioswales, areal measurements are based on the length of swale multiplied by the width of the swale. The swale width at each elevation is based on the bottom width plus the width with 3H:1V side slopes for each depth (each 1-foot of depth increases the width by 6 feet (3' on each side)).

For example, Bioswale 1-2 is 1,323 feet long, 2 foot wide at EL 12.5 and 3H:1V slopes.

Area at EL 12.5 = 1,323 ft x 2 ft = 2646 sf (0.06 ac)

Area at EL 13.0 = 1,323 ft x [2 ft + (3 H:V x 0.5' depth x 2 (slope on both sides)]
= 1,323 x 5 ft wide = 6,615 sf (0.15 ac)

Using the above method, Elevation vs Area tables are determined and included for each Bioswale in the following pages:

For purposes of determining elevation versus discharge rate, orifice flow (low-flow orifices) and weir flow (overflow rim) are modeled. Using the orifice equation $Q = C \times A \times \sqrt{(2\ g\ H)}$ and the weir equation $Q = C \times L \times H^{3/2}$ the flow rate at each elevation can be determined by considering the head (H) above the orifice (low-flow) and weir (rim elevation). The orifice sizing is based on allowing the water quality flow rate generated by a 0.2 in/hr storm intensity to pass with 1 foot of head, to maintain hydration of the wetland area. The length of the weir is the circumference of the outlet structure (L = Circumference = л x diameter).

Thus for Bioswale 1-2, the elevation – discharge table can be determined:

Rim EL = 15.5, Bottom EL = 12.5 (per Reference 9)

Discharge at 0.1' intervals can be determined:

At EL 15.6, Orifice: H = 15.6 – 12.5 = 3.1 ft

Qo = 0.62 x 0.218 (see Pg 24a) x $\sqrt{(2 \times 32.2 \times 3.1')}$ = 1.91 cfs

Weir: H = 15.6 – 15.5 = 0.1 ft

L = л x 24" (diameter) * 1 ft / 12 in = 6.28 ft

C = 3.1 (per Reference 12)

$Qw = 3.1 \times 6.28 \times 0.1^{3/2} = 0.62$ cfs

Discharge at EL 15.6 Q = 1.91 cfs (orifice) + 0.62 cfs (weir) = 2.53 cfs

Discharge at EL 15.7 Q = 1.94 cfs (orifice) + 1.74 cfs (weir) = 3.68 cfs

Elevation vs Discharge tables follow for each outlet control structure (bioswales and pond).

Bioswale 1-2

Bottom Width = 2 ft; Length = 1,323 ft

Using the method for area determination provided on Page 23, the following table summarizes the relationship of elevation versus area of the bioswale for input to HEC-HMS.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
12.5	2	2646	0.06
13.0	5	6615	0.15
14.0	11	14553	0.33
15.0	17	22491	0.51
15.5	20	26460	0.6
16.0	23	30429	0.69
16.5	26	34398	0.78

Standpipe diameter = 24"; Rim Elevation = 15.5 ft

Using the method for weir flow discharge provided on Page 23, the following table summarizes the relationship of elevation versus discharge at the outlet of the bioswale for input to HEC-HMS. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)
12.5 (bottom)	0
15.5 (rim)	0
15.6	0.62
15.7	1.74
15.8	3.2
15.9	4.93
16.0	6.88
16.1	9.05
16.2	11.4
16.3	13.93
16.4	16.62
16.5	19.47

Superseded 9/14/10
See pg 24A

Bioswale 1-2

Bottom Width = 2 ft; Length = 1,323 ft; Bottom Elevation = 12.5 ft

The following tables summarize the Elevation vs. Area and Discharge for HEC-HMS input.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
12.5	2	2646	0.06
13.0	5	6615	0.15
14.0	11	14553	0.33
15.0	17	22491	0.51
15.5	20	26460	0.6
16.0	23	30429	0.69
16.5	26	34398	0.78

Standpipe diameter = 24"; Rim Elevation = 15.5 ft

Drainage Area & Runoff Coefficient:

A = 11.17 (Areas summarized on summary on Page 5a)

C = 2.3 x 0.65 (gravel) + (4.55 + 1.57) x 0.25 (lawn) + 2.75 x 0.95 (impervious) / 11.17 = 0.5

Water quality flow rate: Q = CIA = 0.5 x 0.2 in/hr x 11.17 ac = 1.12 cfs

Orifice equation: $Q=CA\sqrt{(2gh)}$ for 1.12 cfs with h=1.0' and C=0.62, yields A = 0.2245 sf

Ten 2-inch orifices can be used to provide an area of 0.2180 sf (use in orifice equation)

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
12.5 (bottom)	0.00 (orifice)	15.9	6.93 (orifice + weir)
13.0	0.77 (orifice)	16.0	8.91 (orifice + weir)
14.0	1.33 (orifice)	16.1	11.11 (orifice + weir)
15.0	1.71 (orifice)	16.2	13.49 (orifice + weir)
15.5 (rim)	1.88 (orifice)	16.3	16.04 (orifice + weir)
15.6	2.53 (orifice + weir)	16.4	18.76 (orifice + weir)
15.7	3.68 (orifice + weir)	16.5	21.64 (orifice + weir)
15.8	5.17 (orifice + weir)		

Bioswale 3

Bottom Width = 2 ft; Length = 187 ft

Using the method for area determination provided on Page 23, the following table summarizes the relationship of elevation versus area of the bioswale for input to HEC-HMS.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
11.0	2	374	0.01
12.0	8	1496	0.03
13.0	14	2618	0.06
14.0	20	3740	0.08

Standpipe diameter = 24"; Rim Elevation = 13.0 ft

Using the method for weir flow discharge provided on Page 23, the following table summarizes the relationship of elevation versus discharge at the outlet of the bioswale for input to HEC-HMS. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

VOID

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)
11.0 (bottom)	0
13.0 (rim)	0
13.1	0.62
13.2	1.74
13.3	3.2
13.4	4.93
13.5	6.88
13.6	9.05
13.7	11.4
13.8	13.93
13.9	16.62
14	19.47

~~Superseded~~
Removed 9/14/10

Bioswale 4

Bottom Width = 2 ft; Length = 391 ft

Using the method for area determination provided on Page 23, the following table summarizes the relationship of elevation versus area of the bioswale for input to HEC-HMS.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
12.5	2	782	0.01
13.0	5	1955	0.04
14.0	11	4301	0.09
15.0	17	6647	0.15
15.5	20	7820	0.17
16.0	23	8993	0.2
16.5	26	10166	0.23

Standpipe diameter = 24"; Rim Elevation = 15.5 ft

Using the method for weir flow discharge provided on Page 23, the following table summarizes the relationship of elevation versus discharge at the outlet of the bioswale for input to HEC-HMS. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)
12.5 (bottom)	0
15.5 (rim)	0
15.6	0.62
15.7	1.74
15.8	3.2
15.9	4.93
16.0	6.88
16.1	9.05
16.2	11.4
16.3	13.93
16.4	16.62
16.5	19.47

Superseded 9/14/10
See Pg 26A

Bioswale 4

Bottom Width = 2 ft; Length = 391 ft

The following tables summarize the Elevation vs. Area and Discharge for HEC-HMS input.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
12.5	2	782	0.01
13.0	5	1955	0.04
14.0	11	4301	0.09
15.0	17	6647	0.15
15.5	20	7820	0.17
16.0	23	8993	0.2
16.5	26	10166	0.23

Standpipe diameter = 24"; Rim Elevation = 15.5 ft

Drainage Area & Runoff Coefficient:

A = 4.26 (Areas summarized on summary on Page 5a)

C = 2.51 x 0.65 (gravel) + 0.54 x 0.25 (lawn) + 1.21 x 0.95 (impervious) / 4.26 = 0.7

Water quality flow rate: Q = CIA = 0.7 x 0.2 in/hr x 4.26 ac = 0.60 cfs

Orifice equation: $Q=CA\sqrt{(2gh)}$ for 0.60 cfs with h=1.0' and C=0.62, yields A = 0.1199 sf

Five 2-inch orifices can be used to provide an area of 0.1090 sf (use in orifice equation)

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
12.5 (bottom)	0.00 (orifice)	15.9	5.93 (orifice + weir)
13.0	0.38 (orifice)	16.0	7.89 (orifice + weir)
14.0	0.66 (orifice)	16.1	10.08 (orifice + weir)
15.0	0.86 (orifice)	16.2	12.44 (orifice + weir)
15.5 (rim)	0.94 (orifice)	16.3	14.99 (orifice + weir)
15.6	1.57 (orifice + weir)	16.4	17.69 (orifice + weir)
15.7	2.71 (orifice + weir)	16.5	20.55 (orifice + weir)
15.8	4.19 (orifice + weir)		

Bioswale 5

Section 2: Bottom Width = 10 ft; Length = 265 ft

Section 2a: Bottom Width = 8 ft; Length = 120 ft

Using the method for area determination provided on Page 23, the following table summarizes the relationship of elevation versus area of the bioswale for input to HEC-HMS.

Elevation – Area Summary

Elevation (ft)	Width (ft)		Area (sf)		Total Area (ac)
	Section 2	Section 2a	Section 2	Section 2a	
11.0	-	8	-	960	0.02
12.0	10	14	2650	1680	0.09
13.0	16	20	4240	2400	0.15
14.0	22	26	5830	3120	0.2
14.5	25	29	6625	3480	0.23
15.0	28	32	7420	3840	0.25
15.5	31	35	8215	4200	0.28

Standpipe diameter = 36"; Rim Elevation = 14.5 ft

Using the method for weir flow discharge provided on Page 23, the following table summarizes the relationship of elevation versus discharge at the outlet of the bioswale for input to HEC-HMS. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)
11.0 (bottom)	0
14.5 (rim)	0
14.6	0.92
14.7	2.61
14.8	4.8
14.9	7.39
15.0	10.32
15.1	13.57
15.2	17.1
15.3	20.9
15.4	24.93
15.5	29.2

superseded 9/14/10
See Pg 27A

Bioswale 5

Section 2: Bottom Width = 10 ft; Length = 145 ft

The following tables summarize the Elevation vs. Area and Discharge for HEC-HMS input.

Elevation – Area Summary

Elevation (ft)	Width (ft)	Area (sf)	Area (ac)
12.0	10	1450	0.03
13.0	16	2320	0.05
14.0	22	3190	0.07
14.5	25	3625	0.08
15.0	28	4060	0.09
15.5	31	4495	0.10

Standpipe diameter = 36"; Rim Elevation = 14.5 ft

Drainage Area & Runoff Coefficient:

A = 6.08 (Areas summarized on summary on Page 5a)

C = (2.87 + 0.94) x 0.65 (gravel) + 0.95 x 0.25 (lawn) + 1.32 x 0.95 (impervious) / 6.08= 0.65

Water quality flow rate: Q = CIA = 0.65 x 0.2 in/hr x 6.08 ac = 0.8 cfs

Orifice equation: $Q=CA\sqrt{(2gh)}$ for 0.80 cfs with h=1.0' and C=0.62, yields A = 0.1589 sf

Seven 2-inch orifices can be used to provide an area of 0.1526 sf (use in orifice equation)

Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
12.0 (bottom)	0.00 (orifice)	15.0	11.64 (orifice + weir)
13.0	0.76 (orifice)	15.1	14.91 (orifice + weir)
14.0	1.07 (orifice)	15.2	18.46 (orifice + weir)
14.5 (rim)	1.20 (orifice)	15.3	22.28 (orifice + weir)
14.6	2.14 (orifice + weir)	15.4	26.33 (orifice + weir)
14.7	3.86 (orifice + weir)	15.5	30.62 (orifice + weir)
14.8	6.07 (orifice + weir)		
14.9	8.68 (orifice + weir)		

Pond

The proposed pond will provide additional storage capacity for the stormwater runoff from the post-construction site conditions. Below is a table summarizing the relationship of Elevation versus Area (areas measured using AutoCAD).

Elevation – Area Summary

Elevation (ft)	Pond Area (acres)
8.5	0.18
9.0	0.21
10.0	0.26
11.0	0.31
12.0	0.37
13.0	0.43
14.0	0.50
15.0	0.56

The pond outlet structure consists of orifice holes in the vertical standpipe to reduce peak flows and also allows discharge through the rim via weir flow. The method for determining weir flow is consistent with the weir discharge for bioswales. For orifice flow through the standpipe barrel, the orifice equation Q = $C \times A \times \sqrt{2gh}$ is used to determine discharge by considering the head (h) above the orifice discharge elevation. In the pond this elevation is set at EL 10.0 per Reference 11. A is the orifice area. For this calculation, nine 1-inch holes are provided at EL 10.0 to limit maximum flows to 0.5 cfs until the water level is at EL 14.0 (rim). PLN 6/18/10

The elevation – discharge table can be determined:

Orifice EL = 10.0

Discharge at each depth can be determined:

At EL 14.0 (rim), H = 14.0 – 10.0 = 4.0 ft

A = $9 \times (\pi \times r^2)$ = 9 x (π x (0.5 in / 12 in/ft)^2) in = 0.495 sf

C = 0.62 (per Reference 13)

Discharge at EL 14.0 Q = $0.62 \times 0.0495 \times \sqrt{2 \times 32.2 \times 4.0}$ = 0.49 cfs (< 0.50 cfs)

Discharge at EL 12.0 Q = $0.62 \times 0.0495 \times \sqrt{2 \times 32.2 \times 2.0}$ = 0.35 cfs

Superseded 9/14/10
See pg 28A

Pond

The proposed pond will provide additional storage capacity for the stormwater runoff from the post-construction site conditions. Below is a table summarizing the relationship of Elevation versus Area (areas measured using AutoCAD).

Elevation – Area Summary

Elevation (ft)	Pond Area (acres)
8.5	0.33
9.0	0.35
10.0	0.41
11.0	0.48
12.0	0.54
13.0	0.61

The pond outlet structure consists of orifice holes in the vertical standpipe to reduce peak flows and also allows discharge through the rim via weir flow. The method for determining weir flow is consistent with the weir discharge for bioswales. For orifice flow through the standpipe barrel, the orifice equation Q = $C \times A \times \sqrt{2gh}$ is used to determine discharge by considering the head (h) above the orifice discharge elevation. In the pond this elevation is set at EL 8.75 per Reference 11. A is the orifice area. For this calculation, orifices are provided to discharge the water quality volume (WQV) between 24-48 hours.

Per B&V Calc 52.5406.1008 the WQV is 0.30 ac-ft. which is stored in the pond at EL 9.34'.
The average head for the orifice equation is 2/3 of the maximum head of 9.34-8.75 = 0.39'
The target dewatering time is 24 hours for the WQV.
Therefore the average flow rate Q = (0.3 ac-ft x 43560 sf/ac)/ (24 hr x 3600 s/hr) = 0.151 cfs
Orifice equation: Q=CA√(2gh) for 0.151 cfs with h=0.39' and C=0.62, yields A = 0.0486 sf
Eight 1-inch orifices can be used to provide an area of 0.044 sf (use in orifice equation)

The elevation – discharge table can be determined:

Orifice EL = 8.75

Discharge at each depth can be determined:

At EL 12.0 (rim), H = 12.0 – 8.75 = 3.25 ft

A = $8 \times (\pi \times r^2)$ = 11 x (π x (0.5 in / 12 in/ft)^2) in = 0.044 sf

C = 0.62 (per Reference 13)

Discharge at EL 10.0 Q = $0.62 \times 0.044 \times \sqrt{2 \times 32.2 \times 1.25}$ = 0.24 cfs

Discharge at EL 12.0 Q = $0.62 \times 0.044 \times \sqrt{2 \times 32.2 \times 3.25}$ = 0.39 cfs

Standpipe diameter = 36"; Rim Elevation = 14.0 ft

Using the method for weir flow discharge provided on Page 23, and the orifice discharge method on the previous page, the following table summarizes the relationship of elevation versus discharge (weir and orifice) at the pond outlet. This data is input into the HEC-HMS model. Weir discharge is calculated at 0.1-foot intervals due to the rapid increase in discharge as the depth increases. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

Pond Elevation – Discharge Summary

Elevation (ft)	Orifice Discharge (cfs)	Weir Discharge (cfs)	Total Discharge (cfs)
8.5 (bottom)	-	-	0
10.0 (orifice)	0	-	0
11.0	0.25	-	0.25
12.0	0.35	-	0.35
13.0	0.43	-	0.43
14.0	0.49	0	0.49
14.1	0.5	0.92	1.42
14.2	0.5	2.61	3.11
14.3	0.51	4.8	5.31
14.4	0.52	7.39	7.91
14.5	0.52	10.32	10.84
14.6	0.53	13.57	14.1
14.7	0.53	17.1	17.63
14.8	0.54	20.9	21.44
14.9	0.55	24.93	25.48
15.0	0.55	29.2	29.75

superseded 9/14/10

See pg 29A

Standpipe diameter = 36"; Rim Elevation = 14.0 ft

The following table summarizes the relationship of elevation versus discharge (weir and orifice) at the pond outlet for input into the HEC-HMS model. Weir discharge is calculated at 0.1-foot intervals due to the rapid increase in discharge as the depth increases. Refer to Page 30 for discussion of weir / orifice flow into riser pipe.

Pond Elevation – Discharge Summary

Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
8.5 (bottom)	0.00 (below orifice)	12.3	5.21 (orifice + weir)
8.75	0.00 (orifice)	12.4	7.81 (orifice + weir)
9.0	0.11 (orifice)	12.5	10.7 (orifice + weir)
10.0	0.24 (orifice)	12.6	14.0 (orifice + weir)
11.0	0.33 (orifice)	12.7	17.5 (orifice + weir)
12.0 (rim)	0.39 (orifice)	12.8	21.3 (orifice + weir)
12.1	1.32 (orifice + weir)	12.9	25.4 (orifice + weir)
12.2	3.02 (orifice + weir)	13.0	29.7 (orifice + weir)

The capacity of each riser pipe is determined for weir flow and orifice flow based on the peak head above the rim elevation for each outlet control structure. To determine the elevation at which the flow transitions from weir flow over the riser rim to orifice flow when the rim becomes submerged, the value of the head, H that results in weir flow equal to orifice flow is computed. This head value is compared to the peak elevation in the bioswales and pond to determine if weir flow or orifice flow would govern.

Weir flow, Qw = Cw x L x $H^{3/2}$

Orifice Flow, Qo = $Co \times A \times \sqrt{2gH}$

Gravitational Constant, g = 32.2

Setting Qw = Qo, the above equations are reduced to solve for H: $H = \frac{8.025 \times Co \times A}{Cw \times L}$

Weir Coefficient, Cw = 3.1

Orifice Coeff, Co = 0.62

Area, A and Length, L are dependent on the diameter of the riser pipe.

For a 24" riser pipe, A = л x r^2 = 3.14 x $(1\ ft)^2$ = 3.14 sf

L = л x d = 3.14 x 2 ft = 6.28 ft

For a 36" riser pipe, A = л x r^2 = 3.14 x $(1.5\ ft)^2$ = 7.07 sf

L = л x d = 3.14 x 3 ft = 9.42 ft

The Head, H at which weir flow is equal to orifice flow is thus:

For a 24" riser $H = \frac{8.025 \times 0.62 \times 3.14}{3.1 \times 6.28}$ = 0.8 ft. Weir flow will govern up to 0.8' above rim

For a 36" riser $H = \frac{8.025 \times 0.62 \times 7.07}{3.1 \times 9.42}$ = 1.2 ft. Weir flow will govern up to 1.2' above rim

Referring to the HEC-HMS output in Attachment 2, the maximum head above the riser is for Bioswale 1-2 (Peak elevation – rim elevation = 15.99 ft – 15.5 ft = 0.5' of head). This is below the minimum head that results in orifice flow (0.8' for 24" riser). Therefore the use of the weir flow discharge values is correct for all overflow structures for this calculation.

Section 5.0 HEC-HMS Output

The parameters determined in Sections 1.0 through 4.0 were input into the HEC-HMS computer program. The outflow from the wetland is specified in the HEC-HMS program to be 0 at all times (no outflow). The peak discharge rate to the wetland for each storm event was calculated by running the HEC-HMS program. The table below summarizes the runoff rate produced in the pre-construction and post-construction site conditions for each storm event. The output results are included in Attachment 2.

Summary of Runoff Peak Flow Rates to Wetland

Rainfall Event	Pre-Construction Peak Flow Rate to Existing Wetland	Post-Construction Peak Flow Rate to Existing Wetland
1-inch	0.3 ~~0.1~~ cfs	0.2 ~~0.1~~ cfs
10-year	3.6 ~~3.2~~ cfs	2.2 ~~3.1~~ cfs
100-year	12.3 ~~11.8~~ cfs	4.8 ~~9.1~~ cfs

Rev 1 9/14/10 CAK PLW 9/20/10

Conclusion:

Based on the HEC-HMS analysis for the pre- and post-construction conditions, the peak flows to the wetland area will be changed as a result of the proposed development. The increase in runoff volume due to the proposed development is attenuated within the proposed bioswales and detention pond. By installing the bioswales and pond along with outlet control structures, the peak flows are controlled in the post-development condition and result in equal-to or less-than pre-developed conditions.

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 33

52.5406.1007

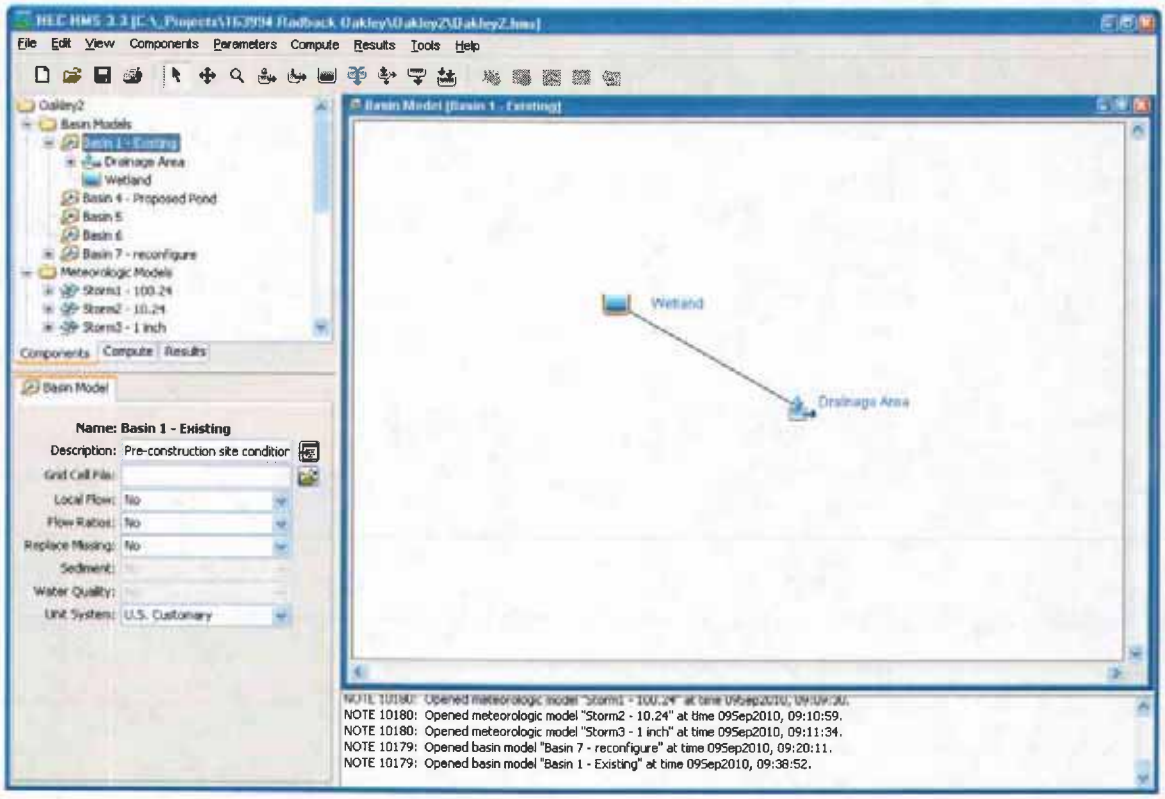
Rev 1 9/14/10
All pages
CAK

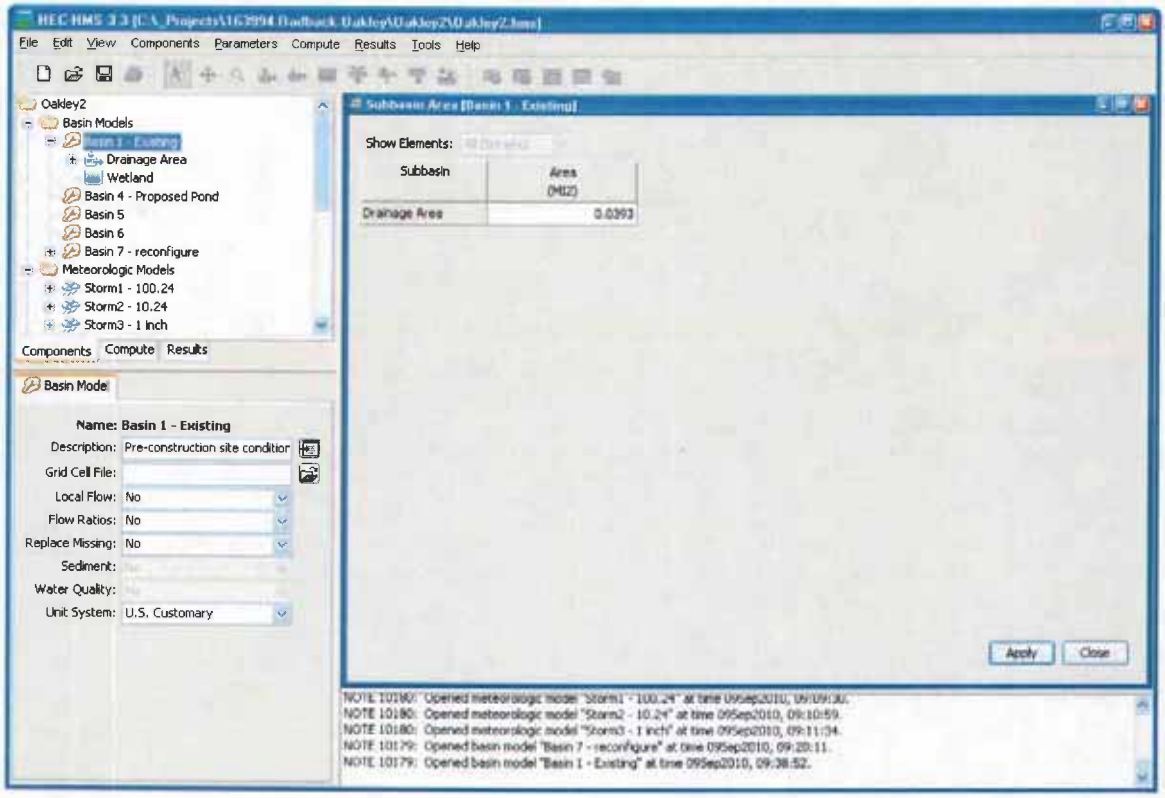
Attachment 1

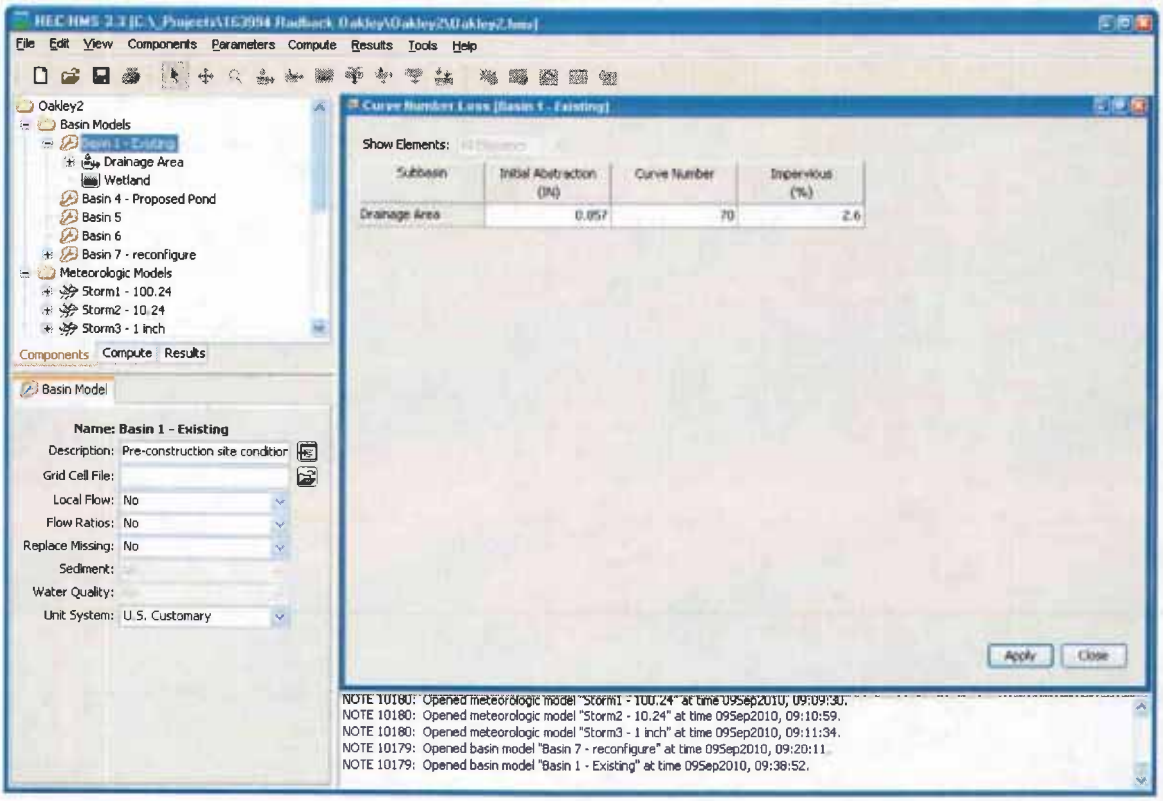
~~Reference~~

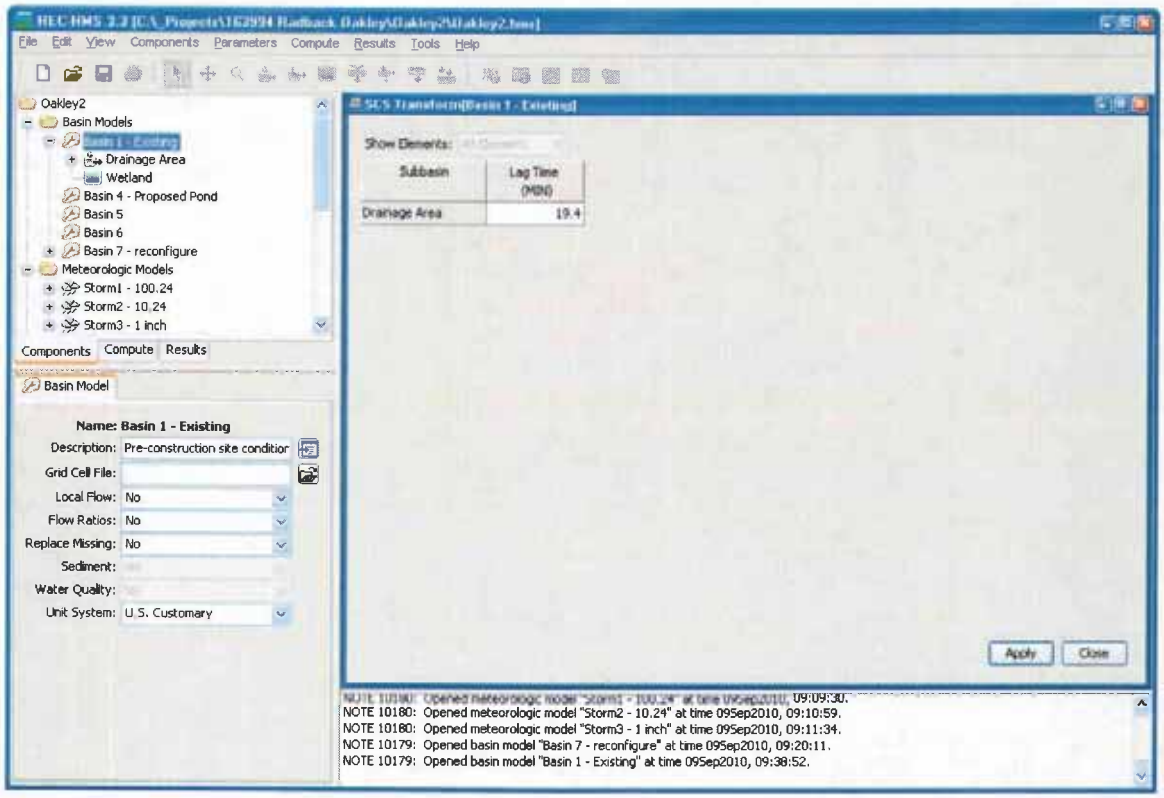
HEC-HMS INPUT

HEC-HMS Input – Basin Model 1 (Existing Condition)

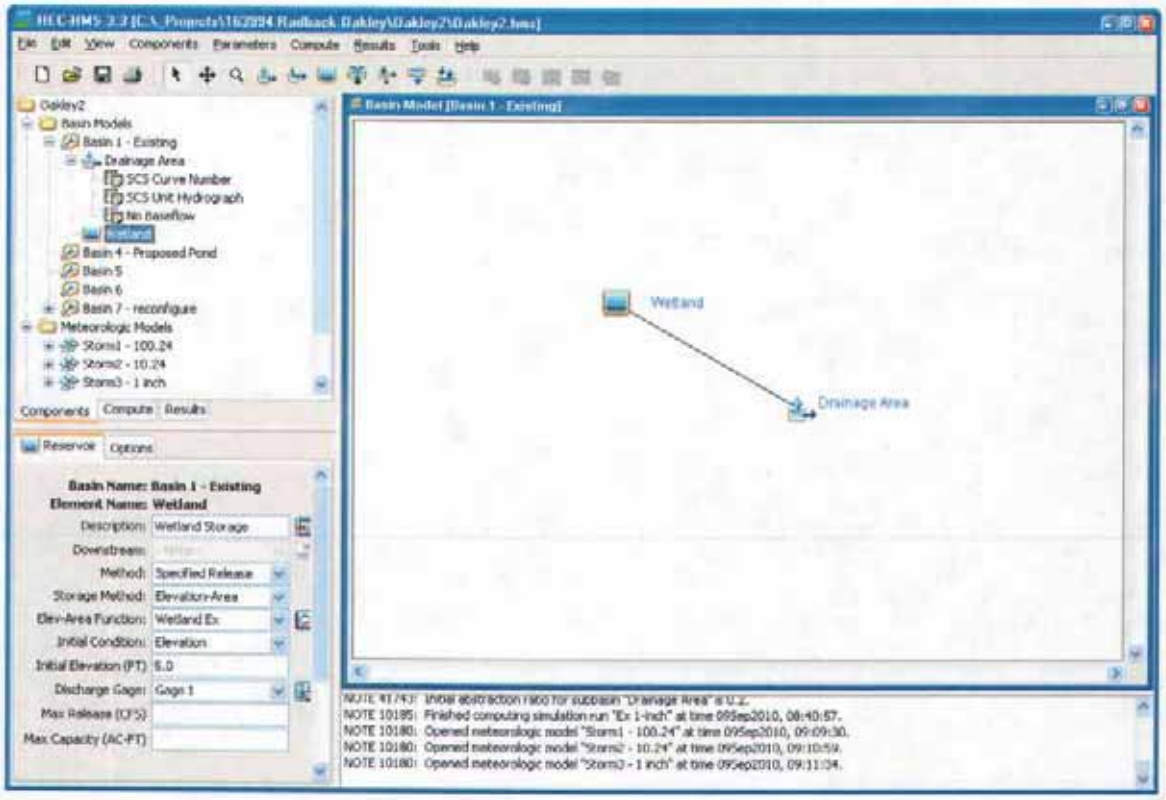


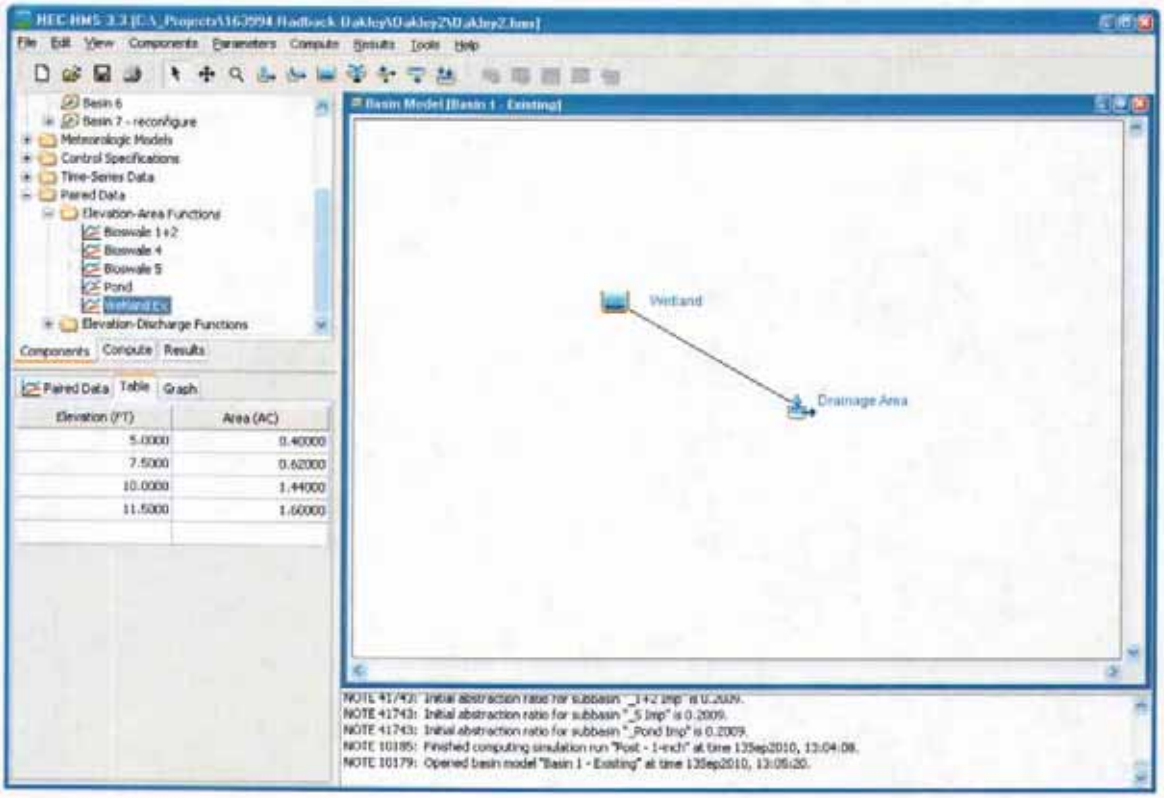



File Edit View Components Parameters Compute Results Tools Help
Oakley2
Basin Models
Basin 1 - Existing
Drainage Area
Wetland
Basin 4 - Proposed Pond
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Components Compute Results
Basin Model
Name: Basin 1 - Existing
Description: Pre-construction site condition
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
Curve Number Loss (Basin 1 - Existing)
Show Elements:
Subbasin
Initial Abstraction (IN)
Curve Number
Impervious (%)
Drainage Area
0.857
70
2.6
Apply
Close
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.


File Edit View Components Parameters Compute Results Tools Help
Oakley2
Basin Models
Basin 1 - Existing
Drainage Area
Wetland
Basin 4 - Proposed Pond
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Components Compute Results
Basin Model
Name: Basin 1 - Existing
Description: Pre-construction site condition
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Sediment:
Water Quality:
Unit System: U.S. Customary
Show Elements:
Subbasin
Lag Time (MIN)
Drainage Area
19.4
Apply
Close
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.

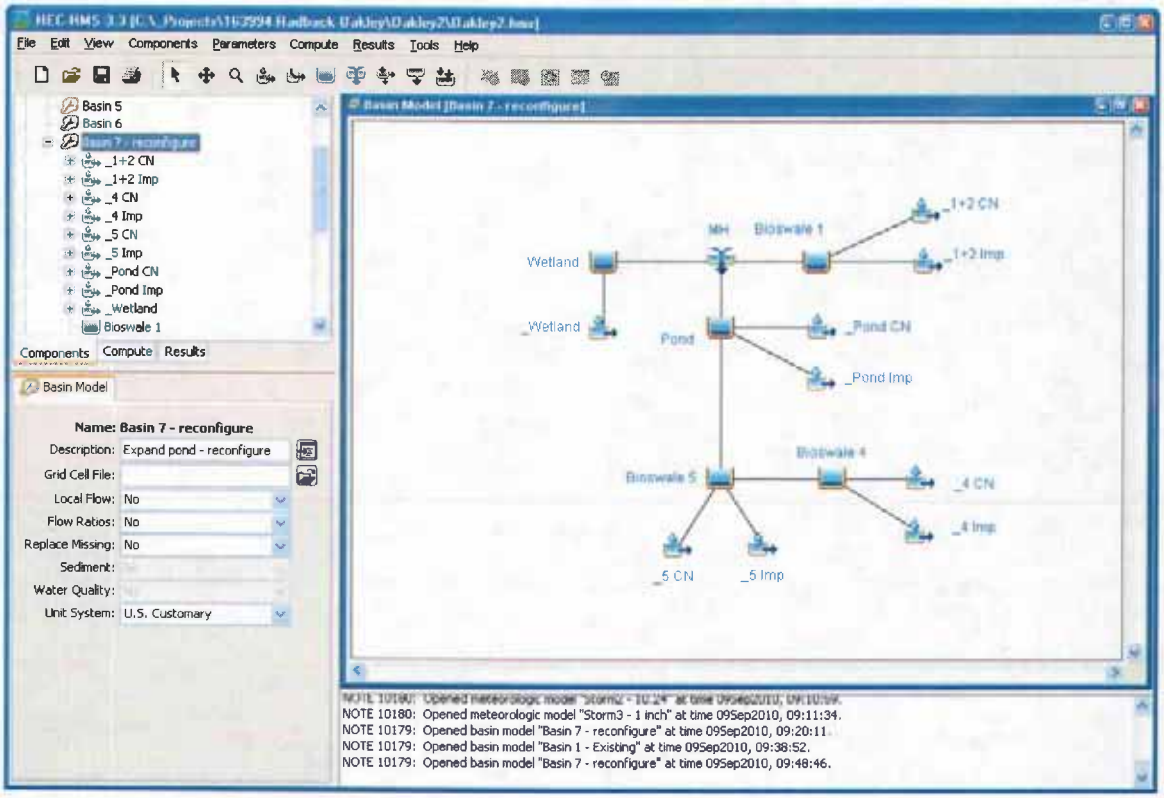
Wetland Storage Capacity Data

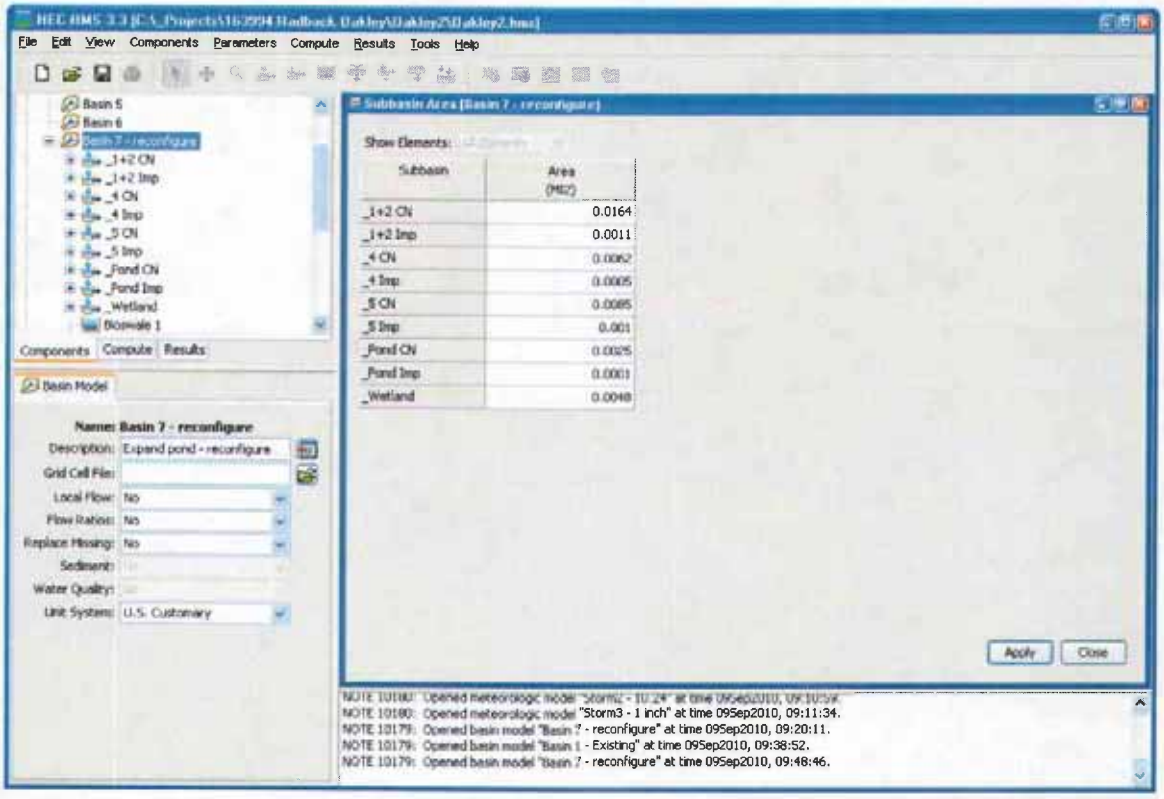


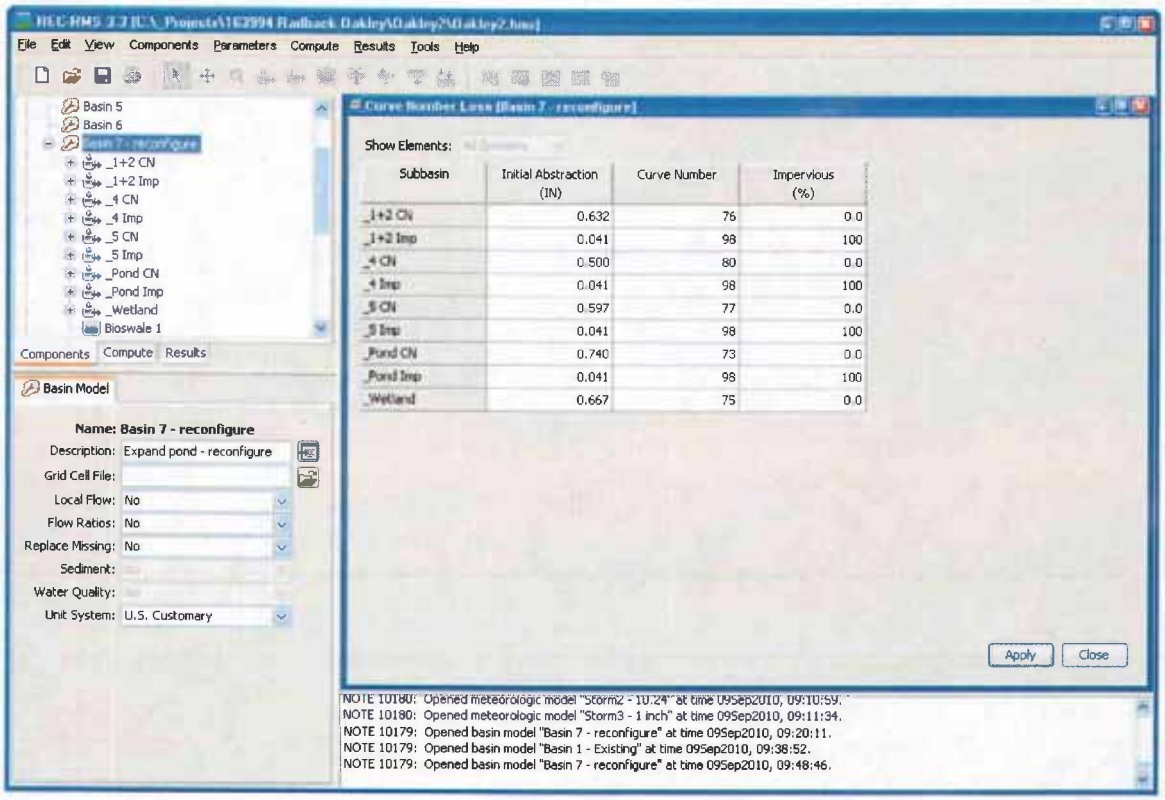


HEC-HMS Input – Basin Model 7 (Post-Construction Condition)

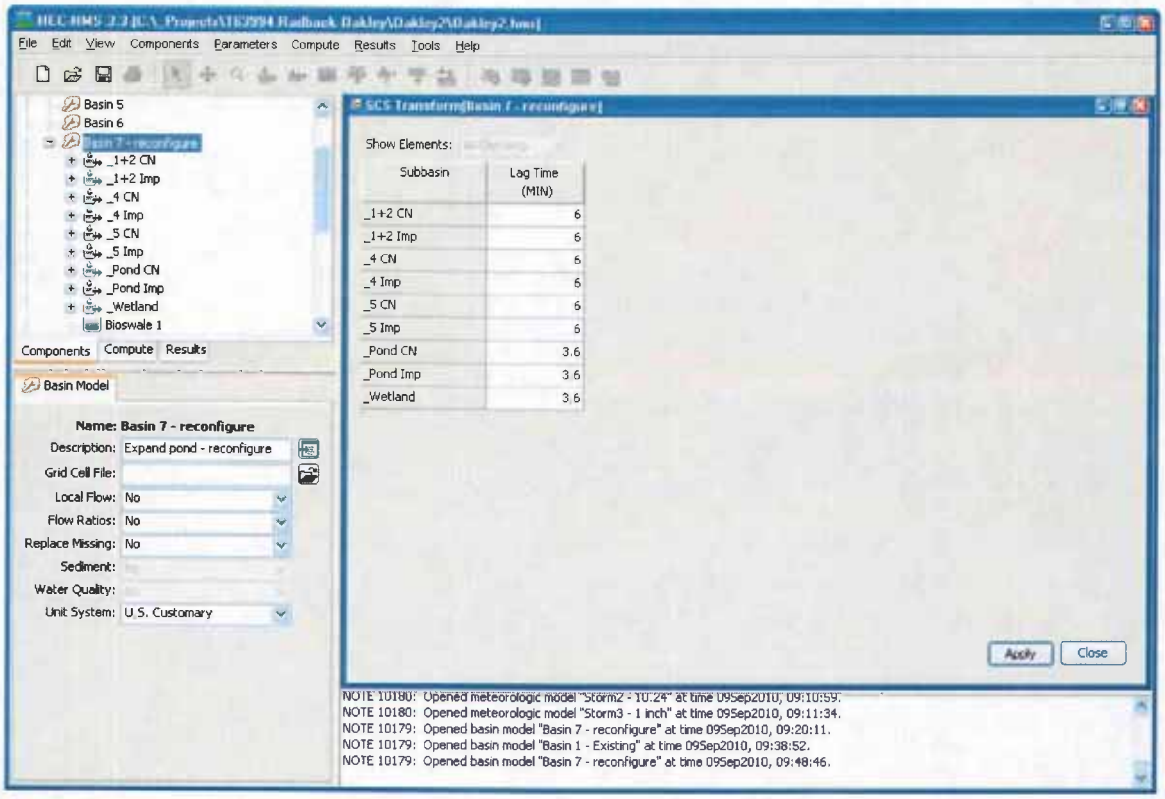
Subbasin Data





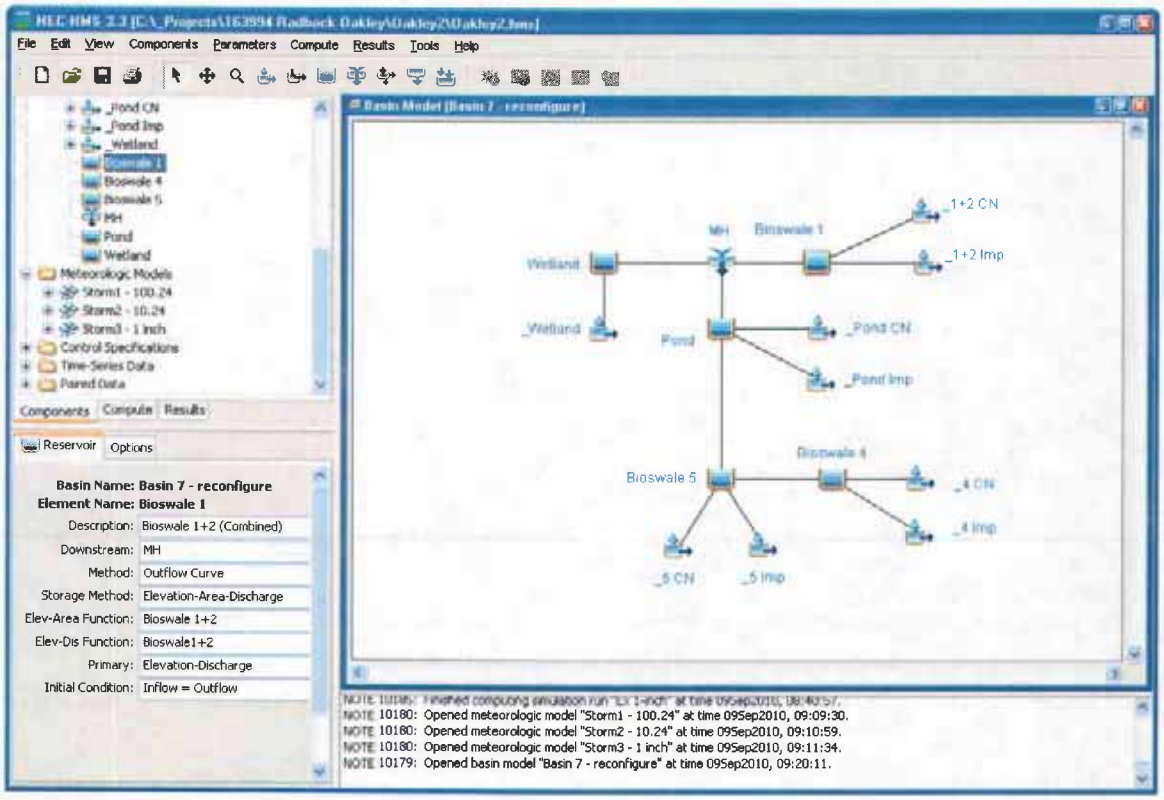


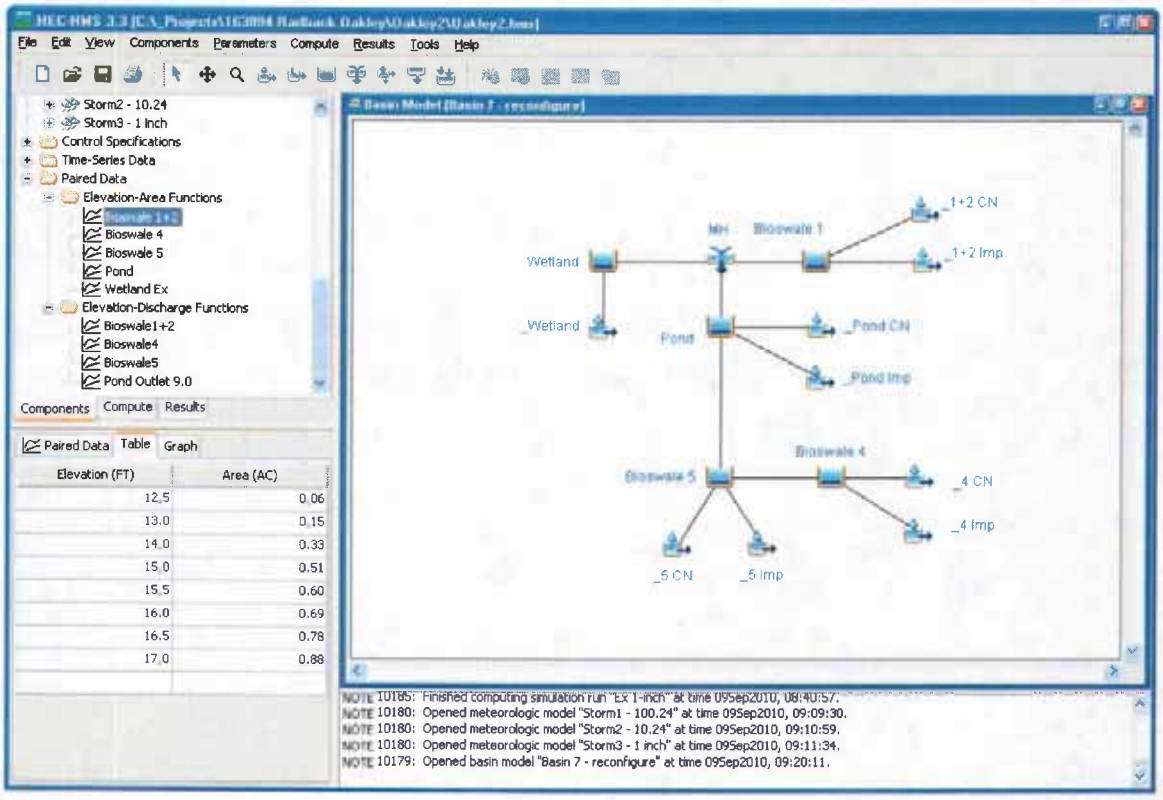
Subbasin	Initial Abstraction (IN)	Curve Number	Impervious (%)
_1+2 CN	0.632	76	0.0
_1+2 Imp	0.041	98	100
_4 CN	0.500	80	0.0
_4 Imp	0.041	98	100
_5 CN	0.597	77	0.0
_5 Imp	0.041	98	100
_Pond CN	0.740	73	0.0
_Pond Imp	0.041	98	100
_Wetland	0.667	75	0.0

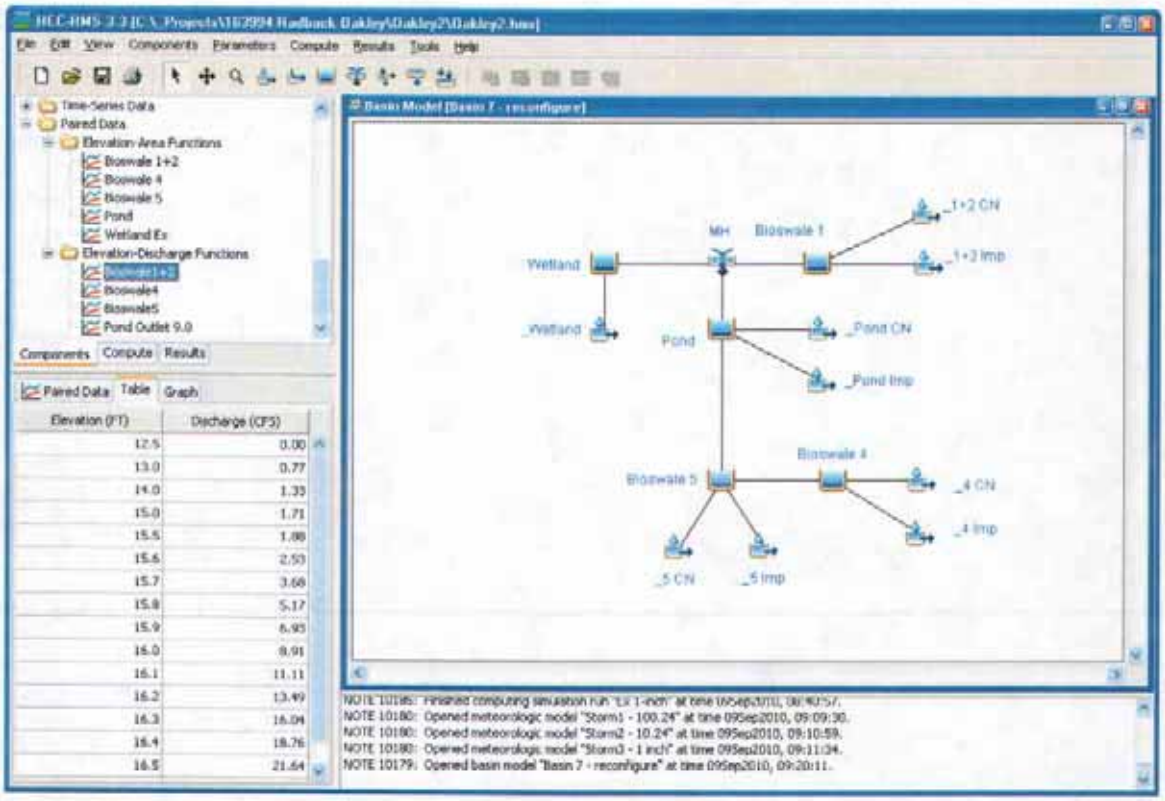


Subbasin	Lag Time (MIN)
_1+2 CN	6
_1+2 Imp	6
_4 CN	6
_4 Imp	6
_5 CN	6
_5 Imp	6
_Pond CN	3.6
_Pond Imp	3.6
_Wetland	3.6

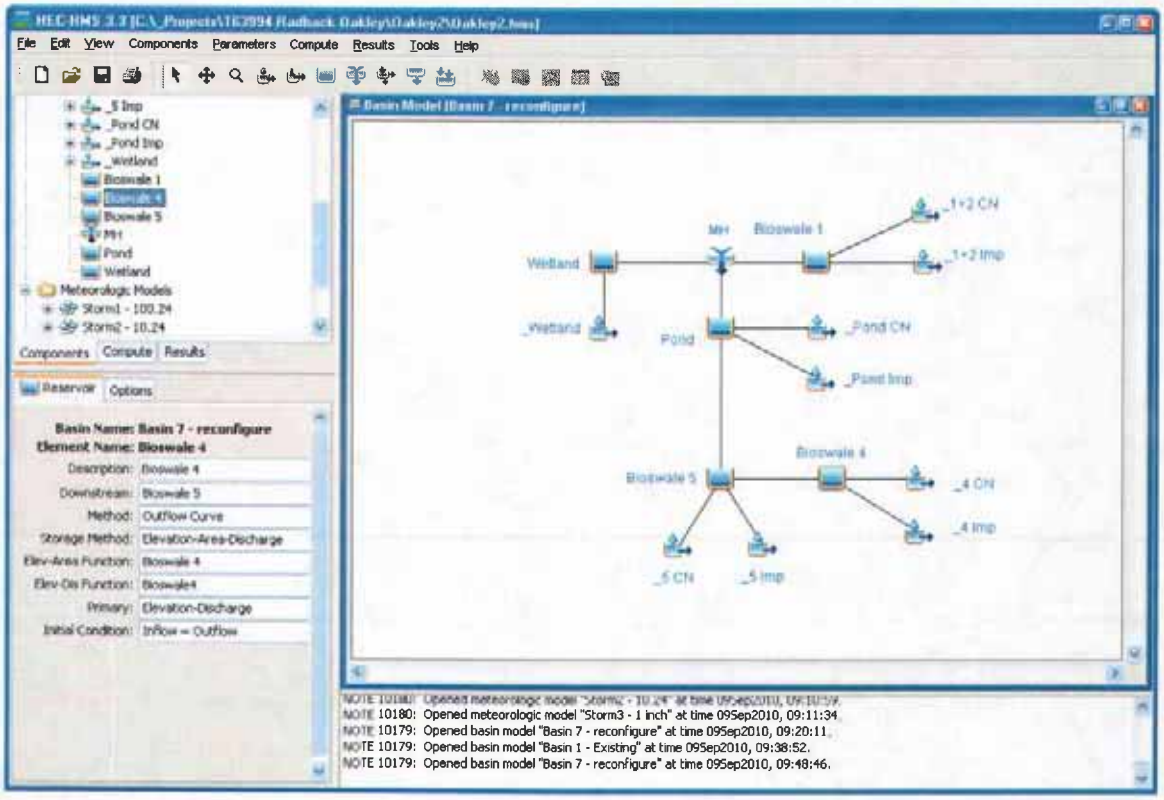
Bioswale 1 Storage Capacity & Discharge Data

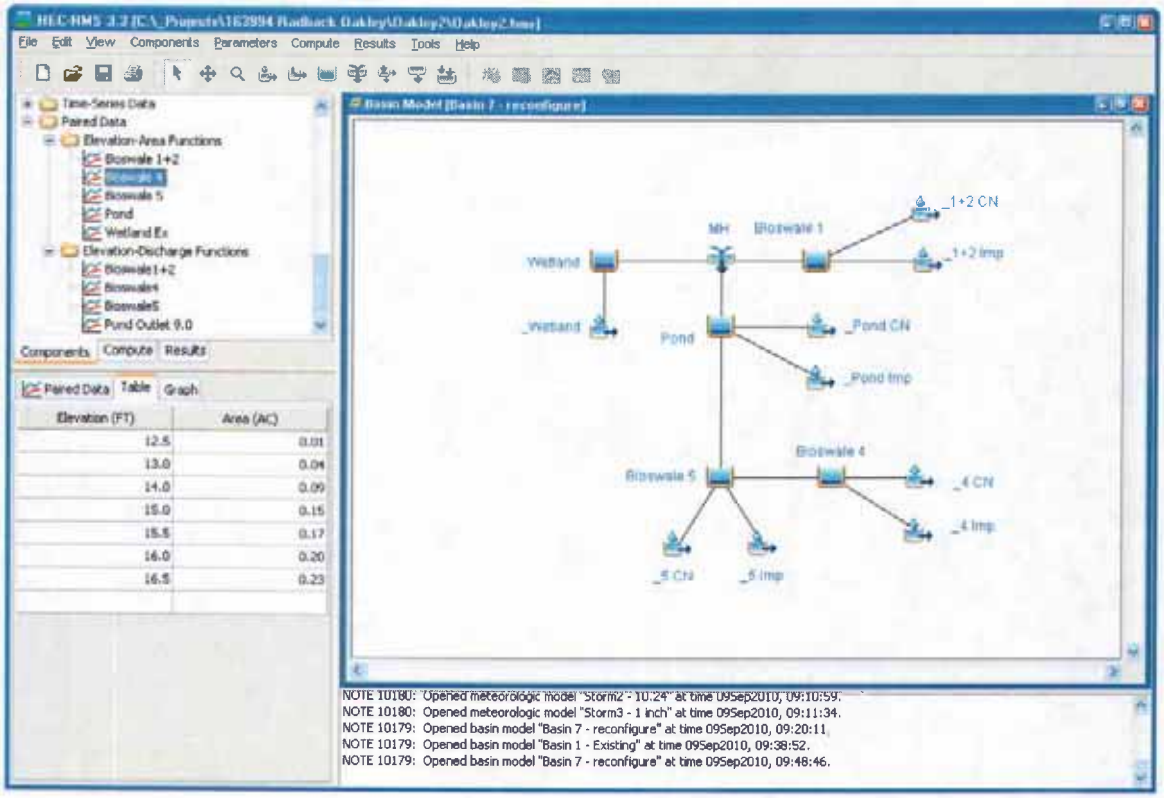


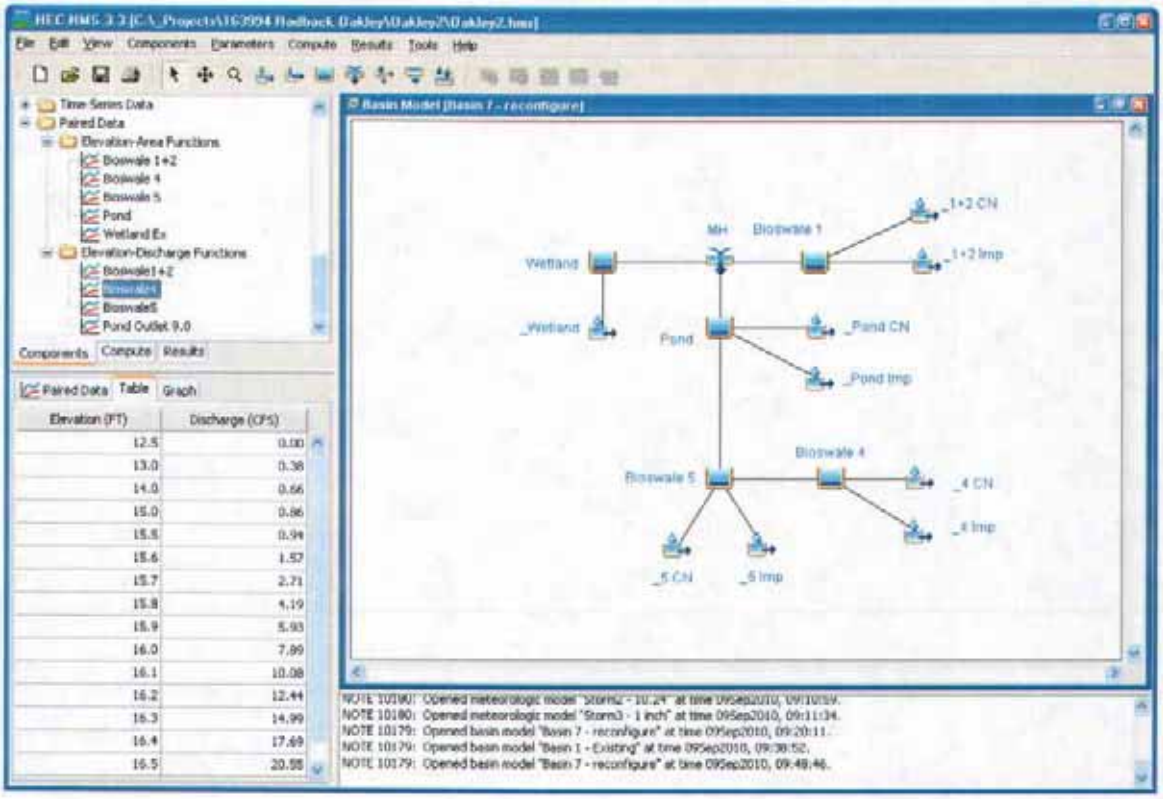



File Edit View Components Parameters Compute Results Tools Help
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Pond Outlet 9.0
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.5 0.00
13.0 0.77
14.0 1.33
15.0 1.71
15.5 1.88
15.6 2.53
15.7 3.68
15.8 5.17
15.9 6.93
16.0 8.91
16.1 11.11
16.2 13.49
16.3 16.04
16.4 18.76
16.5 21.64
Basin Model [Basin 7 - reconfigure]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10180: Opened meteorologic model "Storm1 - 100.24" at time 09Sep2010, 09:09:30.
NOTE 10180: Opened meteorologic model "Storm2 - 10.24" at time 09Sep2010, 09:10:59.
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:04.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.

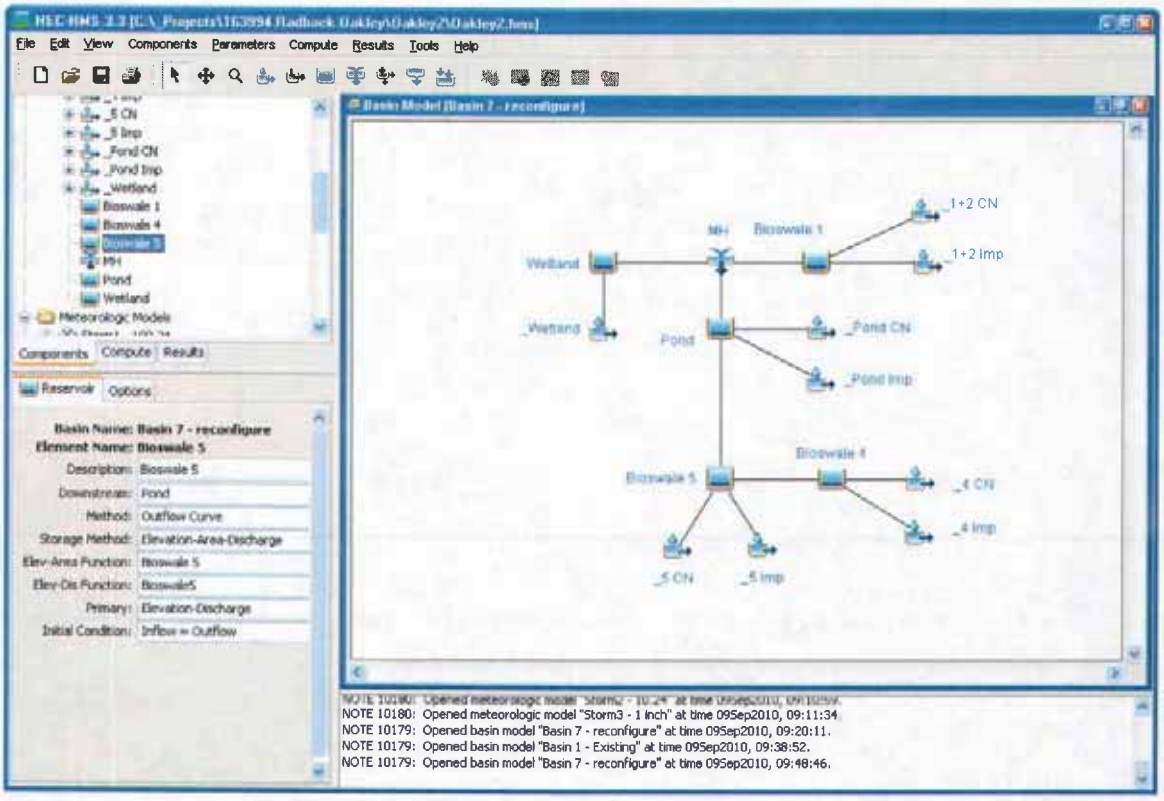
Bioswale 4 Storage Capacity & Discharge Data

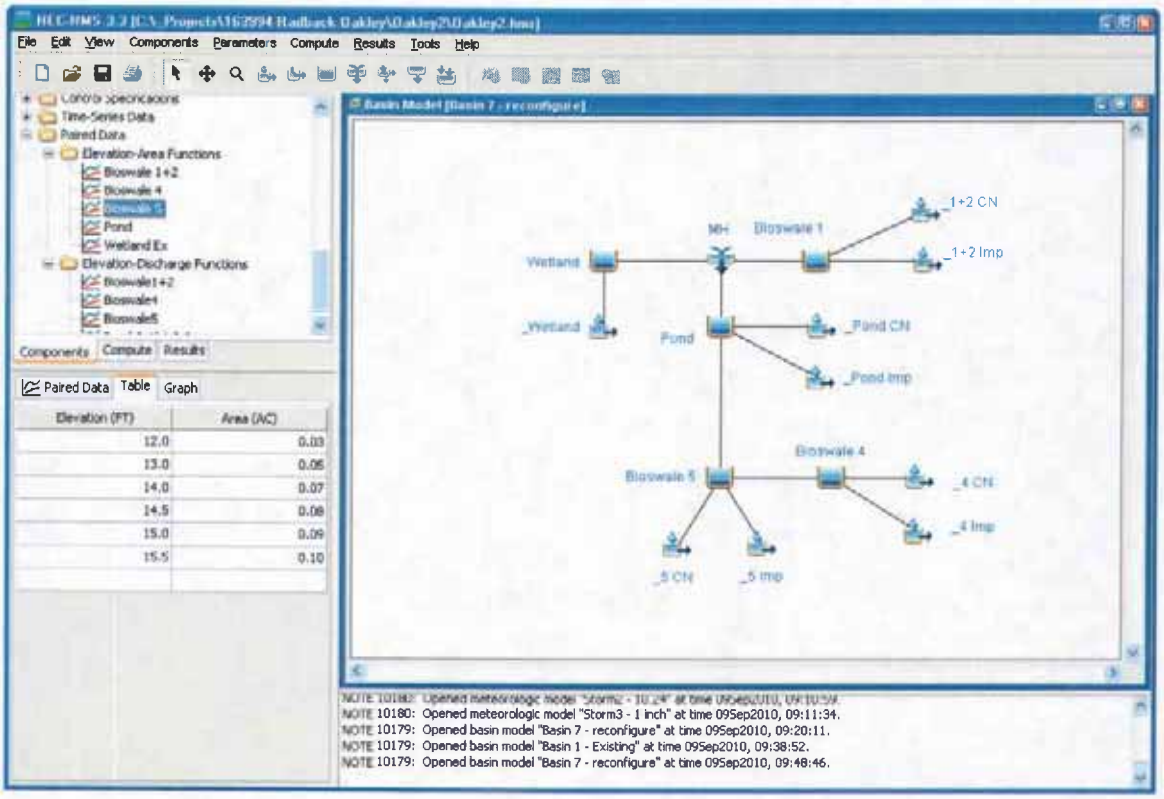


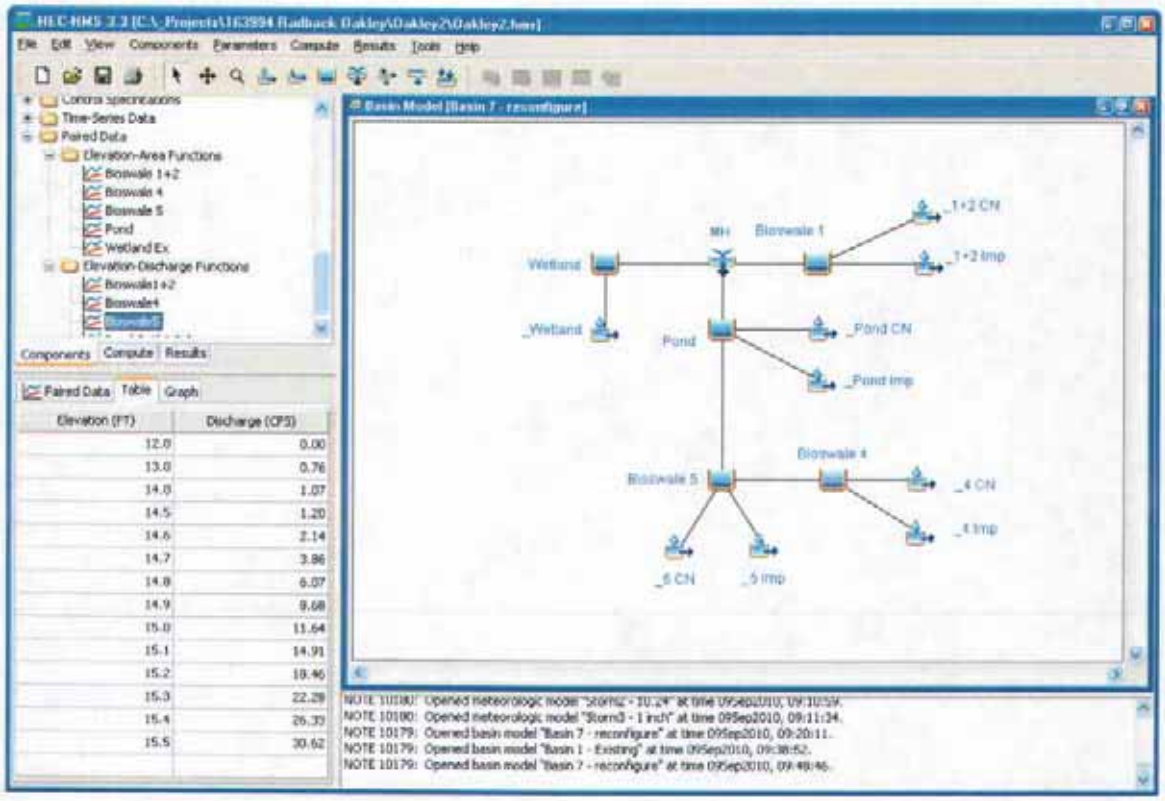



HEC-HMS 3.3 [C:_Projects\163994 Hedback Oakley\Oakley2\Oakley2.hms]
File Edit View Components Parameters Compute Results Tools Help
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Pond Outlet 9.0
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.5 0.00
13.0 0.38
14.0 0.66
15.0 0.86
15.5 0.94
15.6 1.57
15.7 2.71
15.8 4.19
15.9 5.93
16.0 7.89
16.1 10.08
16.2 12.44
16.3 14.99
16.4 17.69
16.5 20.55
Basin Model [Basin 7 - reconfigure]
_1+2 CN
MH
Bioswale 1
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10180: Opened meteorologic model "Storm3 - 1 inch" at time 09Sep2010, 09:11:34.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.

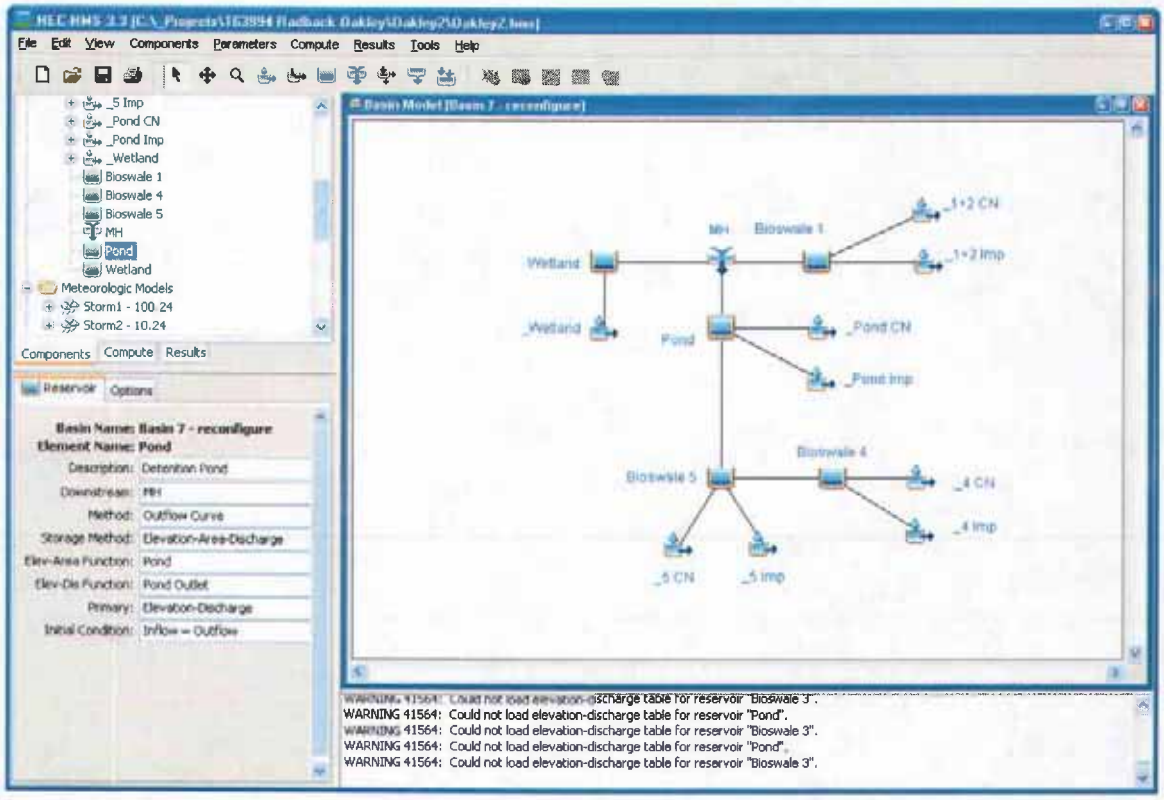
Bioswale 5 Storage Capacity & Discharge Data

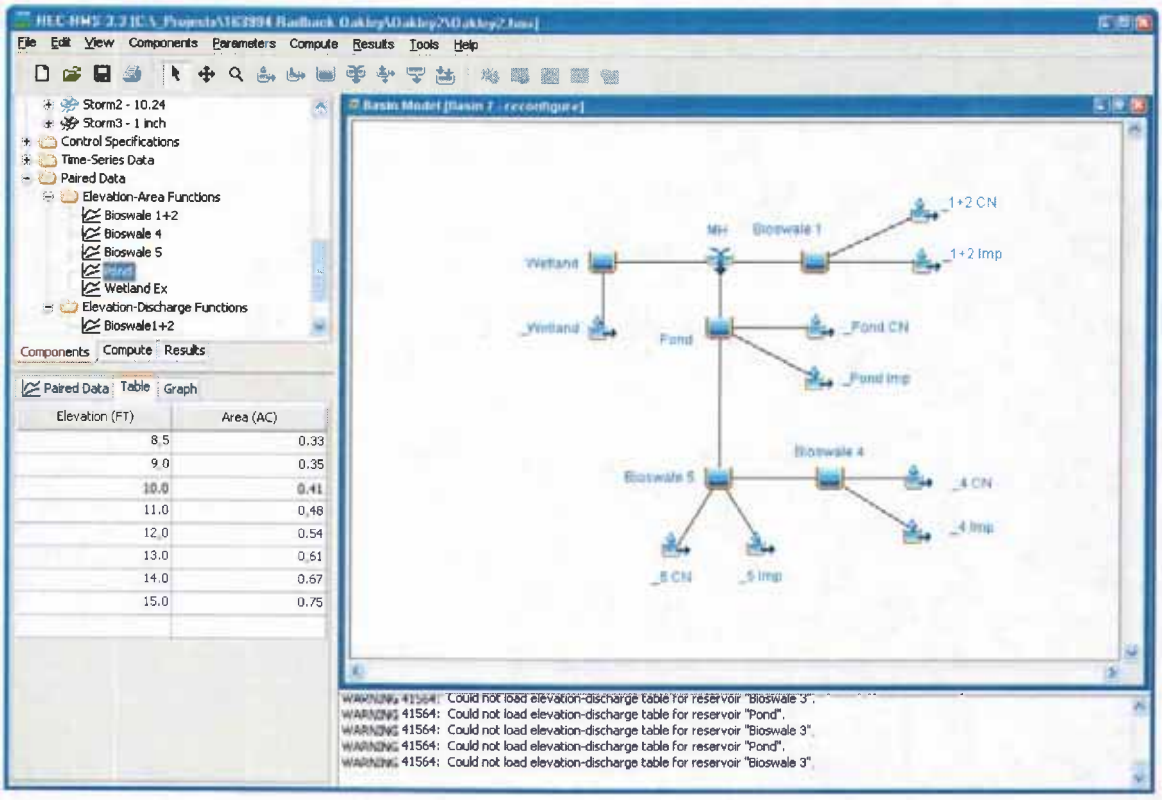


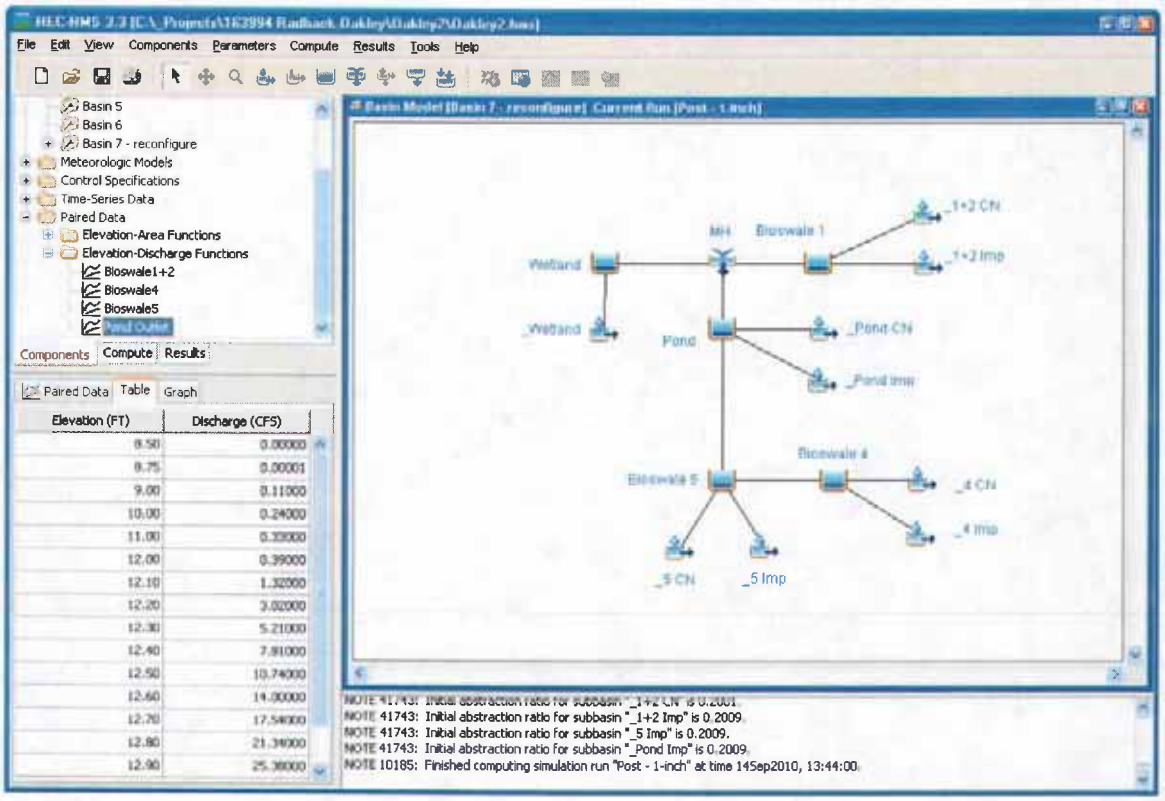



File Edit View Components Parameters Compute Results Tools Help
Control Specifications
Time-Series Data
Paired Data
Elevation-Area Functions
Bioswale 1+2
Bioswale 4
Bioswale 5
Pond
Wetland Ex
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Components Compute Results
Paired Data Table Graph
Elevation (FT) Discharge (CFS)
12.0 0.00
13.0 0.76
14.0 1.07
14.5 1.20
14.6 2.14
14.7 3.86
14.8 6.07
14.9 9.68
15.0 11.64
15.1 14.91
15.2 18.46
15.3 22.28
15.4 26.33
15.5 30.62
Basin Model [Basin 7 - reconfigure]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:20:11.
NOTE 10179: Opened basin model "Basin 1 - Existing" at time 09Sep2010, 09:38:52.
NOTE 10179: Opened basin model "Basin 7 - reconfigure" at time 09Sep2010, 09:48:46.

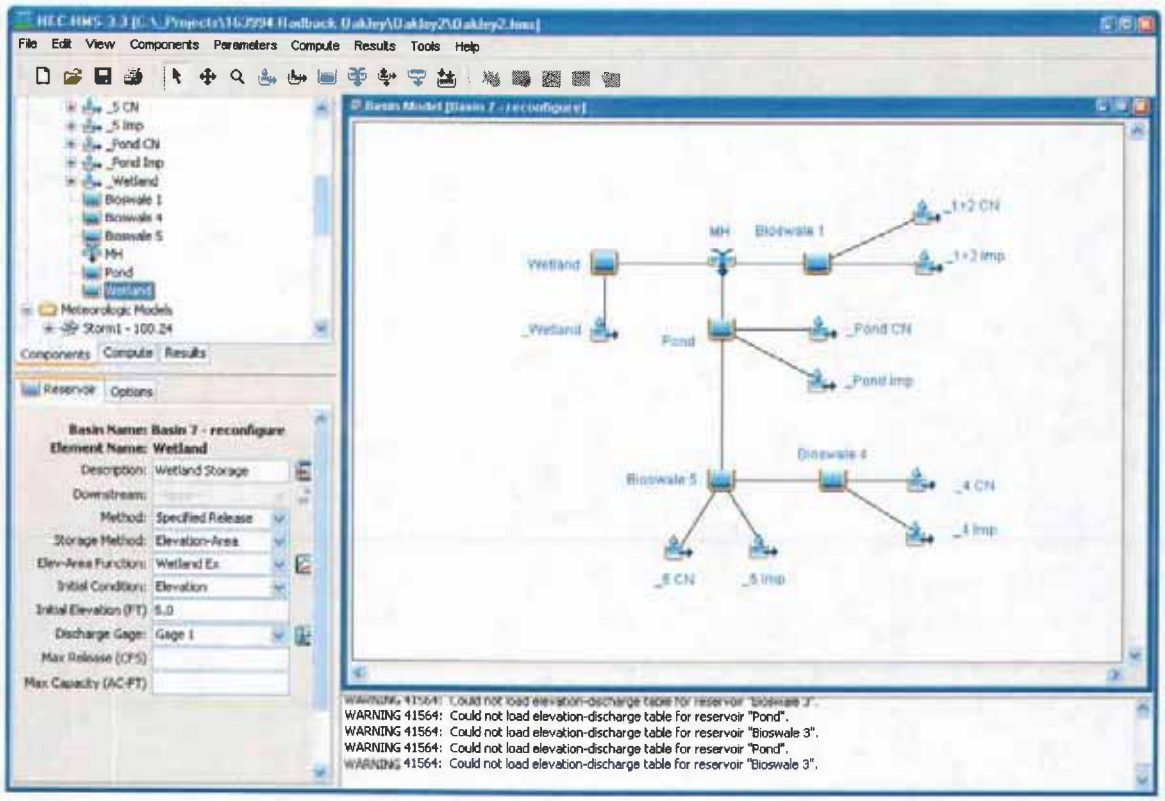
Pond Storage Capacity & Discharge Data

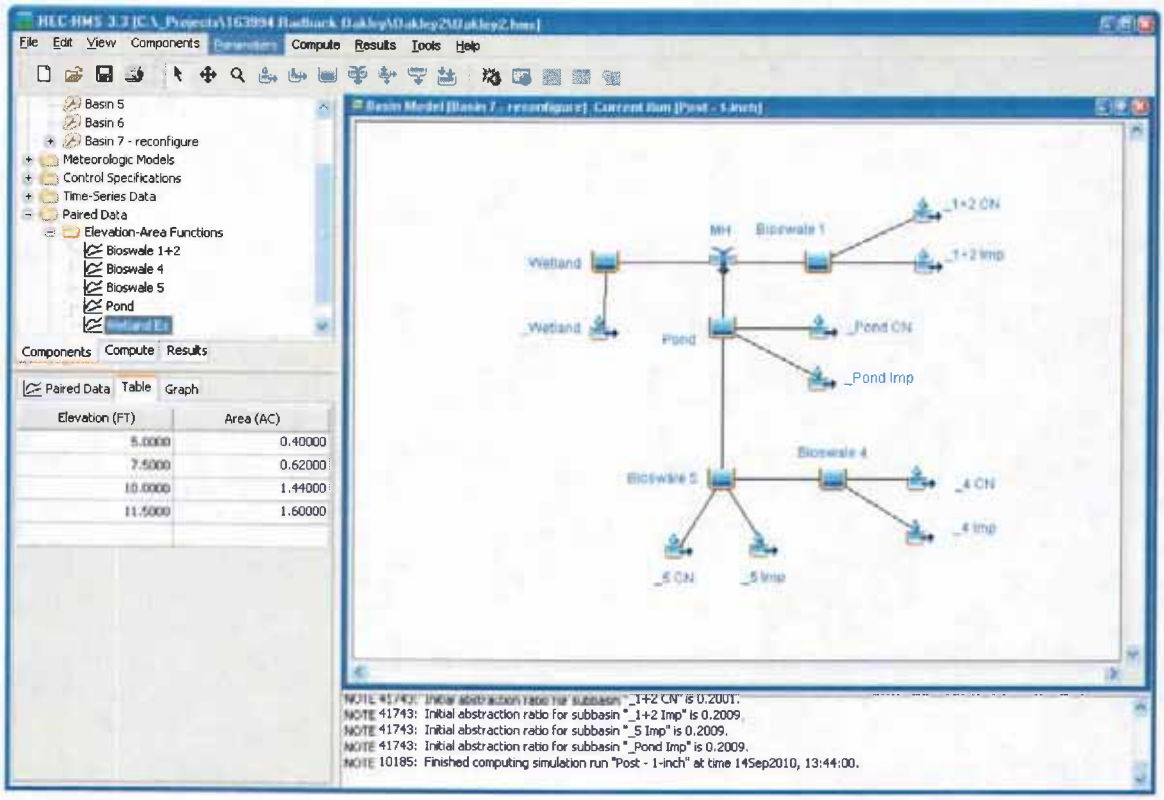


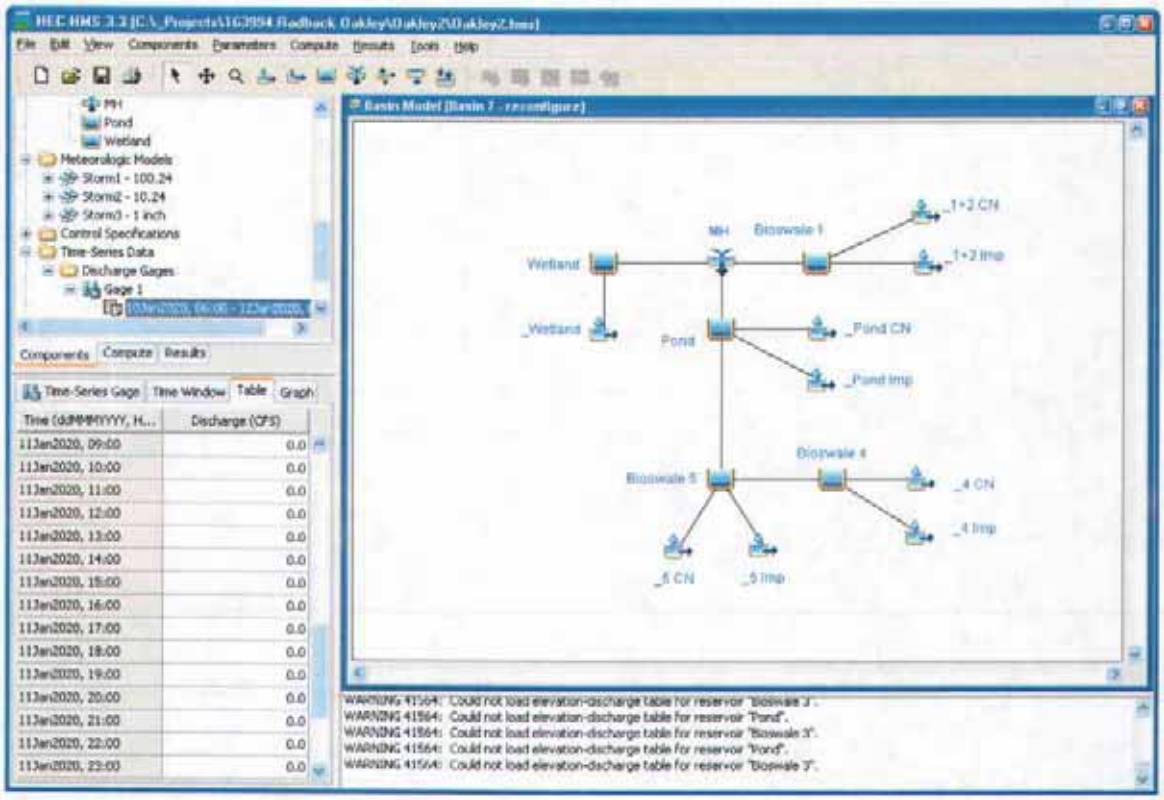



File Edit View Components Parameters Compute Results Tools Help
Basin 5
Basin 6
Basin 7 - reconfigure
Meteorologic Models
Control Specifications
Time-Series Data
Paired Data
Elevation-Area Functions
Elevation-Discharge Functions
Bioswale1+2
Bioswale4
Bioswale5
Pond Outlet
Components
Compute
Results
Paired Data
Table
Graph
Elevation (FT) Discharge (CFS)
8.50 0.00000
8.75 0.00001
9.00 0.11000
10.00 0.24000
11.00 0.33000
12.00 0.39000
12.10 1.32000
12.20 3.02000
12.30 5.21000
12.40 7.81000
12.50 10.74000
12.60 14.00000
12.70 17.54000
12.80 21.38000
12.90 25.38000
Basin Model [Basin 7 - reconfigure] Current Run [Post - 1-inch]
Wetland
_Wetland
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Pond
_Pond CN
_Pond Imp
Bioswale 5
Bioswale 4
_4 CN
_4 Imp
_5 CN
_5 Imp
NOTE 41743: Initial abstraction ratio for subbasin "_1+2 CN" is 0.2001.
NOTE 41743: Initial abstraction ratio for subbasin "_1+2 Imp" is 0.2009.
NOTE 41743: Initial abstraction ratio for subbasin "_5 Imp" is 0.2009.
NOTE 41743: Initial abstraction ratio for subbasin "_Pond Imp" is 0.2009.
NOTE 10185: Finished computing simulation run "Post - 1-inch" at time 14Sep2010, 13:44:00.

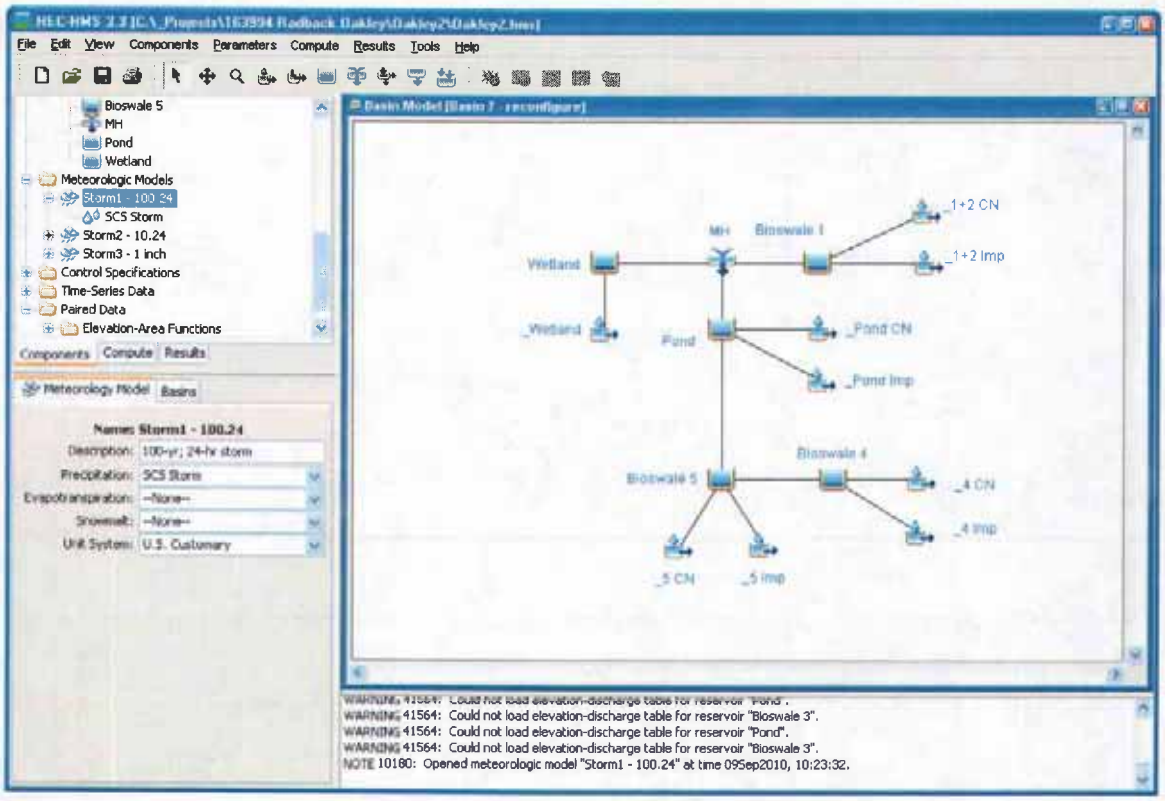
Wetland Storage Capacity Data

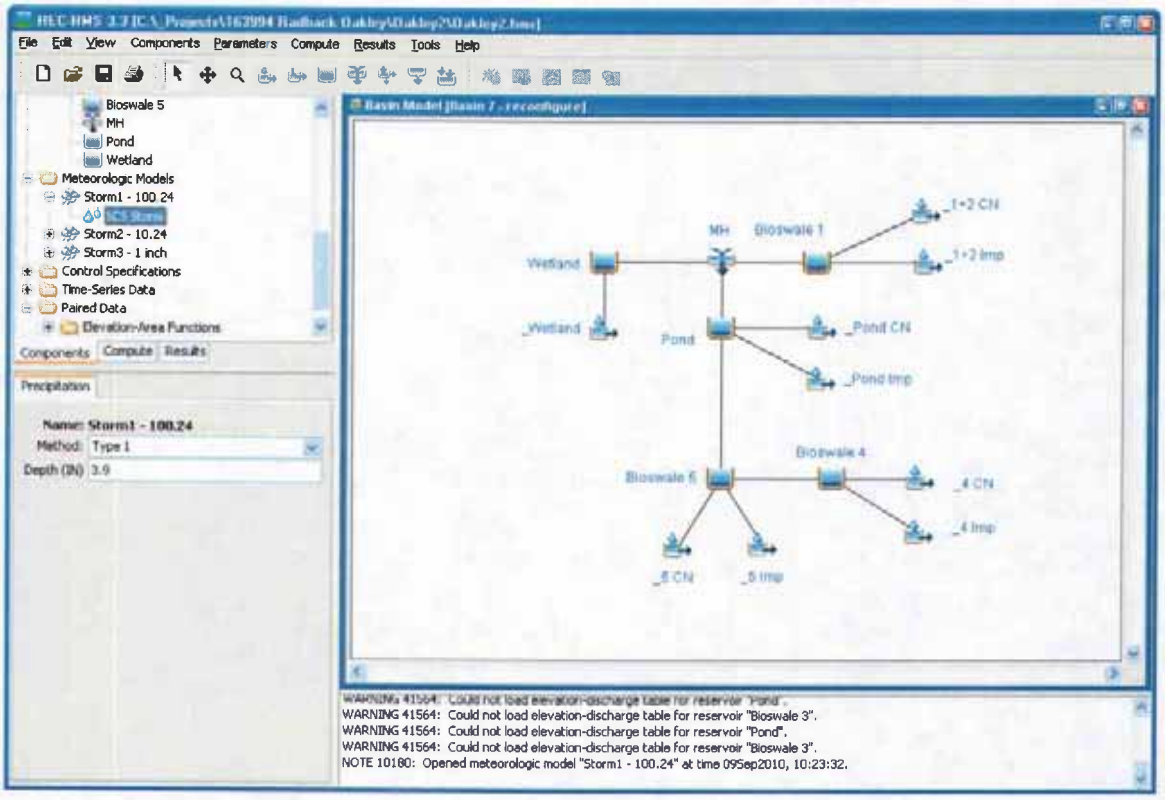




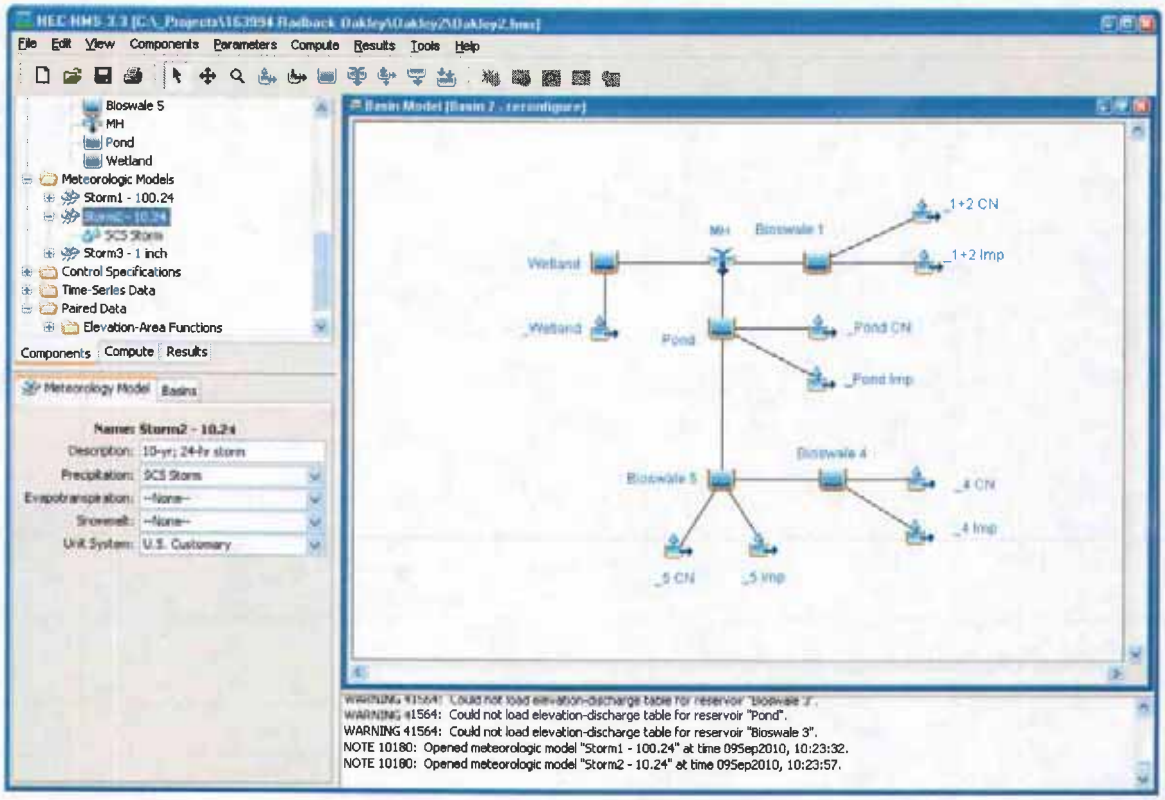

HEC-HMS 3.3 [C:_Projects\163954 Redback Oakley\Oakley2\Oakley2.hms]
File Edit View Components Parameters Compute Results Tools Help
MH
Pond
Wetland
Meteorologic Models
Storm1 - 100.24
Storm2 - 10.24
Storm3 - 1 inch
Control Specifications
Time-Series Data
Discharge Gages
Gage 1
Components Compute Results
Time-Series Gage Time Window Table Graph
Time (ddMMMYYYY, H... Discharge (CFS)
13Jan2020, 09:00 0.0
13Jan2020, 10:00 0.0
13Jan2020, 11:00 0.0
13Jan2020, 12:00 0.0
13Jan2020, 13:00 0.0
13Jan2020, 14:00 0.0
13Jan2020, 15:00 0.0
13Jan2020, 16:00 0.0
13Jan2020, 17:00 0.0
13Jan2020, 18:00 0.0
13Jan2020, 19:00 0.0
13Jan2020, 20:00 0.0
13Jan2020, 21:00 0.0
13Jan2020, 22:00 0.0
13Jan2020, 23:00 0.0
Basin Model [Basin 7 - reconfigure]
MH
Bioswale 1
_1+2 CN
_1+2 Imp
Wetland
_Wetland
Pond
_Pond CN
_Pond Imp
Bioswale 4
Bioswale 5
_4 CN
_4 Imp
_5 CN
_5 Imp
WARNING 41564: Could not load elevation-discharge table for reservoir "Bioswale 3".
WARNING 41564: Could not load elevation-discharge table for reservoir "Pond".
WARNING 41564: Could not load elevation-discharge table for reservoir "Bioswale 3".
WARNING 41564: Could not load elevation-discharge table for reservoir "Pond".
WARNING 41564: Could not load elevation-discharge table for reservoir "Bioswale 3".

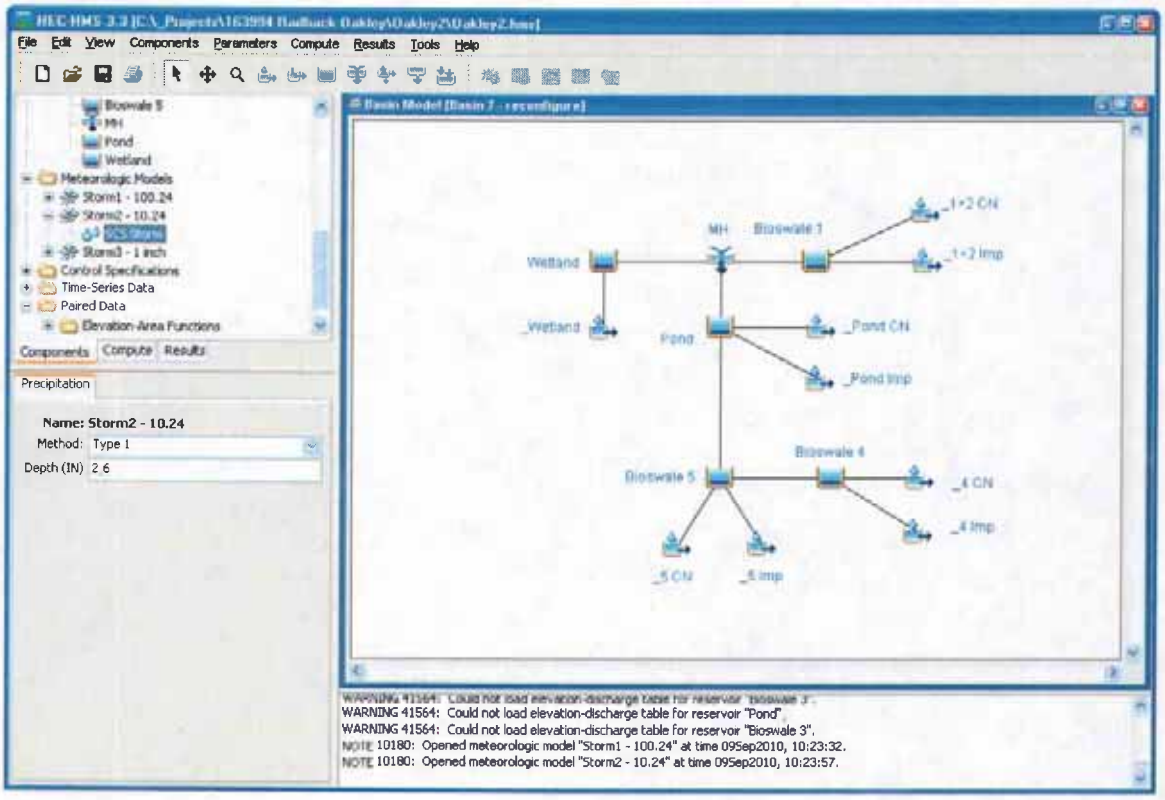
HEC-HMS Input – Meteorologic Model Storm1 – 100-year, 24-hour storm



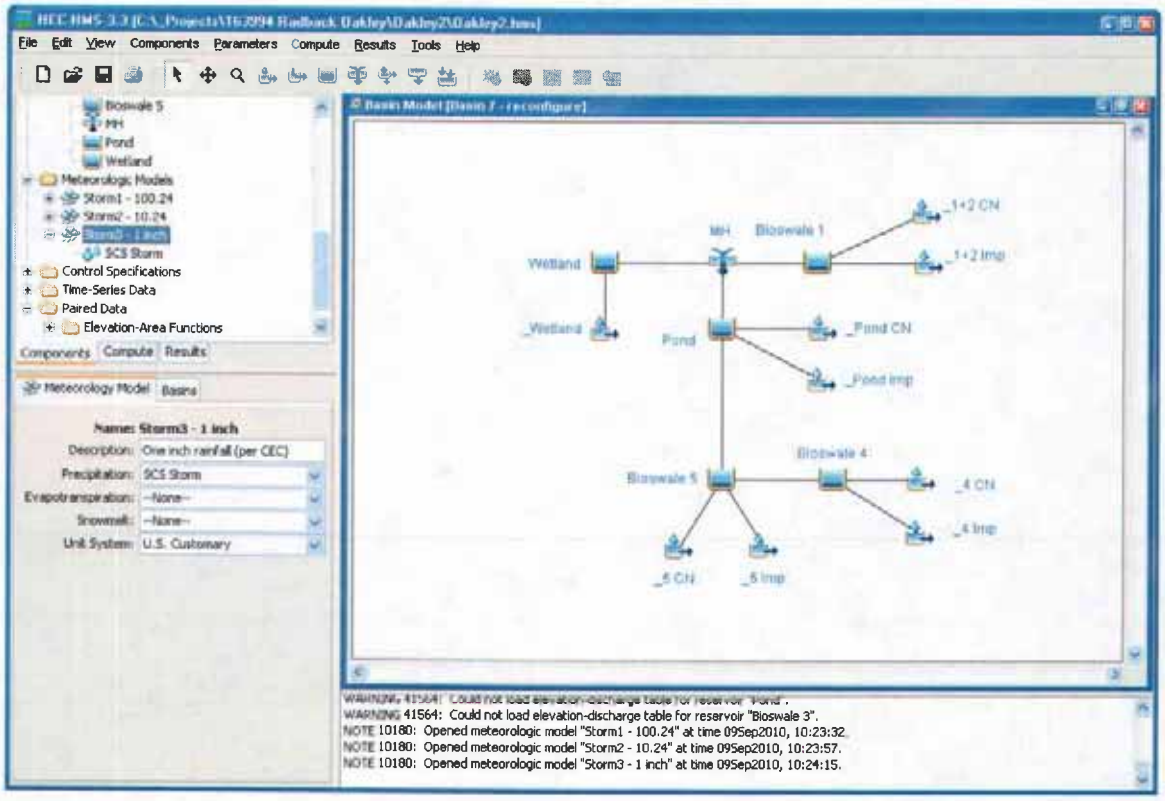


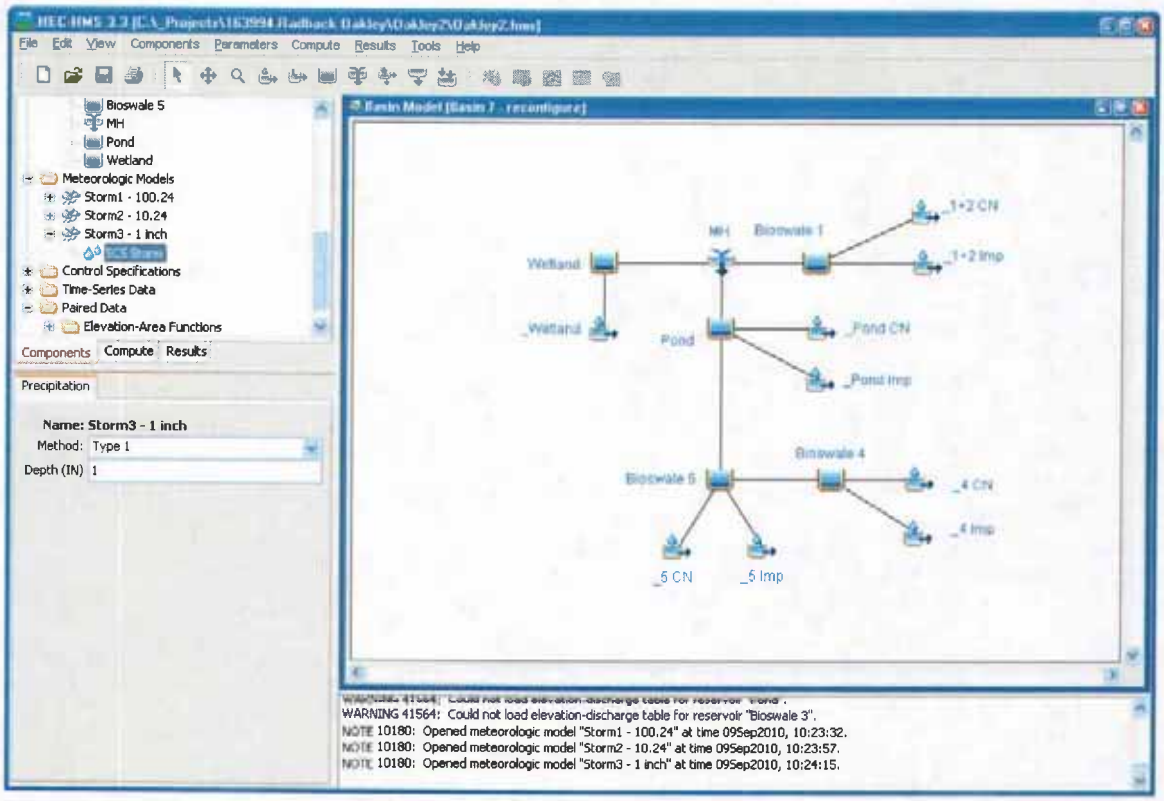
HEC-HMS Input – Meteorologic Model Storm2 – 10-year, 24-hour storm



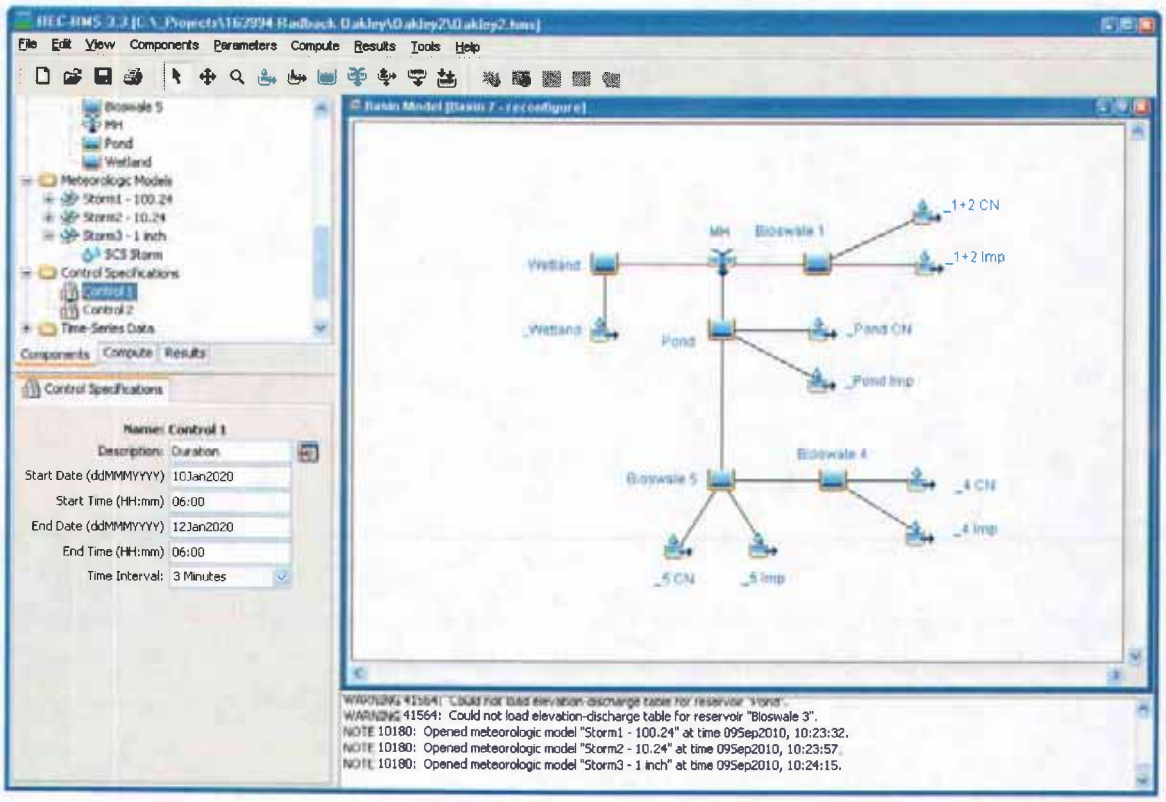


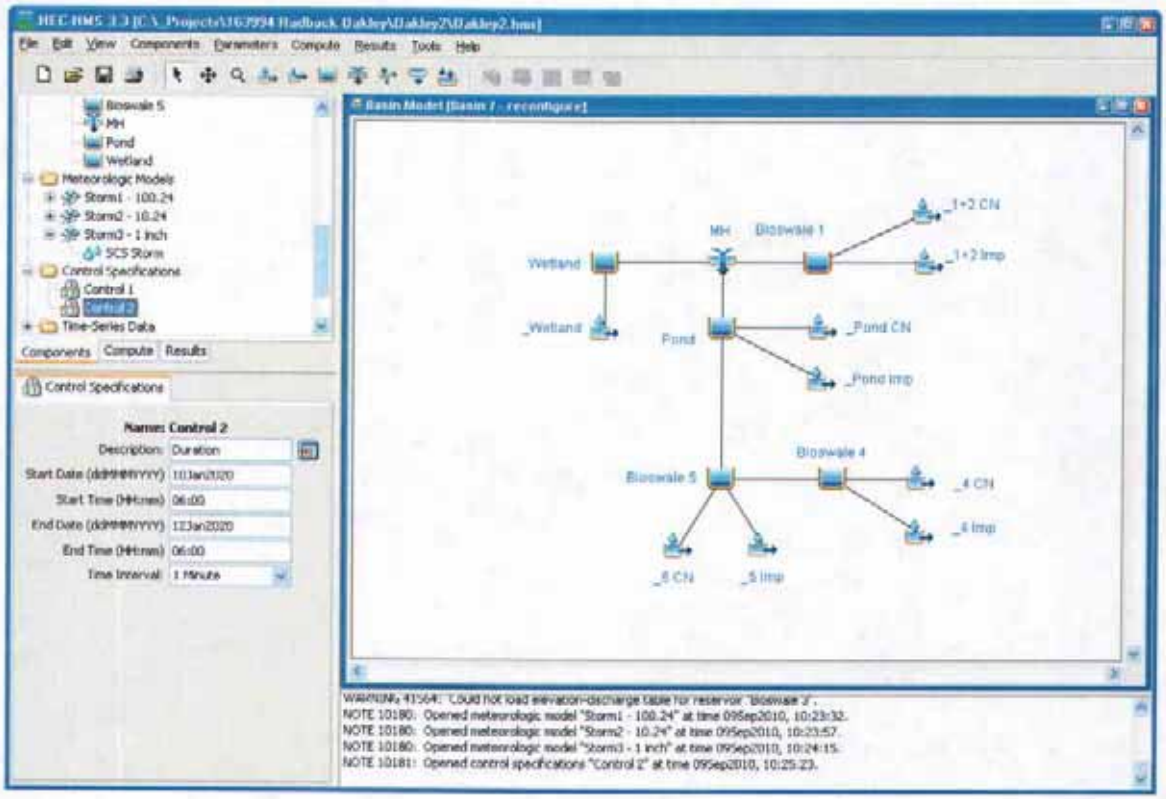
HEC-HMS Input – Meteorologic Model Storm3 – 1-inch rainfall





HEC-HMS Input – Control Data





Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 13

52.5406.1007

Rev 1 9/14/10
All Pages
CAK

Attachment 2

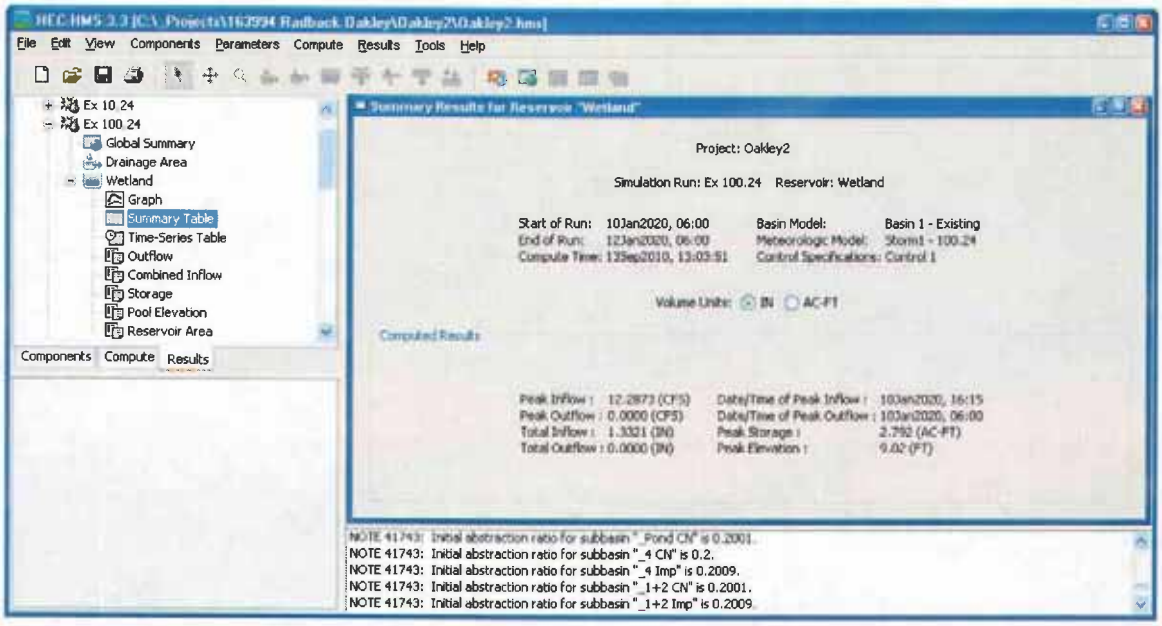
~~Reference~~

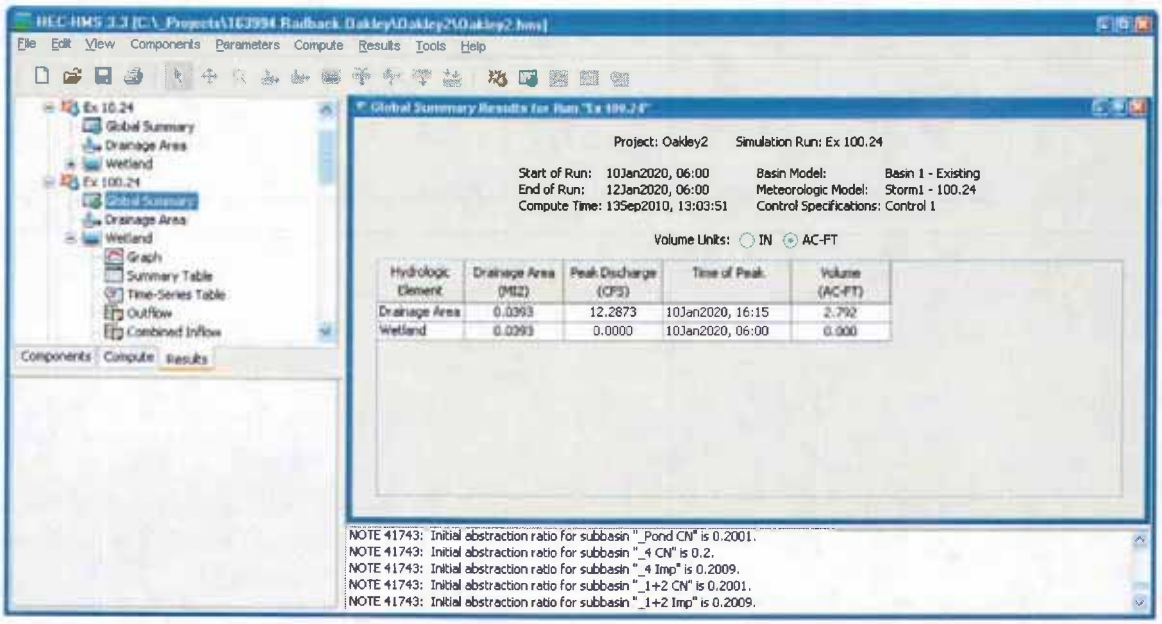
HEC-HMS OUTPUT

Description Key for HEC-HMS Input/Output Data

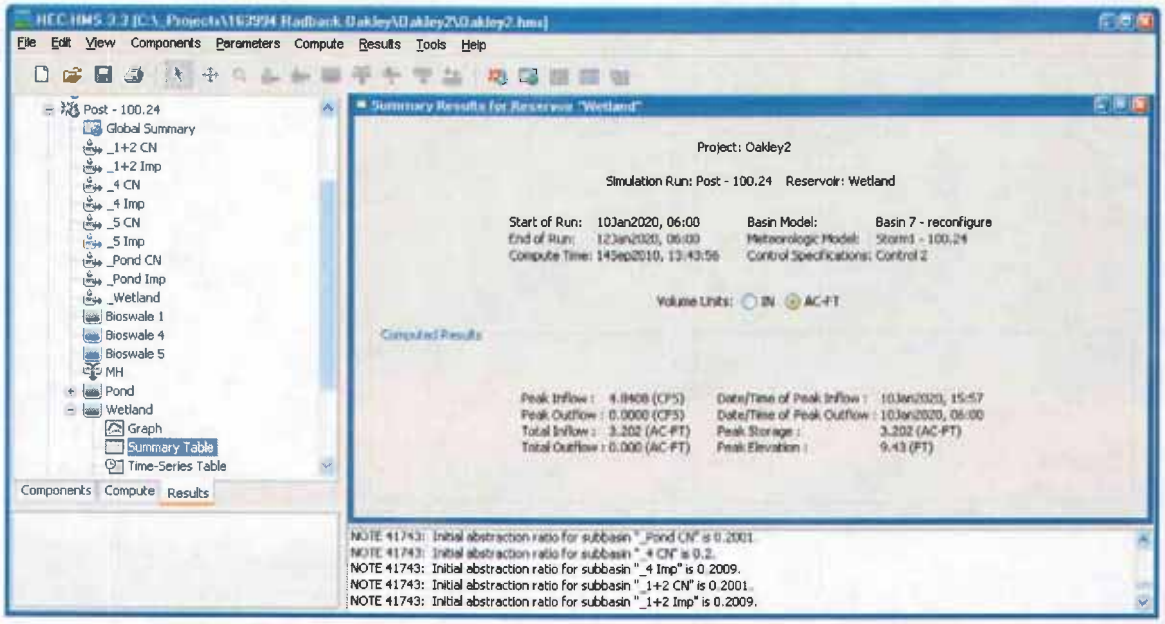
Hydrologic Element	Description
_1+2	Drainage area flowing to Bioswale 1+2
~~_3~~	~~Drainage area flowing to Bioswale 3~~
_4	Drainage area flowing to Bioswale 4
_5	Drainage area flowing to Bioswale 5
_Pond	Drainage area flowing directly to Pond
_Wetland	Drainage area flowing directly to Wetland
Bioswale 1+2	Flow from Bioswale 1+2 outlet (to MH1)
Bioswale 3	Flow from Bioswale 3 outlet (to MH2)
Bioswale 4	Flow from Bioswale 4 outlet (to MH1)
Bioswale 5	Flow from Bioswale 5 outlet (to Wetland)
MH1	Flow from Bioswales 1+2 and 4 (to Pond)
MH2	Flow from Pond and Bioswale 3 (to Wetland)
Pond	Flow from Pond Outlet (to MH2)
Wetland	Flow from Wetland (set to 0.0)

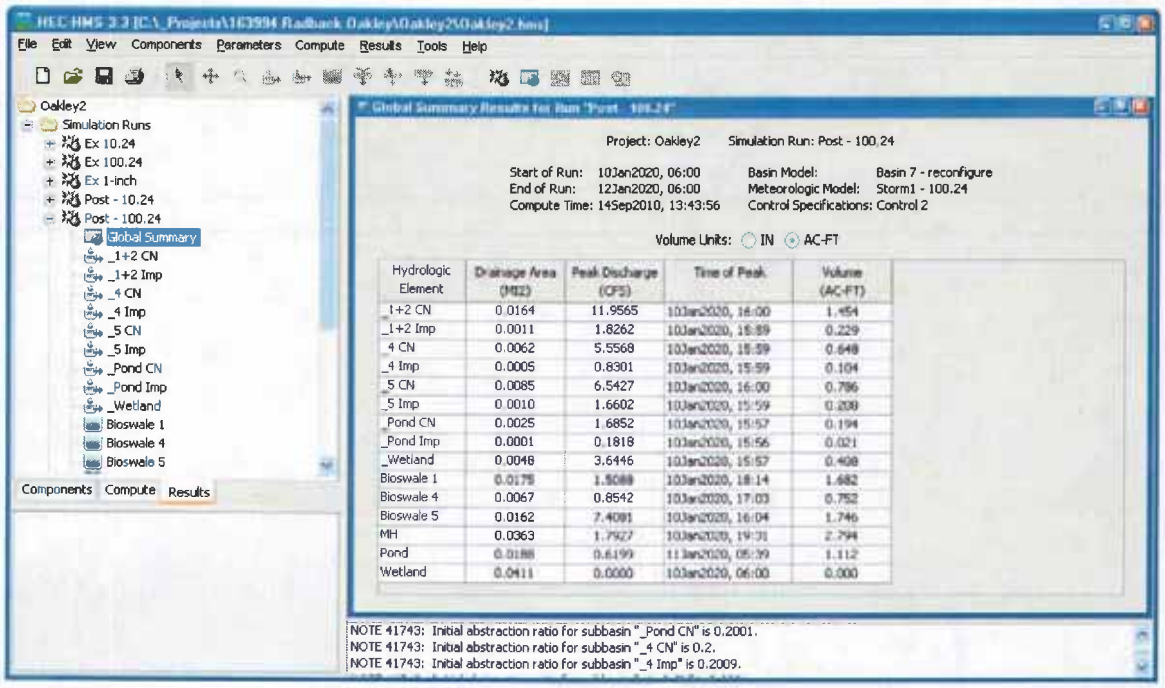
HEC-HMS Output – Pre-Construction 100-Year, 24-Hour Flow to Wetland





HEC-HMS Output – Post-Construction 100-Year, 24-Hour Flow to Wetland

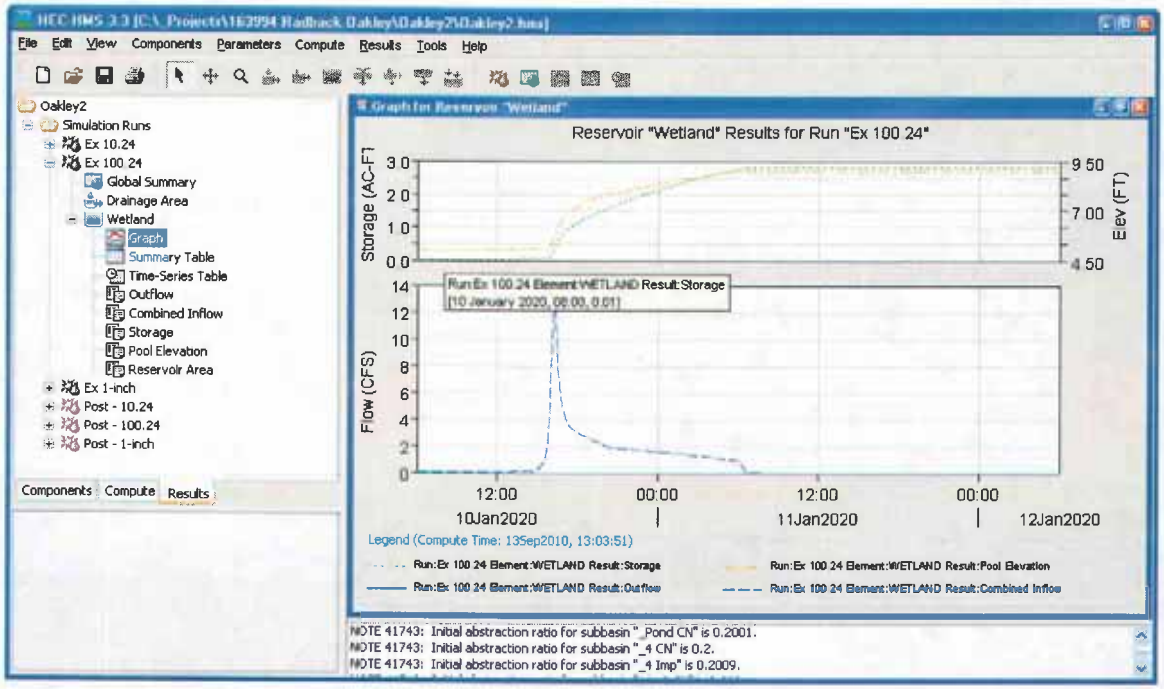




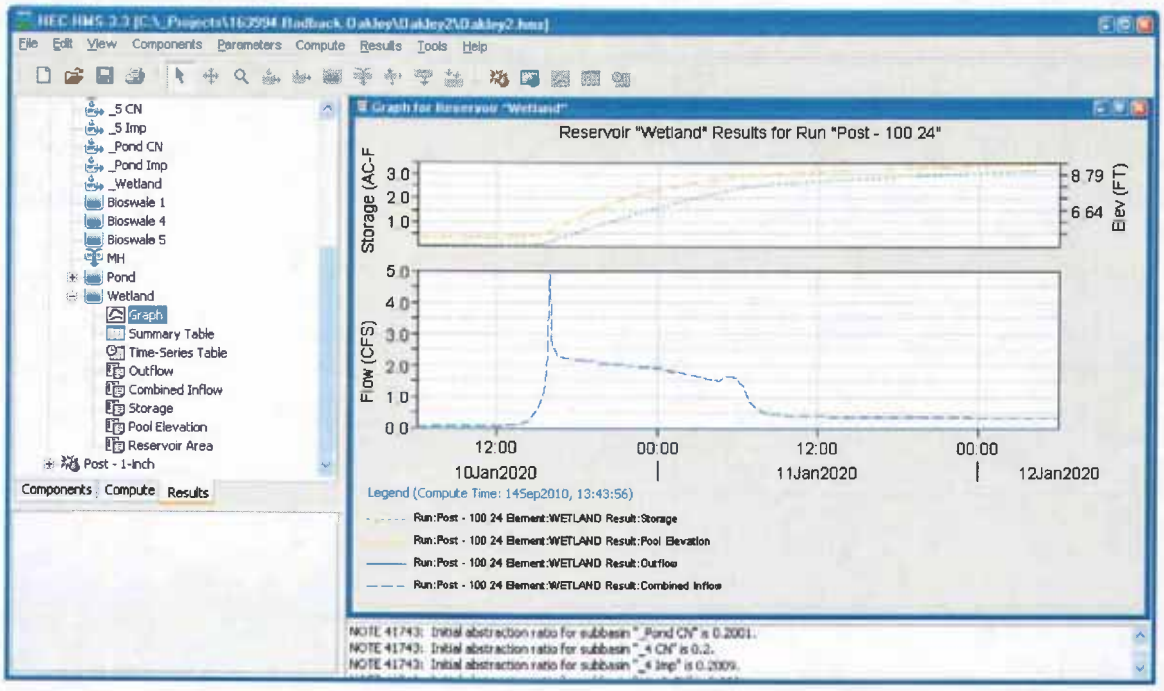
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
_1+2 CN	0.0164	11.9565	10Jan2020, 16:00	1.454
_1+2 Imp	0.0011	1.8262	10Jan2020, 15:59	0.229
_4 CN	0.0062	5.5568	10Jan2020, 15:59	0.648
_4 Imp	0.0005	0.8301	10Jan2020, 15:59	0.104
_5 CN	0.0085	6.5427	10Jan2020, 16:00	0.786
_5 Imp	0.0010	1.6602	10Jan2020, 15:59	0.208
_Pond CN	0.0025	1.6852	10Jan2020, 15:57	0.194
_Pond Imp	0.0001	0.1818	10Jan2020, 15:56	0.021
_Wetland	0.0048	3.6446	10Jan2020, 15:57	0.408
Bioswale 1	0.0175	1.5088	10Jan2020, 18:14	1.682
Bioswale 4	0.0067	0.8542	10Jan2020, 17:03	0.752
Bioswale 5	0.0162	7.4081	10Jan2020, 16:04	1.746
MH	0.0363	1.7927	10Jan2020, 19:31	2.794
Pond	0.0188	0.6199	11Jan2020, 05:39	1.112
Wetland	0.0411	0.0000	10Jan2020, 06:00	0.000

HEC-HMS Output – Comparison Graphs 100-Year, 24-Hour Flow to Wetland

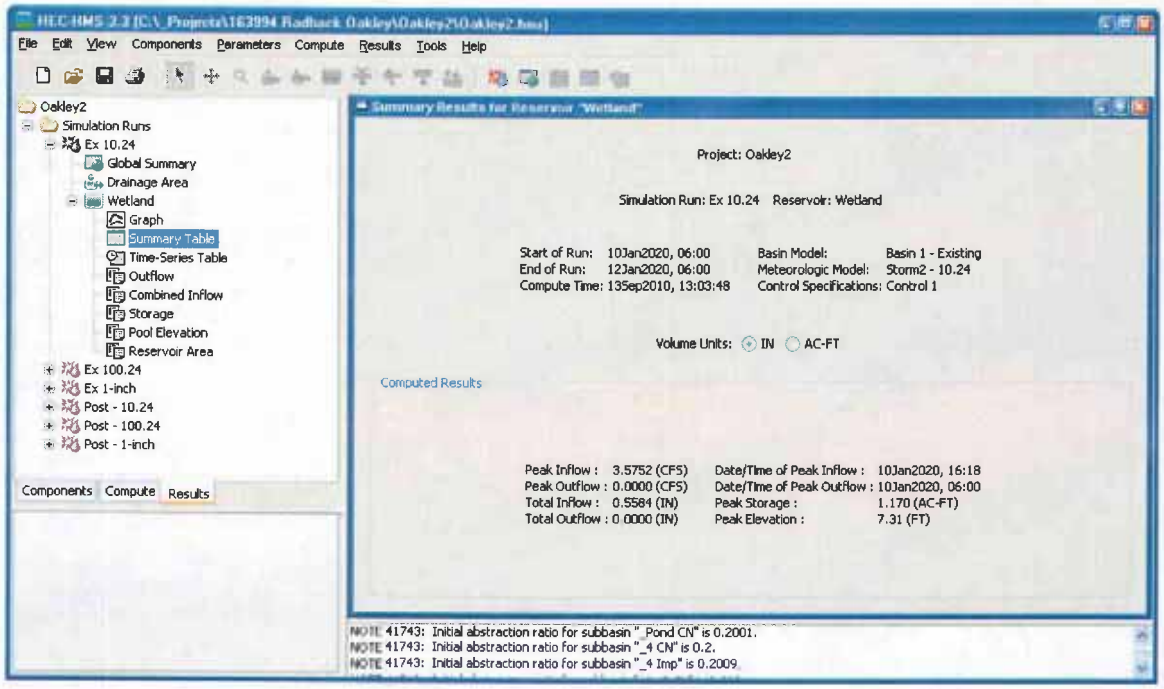
Pre-Construction

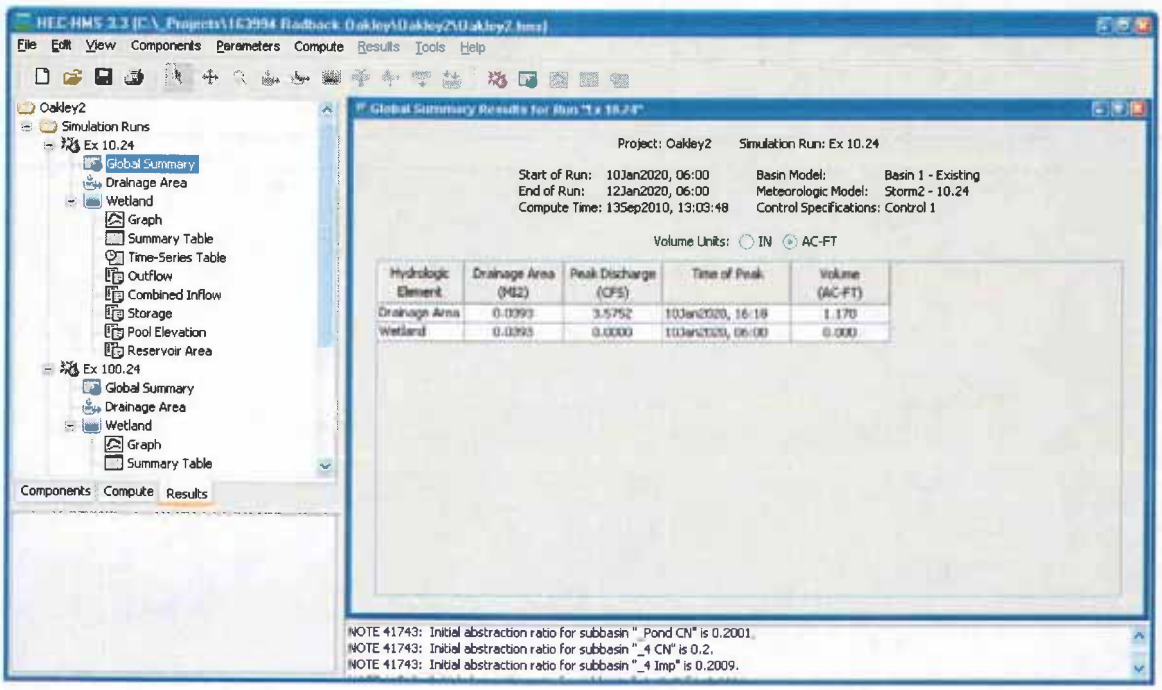


Post-Construction

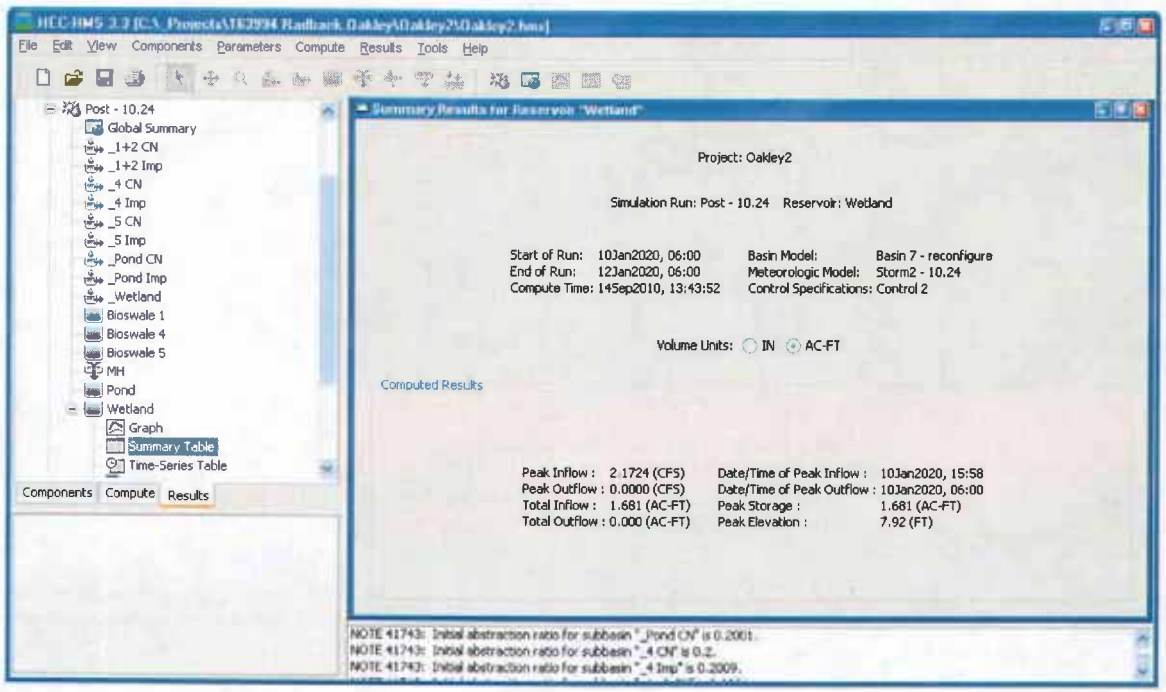


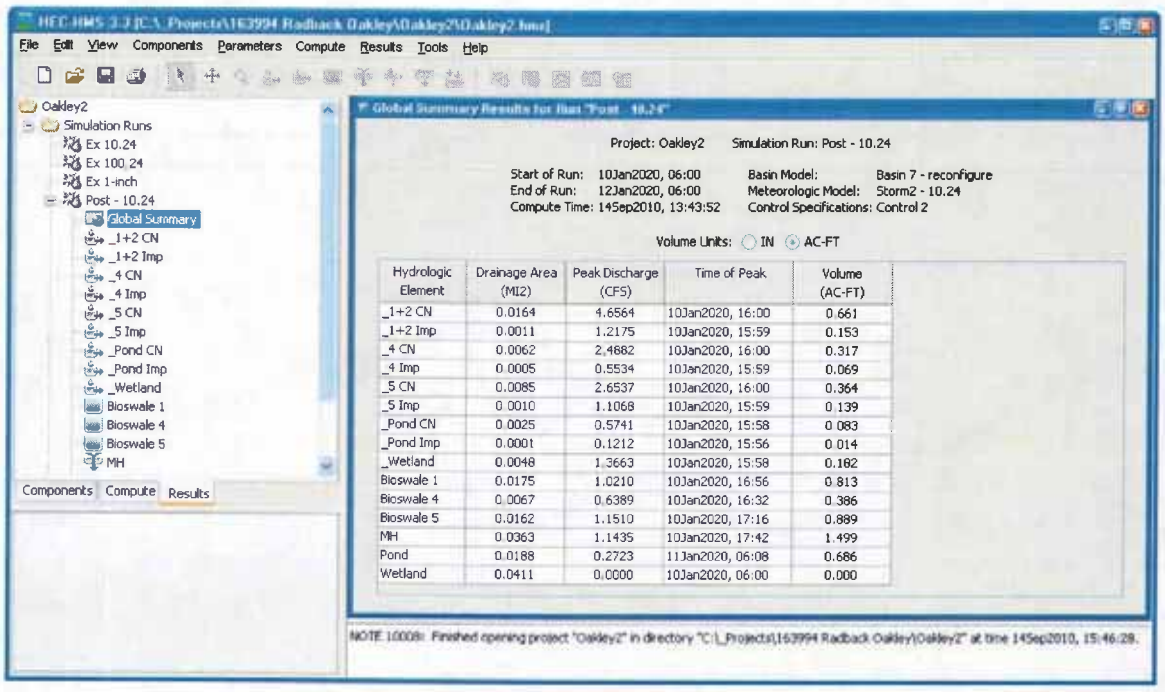
HEC-HMS Output – Pre-Construction 10-Year, 24-Hour Flow to Wetland





HEC-HMS Output – Post-Construction 10-Year, 24-Hour Flow to Wetland

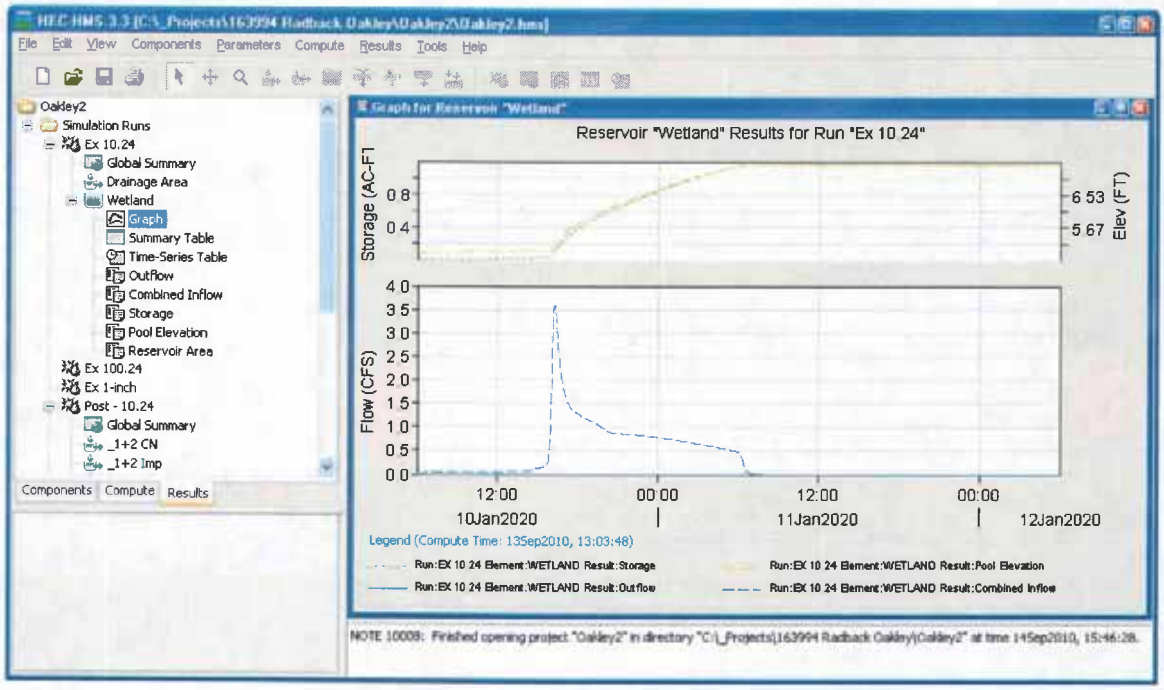




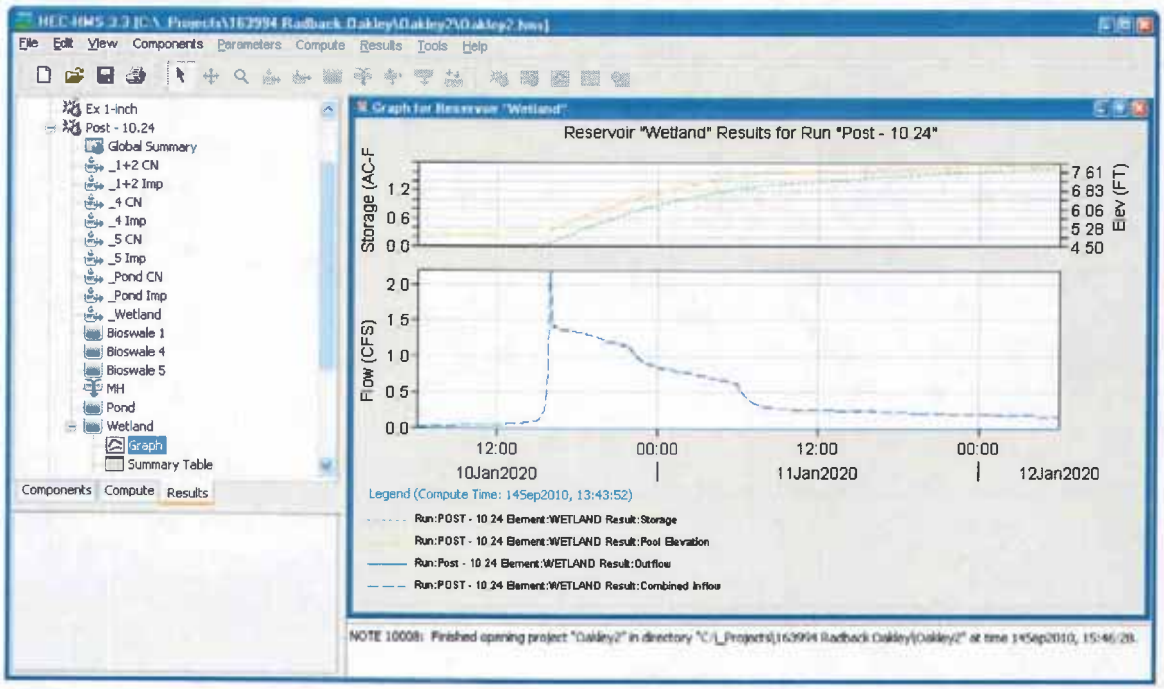
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
_1+2 CN	0.0164	4.6564	10Jan2020, 16:00	0.661
_1+2 Imp	0.0011	1.2175	10Jan2020, 15:59	0.153
_4 CN	0.0062	2.4882	10Jan2020, 16:00	0.317
_4 Imp	0.0005	0.5534	10Jan2020, 15:59	0.069
_5 CN	0.0085	2.6537	10Jan2020, 16:00	0.364
_5 Imp	0.0010	1.1068	10Jan2020, 15:59	0.139
_Pond CN	0.0025	0.5741	10Jan2020, 15:58	0.083
_Pond Imp	0.0001	0.1212	10Jan2020, 15:56	0.014
_Wetland	0.0048	1.3663	10Jan2020, 15:58	0.182
Bioswale 1	0.0175	1.0210	10Jan2020, 16:56	0.813
Bioswale 4	0.0067	0.6389	10Jan2020, 16:32	0.386
Bioswale 5	0.0162	1.1510	10Jan2020, 17:16	0.889
MH	0.0363	1.1435	10Jan2020, 17:42	1.499
Pond	0.0188	0.2723	11Jan2020, 06:08	0.686
Wetland	0.0411	0.0000	10Jan2020, 06:00	0.000

HEC-HMS Output – Comparison Graphs 10-Year, 24-Hour Flow to Wetland

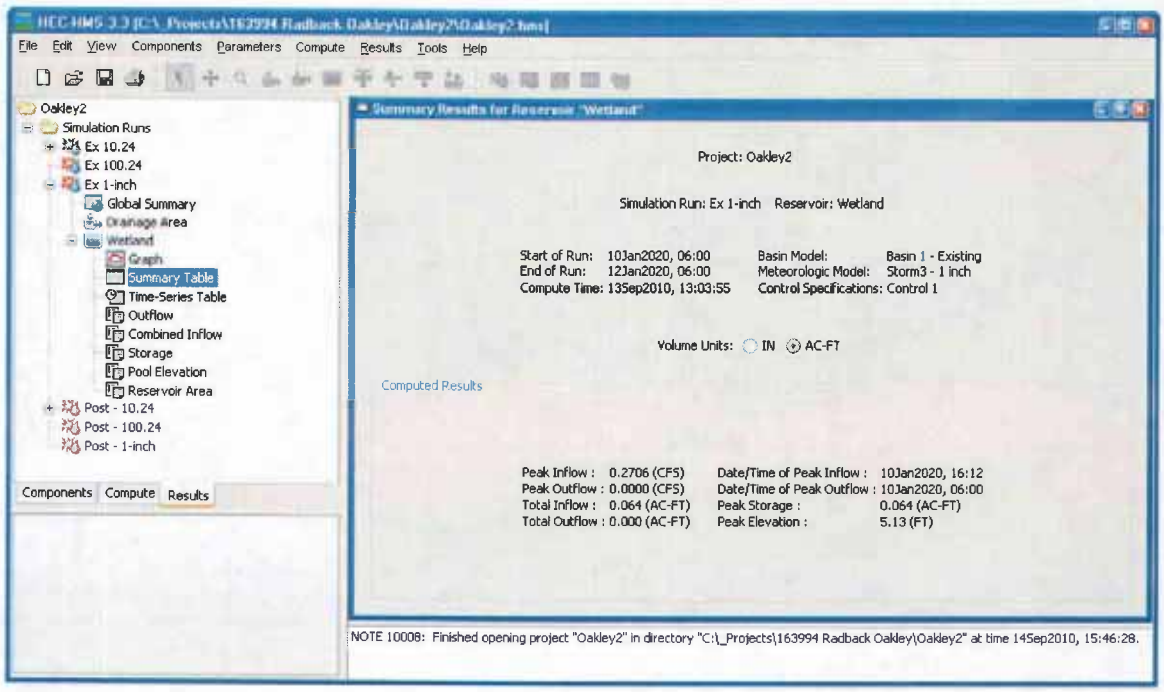
Pre-Construction

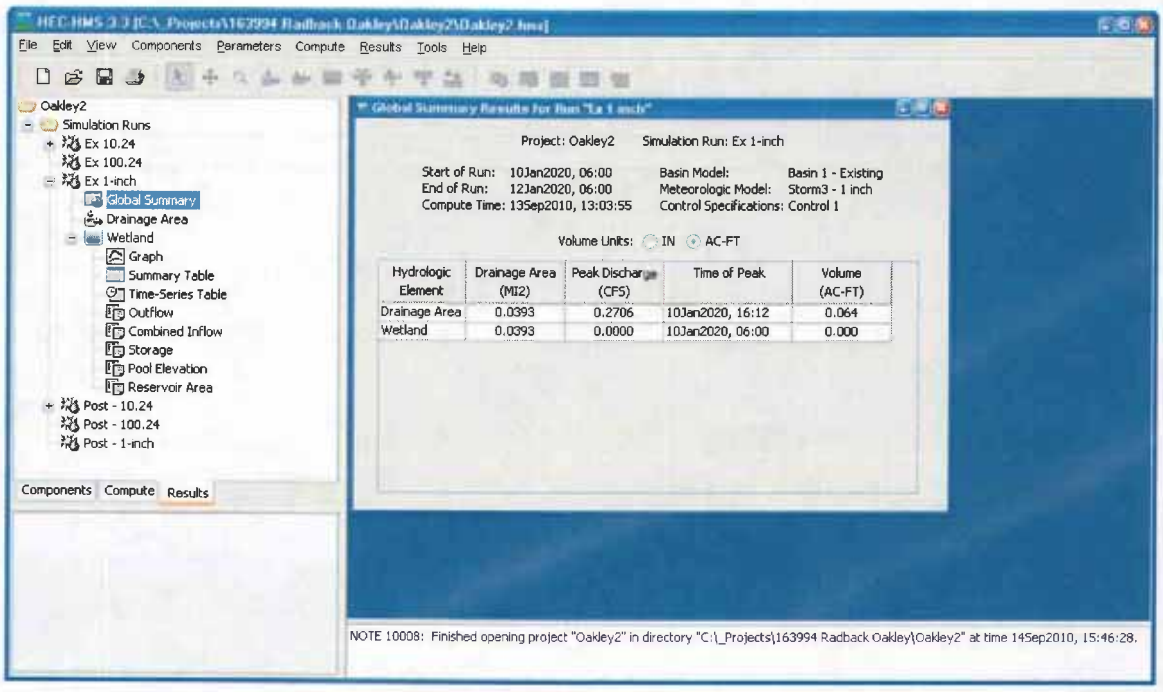


Post-Construction

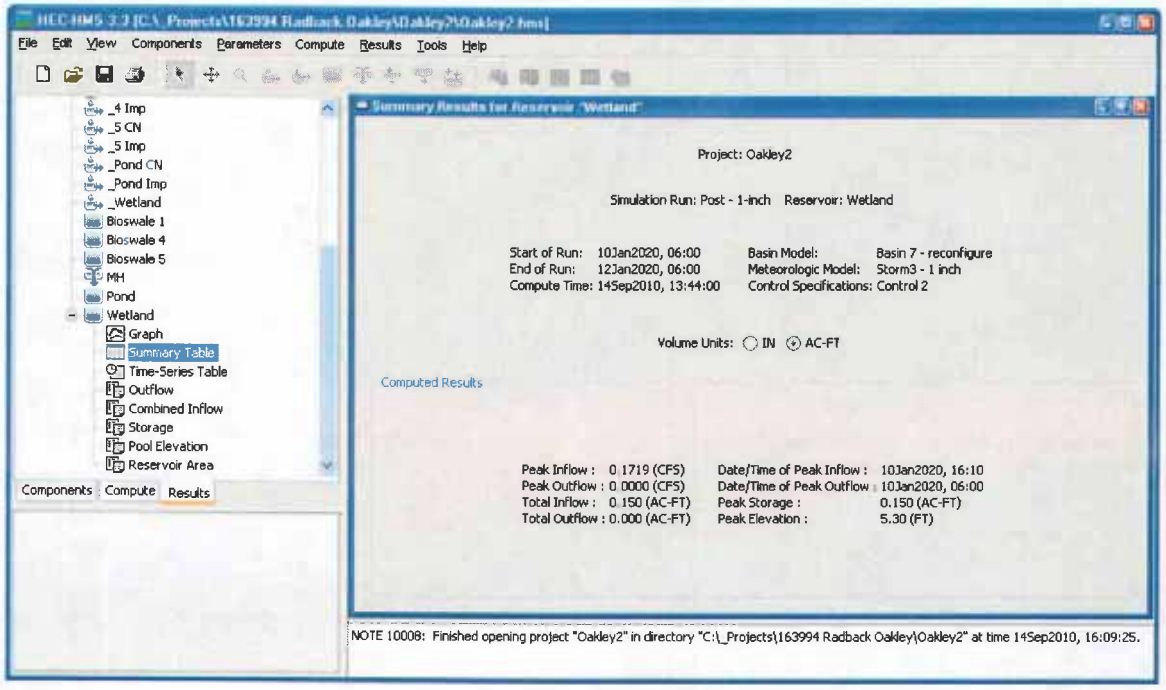


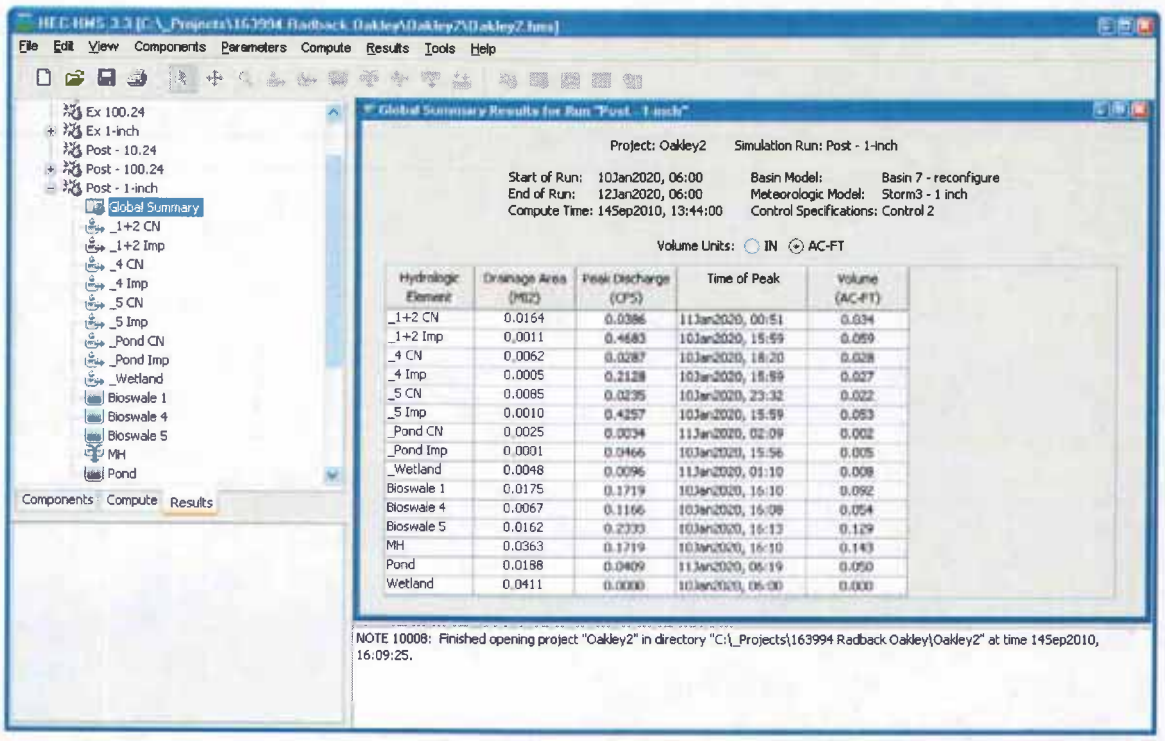
HEC-HMS Output – Pre-Construction 1-Inch Rainfall Flow to Wetland





HEC-HMS Output – Post-Construction 1-Inch Rainfall Flow to Wetland

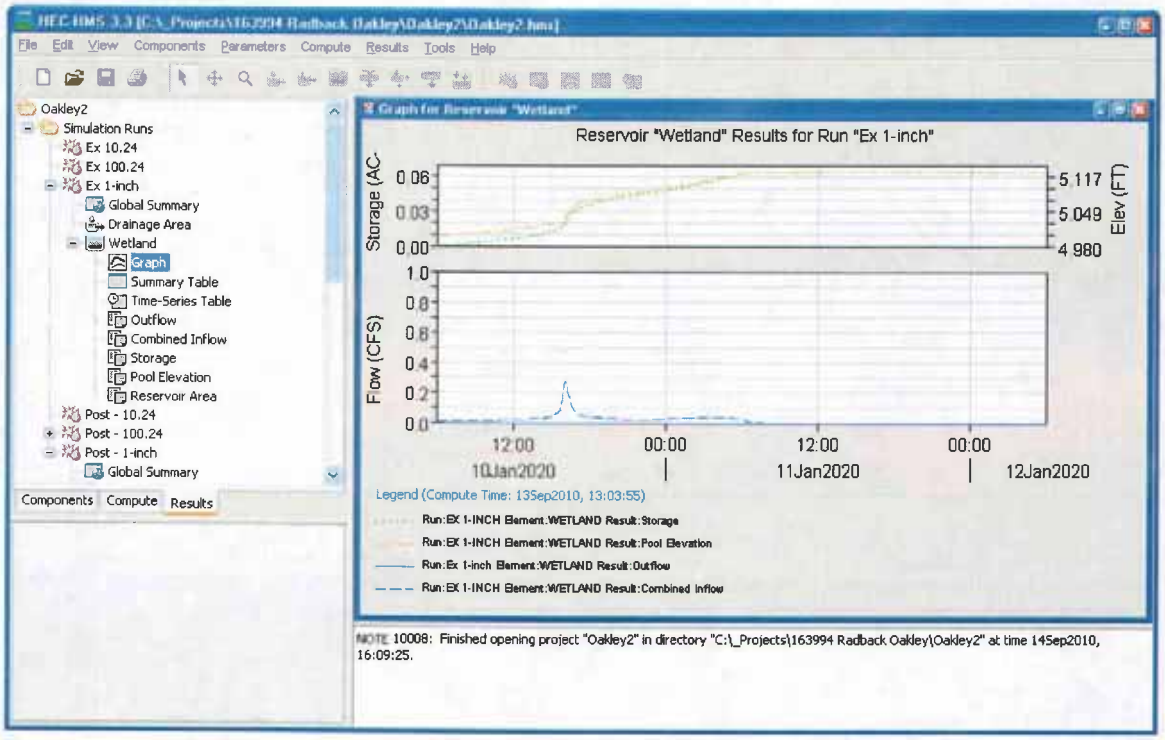




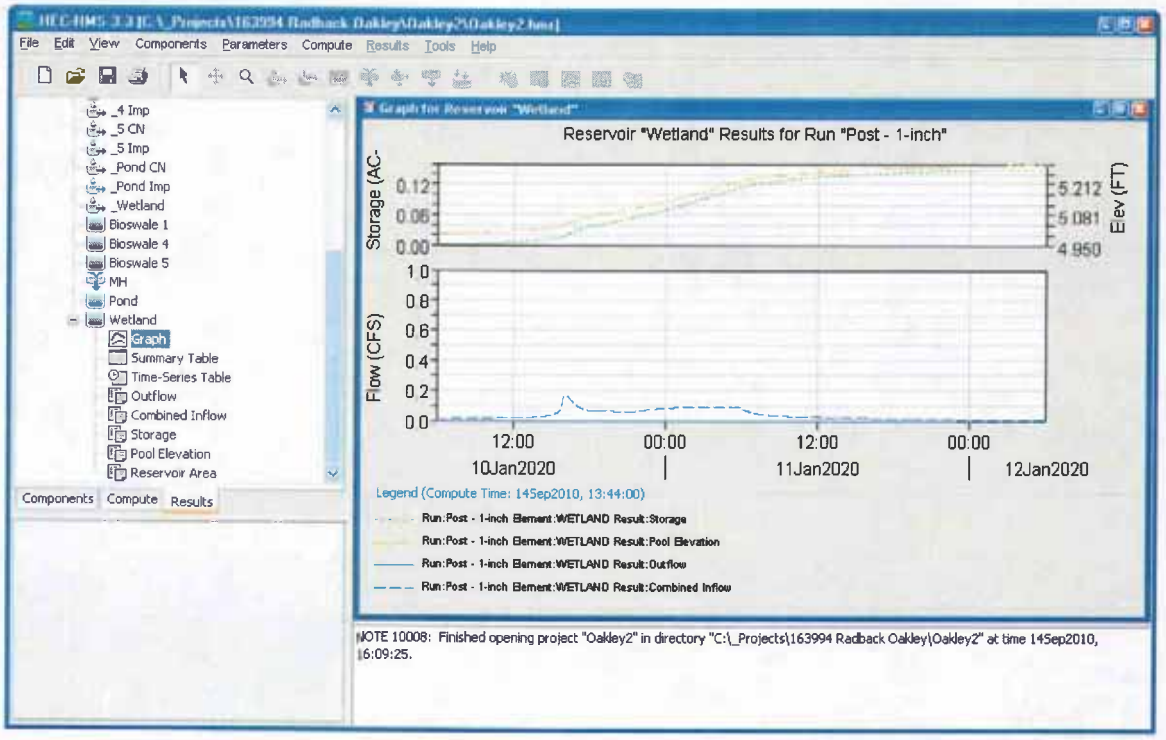
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
_1+2 CN	0.0164	0.0386	11Jan2020, 00:51	0.034
_1+2 Imp	0.0011	0.4683	10Jan2020, 15:59	0.059
_4 CN	0.0062	0.0287	10Jan2020, 18:20	0.028
_4 Imp	0.0005	0.2128	10Jan2020, 15:59	0.027
_5 CN	0.0085	0.0235	10Jan2020, 23:32	0.022
_5 Imp	0.0010	0.4257	10Jan2020, 15:59	0.053
_Pond CN	0.0025	0.0034	11Jan2020, 02:09	0.002
_Pond Imp	0.0001	0.0466	10Jan2020, 15:56	0.005
_Wetland	0.0048	0.0096	11Jan2020, 01:10	0.008
Bioswale 1	0.0175	0.1719	10Jan2020, 16:10	0.092
Bioswale 4	0.0067	0.1166	10Jan2020, 16:08	0.054
Bioswale 5	0.0162	0.2333	10Jan2020, 16:13	0.129
MH	0.0363	0.1719	10Jan2020, 16:10	0.143
Pond	0.0188	0.0409	11Jan2020, 05:19	0.050
Wetland	0.0411	0.0000	10Jan2020, 06:00	0.000

HEC-HMS Output – Comparison Graphs 1-Inch Event Flow to Wetland

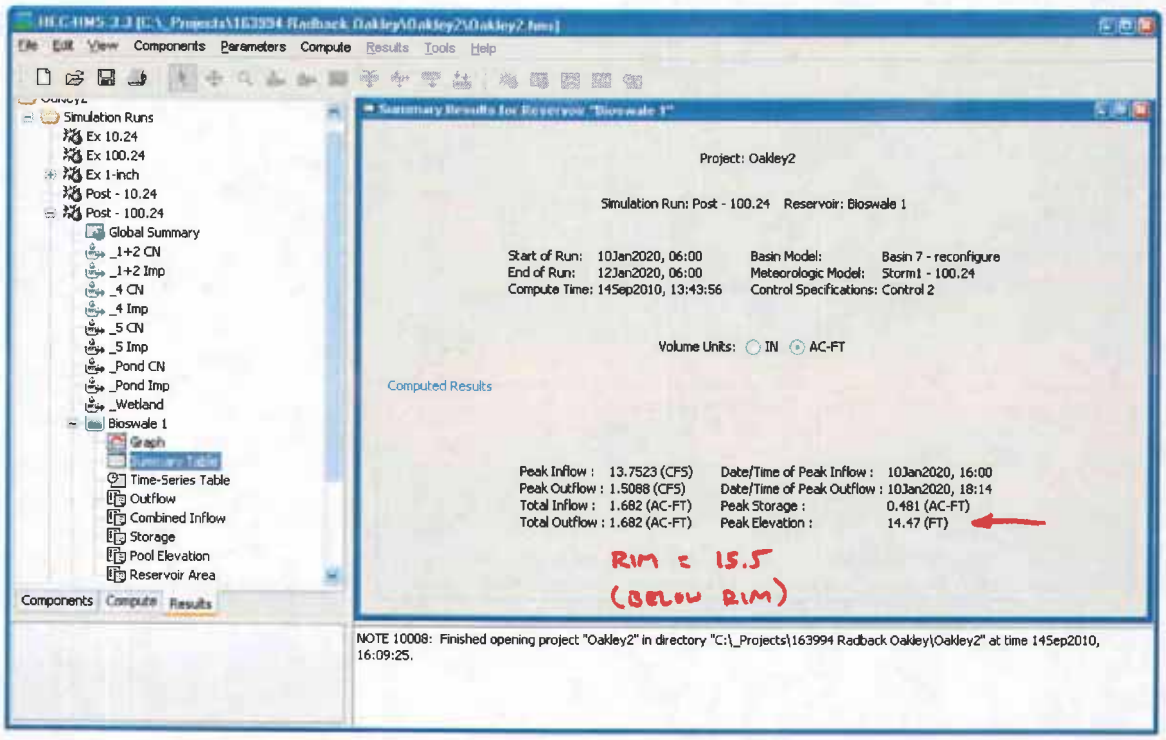
Pre-Construction



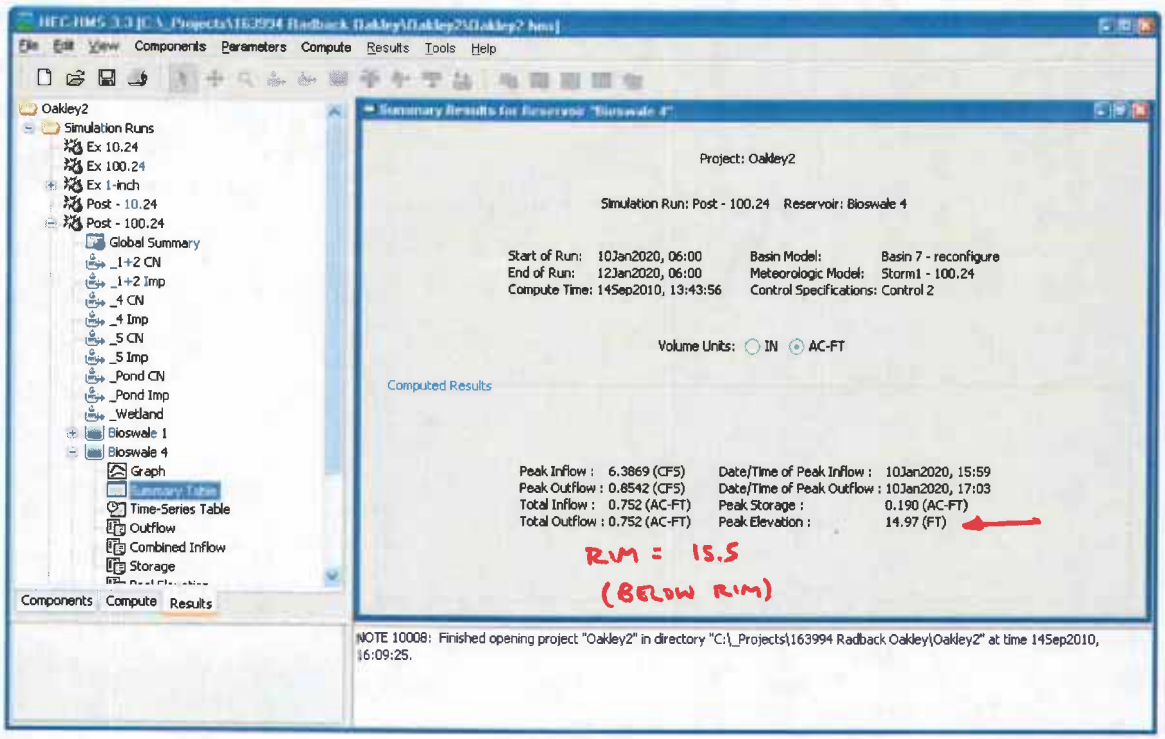
Post-Construction



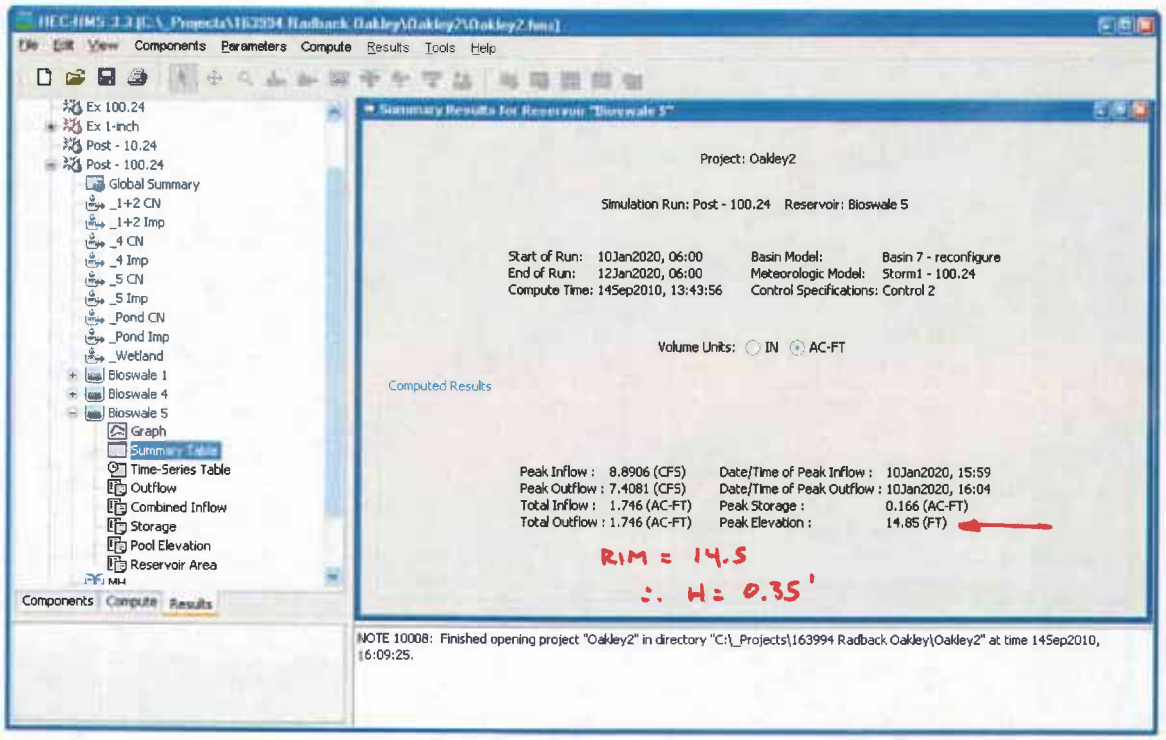
HEC-HMS Output – Post Construction 100-Year, 24-Hour Flow Bioswale 1-2



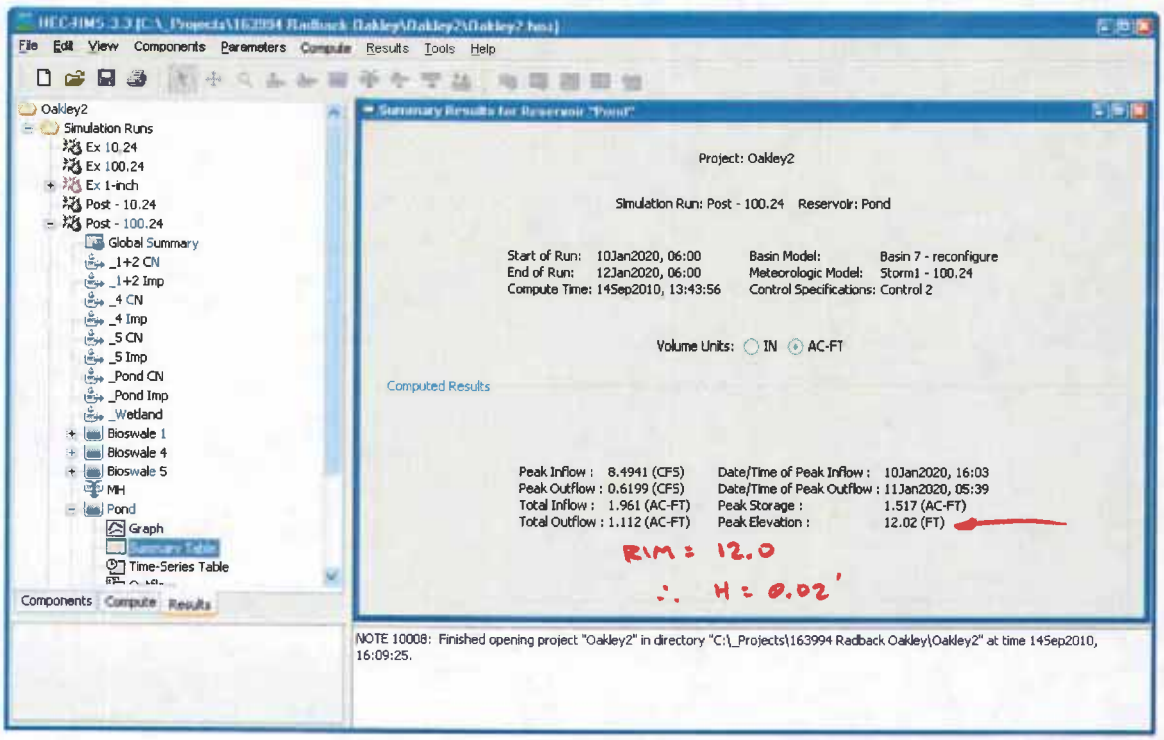
HEC-HMS Output – Post Construction 100-Year, 24-Hour Flow Bioswale 4



HEC-HMS Output – Post Construction 100-Year, 24-Hour Flow Bioswale 5



HEC-HMS Output – Post Construction 100-Year, 24-Hour Flow Pond



Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 9

52.5406.1007

Attachment 3

Reference 2

Select Pages

Chapter 2 Estimating Runoff

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S
[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Rev 2

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull elevation.

Chapter 3 Time of Concentration and Travel Time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[eq. 3-2]}$$

where:

T_c = time of concentration (hr)
m = number of flow segments

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow

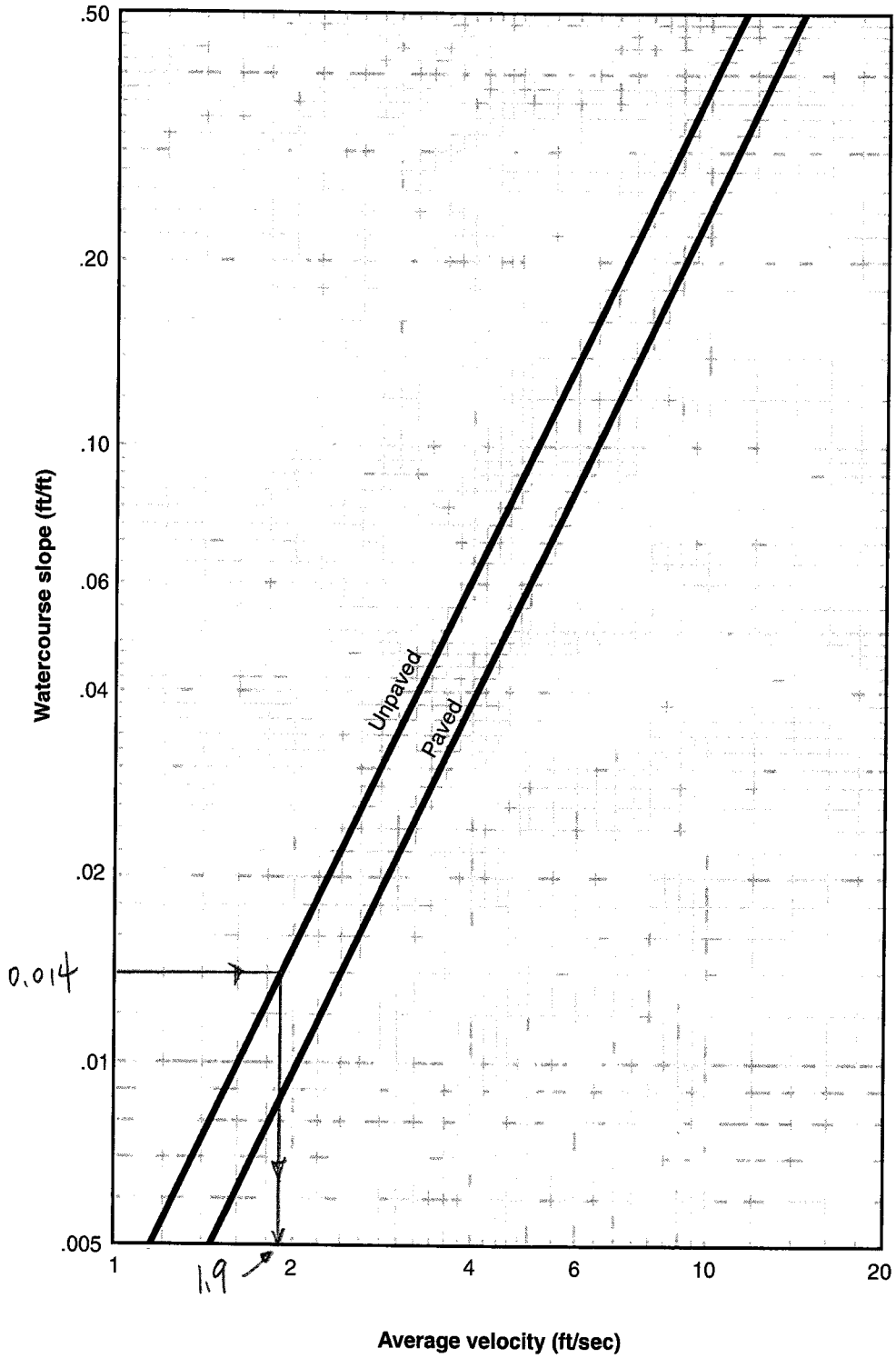
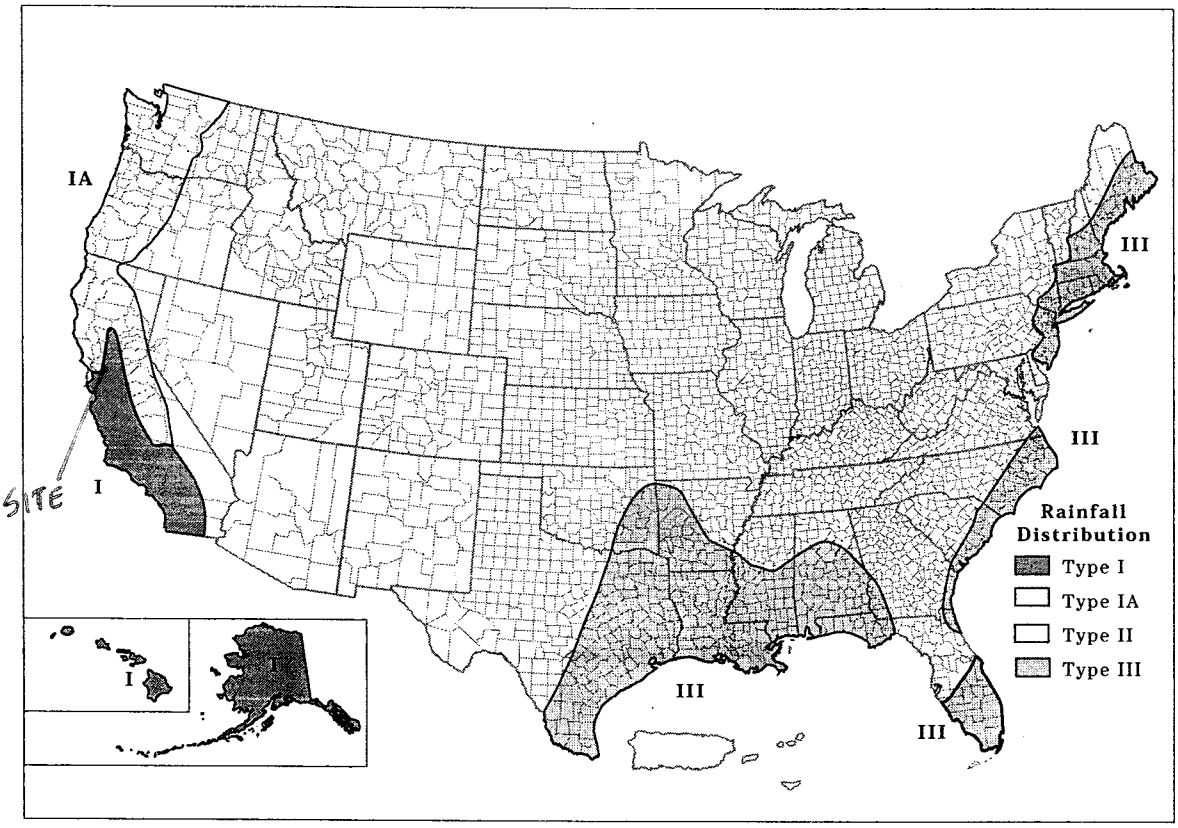


Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 5

52.5406.1007

Attachment 4

Reference 6

Select pages

(printed out from the online web soil survey)

Project site

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series.* All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 5

52.5406.1007

Attachment 5

Reference 8

92
89

IMP Sizing for Bioswale #1-2

Refer to Page 5, the total drainage area for bioswale #1-2 is measured to be: 491,168 ft^2 (11.28 ac). The bioswale is measured to be 1,323 feet long.

Six drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; (5) Transformer Containment; and (6) Open-Graded Aggregates (ACC Area).

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	54,900
DMA-2	Asphalt Pavement	65,113
DMA-3	Gravel Surfacing	100,200
DMA-4	Grass/Landscape	198,264
DMA-5	Transformer Containment	4,491
DMA-6	Open-Graded Aggregates	68,200

Runoff Coefficients

Dense-graded aggregate (Caltran Class 2 aggregate) will be utilized as the materials for aggregate surfacing. After being compacted, the dense-graded aggregate is estimated to have a runoff coefficient of 0.5 to 0.7. See communications with Contra Costa County Clean Water Program (Attachment 6). Use 0.6 in this calculation.

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Open Graded Aggregates" will have a runoff coefficient of 0.1. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (54{,}900 \times 1 + 65{,}113 \times 1 + 100{,}200 \times 0.6 + 198{,}264 \times 0.1 + 4{,}491 \times 0 + 68{,}200 \times 0.1)$$

$$= 206{,}779\ ft^2.$$

IMP Sizing for Bioswale #3

Refer to Page 5, the total drainage area for bioswale #3 is measured to be: 25,711 ft^2 (0.59 ac). The bioswale #3 is measured to be 187 feet long.

Three drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; and (3) Grass/Landscape.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	3,873
DMA-2	Asphalt Pavement	2,086
DMA-3	Grass/Landscape	19,752

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (3{,}873 \times 1.0 + 2{,}086 \times 1.0 + 19{,}752 \times 0.1)$$

$$= 7{,}934\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

IMP Sizing for Bioswale #4

Refer to Page 5, the total drainage area for bioswale #4 is measured to be: 190,955 ft^2 (4.38 ac). The bioswale #4 is measured to be 391 feet long.

Five drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; and (5) Transformer Containment.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	19,314
DMA-2	Asphalt Pavement	33,262
DMA-3	Gravel Surfacing	109,208
DMA-4	Grass/Landscape	23,692
DMA-5	Transformer Containment	5,479

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (19{,}314 \times 1.0 + 33{,}262 \times 1.0 + 109{,}208 \times 0.6 + 23{,}692 \times 0.1 + 5{,}479 \times 0)$$

$$= 120{,}470\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

IMP Sizing for Bioswale #5

Refer to Page 5, the total drainage area for bioswale #5 is measured to be: 290,529 ft^2 (6.67 ac) (natural gas facility included). The bioswale #5 is measured to be 385 feet long total.

Four drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; and (4) Grass/Landscape.

Including Railroad yard
PW 6/17/10

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	12,670
DMA-2	Asphalt Pavement	25,905
DMA-3	Gravel Surfacing	186,725
DMA-4	Grass/Landscape	65,229

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (12{,}670\text{x}1.0+25{,}905\text{x}1.0+186{,}725\text{x}0.6+89{,}695\text{x}0.1)$$

$$= 157{,}133\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

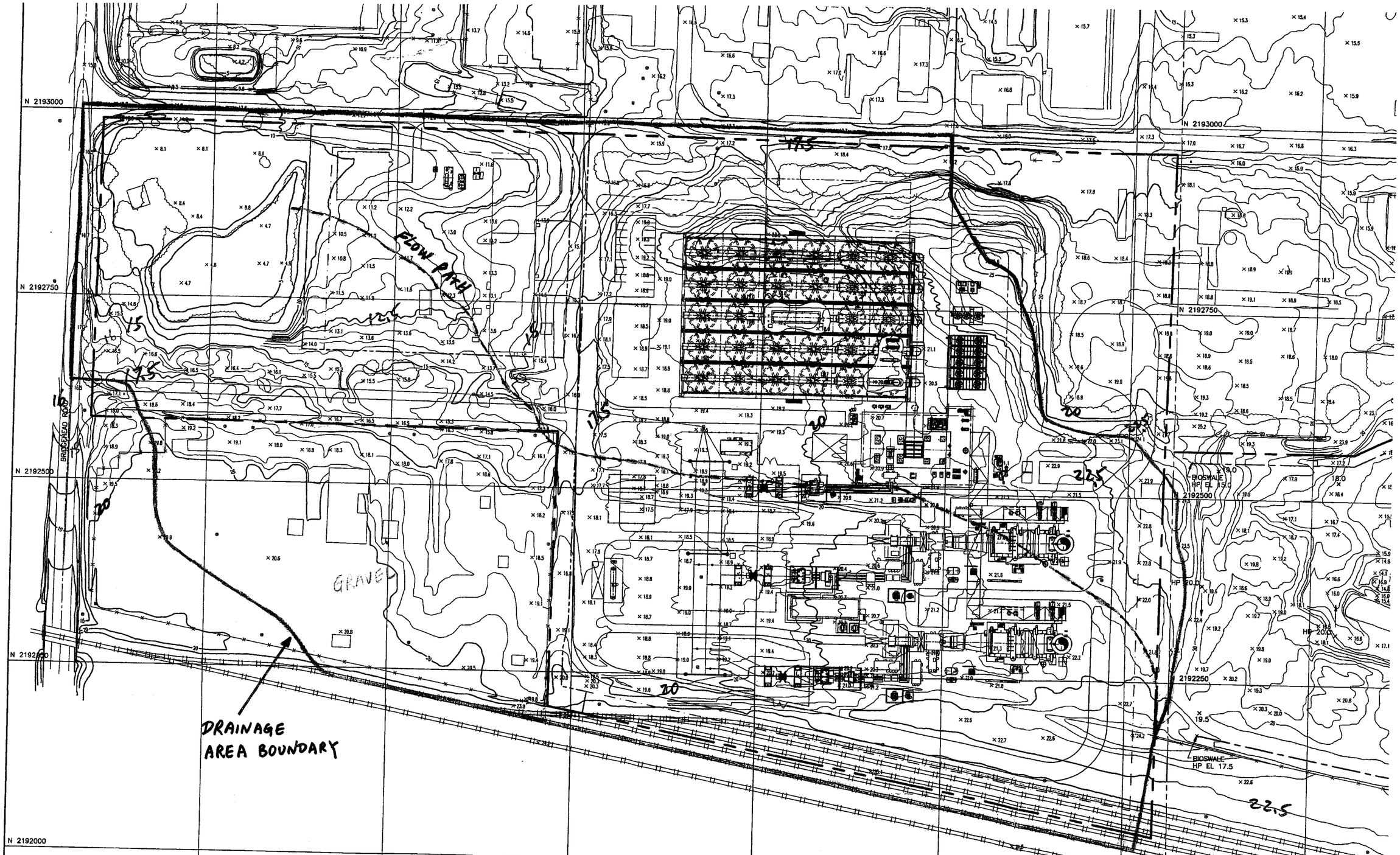
pages 3

52.5406.1007

Attachment 6

Reference 9

Select pages



Radback Tenaska project
project # 163994
52.5406.1003

stormwater Analysis

page 5 of 53

prepared by: J zhong
Date: 3/4/09
checked by: PW
Date: 3/6/09

NOTE: THIS PAGE IS A PORTION OF B&V Drawing 163994-SS-3001 Rev A.

AQUO 16.1s (LMS Tech)
1=1
E1 39:17:10

Hydrology Modeling – HEC-HMS

PRE-CONSTRUCTION

There is one drainage area that will drain to the wetland. See Page 5 for the boundary delineation of this area. This drainage area generally has four types of ground cover: (1) Vineyard, 19.85 acres; (2) Gravel Pavement, 3.96 acres; (3) Railroad Yard, 0.94 acres; and (4) Wetland, 0.40 acres. The total area of this drainage area is 25.15 acres (0.0393 mile^2). The measurements of the above areas were made by using AutoCAD.

The stormwater runoff to the wetland for a 100-year 24-hour storm event was modeled by using a computer program, HEC-HMS version 3.3, developed by the US Army Corps of Engineers (Ref. 3).

Section 1.0 Determine the Time of Concentration

Time of concentration (T_c) can be calculated as:

$$T_c = T_{sheet} + T_{shallow} + T_{channel} \qquad \text{(Ref. 4, Eq. 6-11)}$$

Where:

T_{sheet} = travel time in sheet flow;
$T_{shallow}$ = travel time in shallow concentrated flow;
$T_{channel}$ = travel time in open channels.

There is no open channel flow on this site. Thus $T_{channel} = 0$.

The flow path from the hydraulically most distant point of this drainage area to the wetland is identified as shown on Page 5.

The total flow length is measured to 1490 feet.

(1) Sheet Flow

Sheet flow travel time can be calculated as:

$$T_{sheet} = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{(Ref. 2, Eq. 3-3)}$$

Where:

n = roughness coefficient;
L = flow length (ft);
P_2 = 2-year, 24-hour rainfall (in);
s = land slope (ft/ft).

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 2

52.5406.1007

Attachment 7

Reference 11

$$\text{Incremental Storage Volume} = \left(\frac{AreaHi + AreaLo}{2} \times (ElevHi - ElevLo)\right)$$

For the volume between elevations 5.0 and 7.5:

$$\text{Incremental Storage Volume} = \left(\frac{0.62 + 0.40}{2} \times (7.5 - 5.0)\right) = 1.28 \text{ ac-ft}$$

Wetland Elevation – Area – Storage Summary (See Ref. 9, Pg 11)

Elevation (ft)	Wetland Area (acre)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
5.0	0.40	-	-
7.5	0.62	1.28	1.28
10.0	1.44	2.57	3.85
11.5	1.6	2.28	6.13

There is an outlet control structure proposed between the pond and wetland that will allow water to flow from the pond into the wetland when the water level in the pond is above elevation 10.0. The volume retained in the pond below elevation 10.0 prior to allowing discharge into the wetland is determined by calculating the total incremental storage provided below elevation 10.0 as shown in the table on the following page.

Retained Volume to Elevation 10.0 = 0.10 ac-ft + 0.23 ac-ft = 0.33 ac-ft

This storage volume reduces the runoff that reaches the wetland. The wetland water-surface elevation in the post-construction site condition takes this into account.

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 2

52.5406.1007

Attachment 8

Reference 12

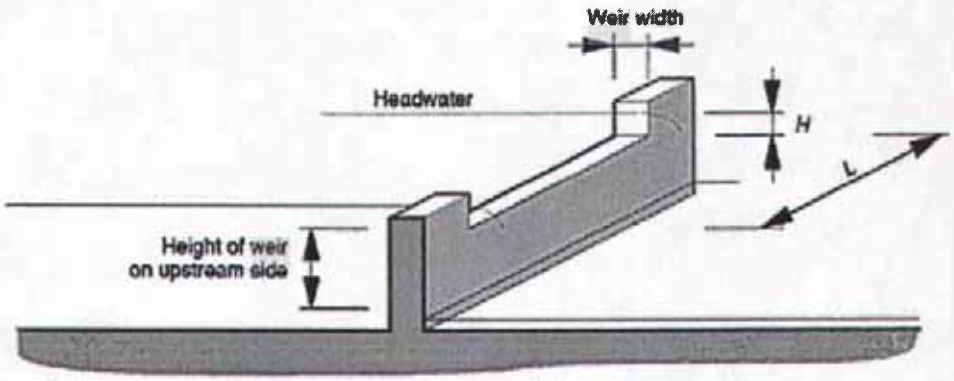


Figure 6.16 Dimensions of a rectangular weir.

WEIRS

A weir is a shelf that water falls over, such as the top of a barrel pipe, a timber check dam, or the crest of a concrete dam.

Weir discharge is governed by the simple principle that as head increases upstream of a weir, the flow over it increases. The type of material is irrelevant as long as the weir has only enough width for structural strength and water does not contact it long enough to be slowed down by friction.

A weir that is straight and level, with vertical sides, like that in Figure 6.16, is referred to as a rectangular weir. Discharge over this type of weir is predicted by the weir equation (U.S. Bureau of Reclamation, 1974, p. 373):

$$q = C\,L\,H^{3/2}$$

where

q = discharge, cfs

C = coefficient (no units) equal to 3.3 where a weir has significant height on the upstream side, such as at a dam or a barrel pipe, or 3.09 where a weir has no upstream height, such as at a drop structure in a channel

USE C = 3.1

L = horizontal length of crest, ft

H = head of water above the crest, ft

Radback Oakley Project

Project # 163994

Stormwater Analysis

CK 6/17/10

pages 2

52.5406.1007

Attachment 9

Reference 7

Type of channel	Values of the roughness coefficient n		
	Minimum	Normal	Maximum
1. Neat, surface	0.010	0.011	0.013
2. Mortar	0.011	0.013	0.015
b. Wood			
1. Planed, untreated	0.010	0.012	0.014
2. Planed, creosoted	0.011	0.012	0.014
3. Unplaned	0.011	0.013	0.015
4. Plank with battens	0.012	0.015	0.018
5. Lined with roofing paper	0.010	0.014	0.017
c. Concrete			
1. Trowel finish	0.011	**0.013**	0.015
2. Float finish	0.013	0.015	0.016
3. Finished, with gravel on bottom	0.015	0.017	0.020
4. Unfinished	0.014	0.017	0.020
5. Gunite, good section	0.016	0.019	0.023
6. Gunite, wavy section	0.018	0.022	0.025
7. On good excavated rock	0.017	0.020	—
8. On irregular excavated rock	0.022	0.027	—
d. Concrete bottom float with sides of			
1. Dressed stone in mortar	0.015	0.017	0.020
2. Random stone in mortar	0.017	0.020	0.024
3. Cement, rubble masonry, plastered	0.016	0.020	0.024
4. Cement rubble masonry	0.020	0.025	0.030
5. Dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0.023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. Glazed	0.011	**0.013**	0.015
2. In cement mortar	0.012	**0.015**	0.018
g. Masonry			
1. Cemented rubble	0.017	0.025	0.030
2. Dry rubble	0.023	0.032	0.035
h. Dressed ashlar	0.013	0.015	0.017
i. Asphalt			
1. Smooth	0.013	0.013	—
2. Rough	0.016	0.016	—
j. Vegetal cover	0.030	—	0.500
C. *Excavated or Dredged*			
C–1 General			
a. Earth, straight and uniform			
1. Clean and recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	**0.022**	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033

Use n=0.027 for vegetated ditch

Radback Oakley Project

Project # 163994

Stormwater

Analysis

Ck 6/17/10

pages 2

52.5406.1007

Attachment 10

Reference 13

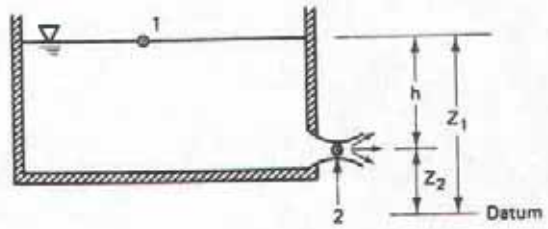


FIGURE 8–4 Schematic diagram of flow through an orifice.

$$\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \tag{8–13}$$

This can be simplified by making the following assumptions: (1) The pressure at both points is atmospheric, therefore $p_1 = p_2$; (2) The surface area of the pool A_1 is very large relative to the area of the orifice A_2, so from the continuity equation, V_1 is essentially 0; and (3) $z_1 - z_2 = h$. Thus, Equation 8–13 becomes

$$h = V_2^2/2g \tag{8–14}$$

Solving for V_2 and substituting it into the continuity equation yields

$$q = AV = A\sqrt{2gh} \tag{8–15}$$

Equation 8–15 depends on two assumptions that are not always true: there are no losses and the pressure is atmospheric across the opening of the orifice; it is actually atmosphere at a point below the orifice, called the vena contracta, where the cross-sectional area is a minimum. Because of these violations, the discharge will be less than that given by Equation 8–15. The actual discharge through the orifice is estimated by applying a discharge coefficient C_d to Equation 8–15:

$$q = C_d A\sqrt{2gh} \tag{8–16}$$

in which C_d is called the discharge coefficient. Equation 8–16 is referred to as the orifice equation. For some design problems, the q of Equation 8–16 is multiplied by an efficiency factor f to reflect other types of losses that limit the discharge rate. Values of C_d range from 0.5 to 1.0, with a value of 0.6 often used. C_d is dimensionless.

use 0.62

Example 8–3

A forklift is accidentally driven into the side of an above-ground storage tank and it punctures an 11-in.^{2} hole 6 in. above the ground. In order to complete the environmental report, the engineer needs to estimate the amount of petroleum that leaked out of the tank during the 25 min between the time of the puncture and the time that the hole was plugged. The surface elevation of the petroleum above the ground was 8.46 ft after the leak was stopped. The tank has a diameter of 40 ft. The engineer estimates the discharge coefficient is 0.55, which is less than the 0.6 value because of the additional losses created by the jagged edges of the hole. Thus, the estimated discharge is

$$q = C_d A\sqrt{2gh} = 0.55\left(\frac{11}{144}\right)[2\,(32.2)\,(8.46 - 0.5)]^{0.5}$$
$$= 0.951\ \text{ft}^3/\text{sec}$$

BLACK & VEATCH Building a world of difference.

CALCULATION RECORD

Client Name: Radback Energy Page 1 of 19

Project Name: Oakley Generating Station Project No.: 163994

Calculation Title: IMP Sizing for Plant Area

Calculation No./File No.: 52.5406.1008

Verification Method: ☒ Check and Review ☐ Alternate Calculations

Objective To determine the minimum required size of bioswales to satisfy Stormwater C.3 requirements for treatment and flow control for the plant area for the proposed Oakley Generating project.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

Refer to Page _____ of this calculation for additional assumptions.

This Section Used for Software-Generated Calculations

Program Name/Number: _____ Version: _____

Standard B&V Application Used? ☐ Yes ☐ No

If no, list approved deviation permit number below and attach approved deviation permit.

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	C Kantola	15 June 2010	PLNelson	6/18/10	PLNelson	16 June 2010
1	C Kantola	9/13/10	PLNelson	9/21/10	PLNelson	9/21/10

Purpose

To determine the minimum required size of bioswales to satisfy Stormwater C.3 requirements for treatment and flow control for the plant area for proposed Tenaska Project.

References

1. Black & Veatch Drawing:
   - 163994-SS-3001, Rev. ~~1~~ 2, "Grading & Drainage - Site Plan - Sheet 1"
   - 163994-SS-3201, Rev. 0, "Surfacing/Fencing/Roadway - Site Plan - Sheet 1"
   - 163994-SS-3050, Rev. ~~1~~ 2, "Site Sections and Details"
   - 163994-SS-1002, Rev. 2, "General Arrangement – Site"
2. Contra Costa Clean Water Program; Stormwater C.3 Guidebook; Stormwater Quality Requirements for Development Applications; Fourth Edition; September 10, 2008.
3. Contra Costa County Public Works Department; Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973; Drawing No. B-166; December 1977.
4. US Department of Agriculture, Natural Resources Conservation Service; Web Soil Survey; http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.
5. US Department of Agriculture; Urban Hydrology for Small Watersheds, 2nd Edition; Technical Release 55 (TR-55); June 1986.
6. Email Communications between Black & Veatch and Contra Costa Clean Water Program; March 2009.

Definition of Units and Constants

English units will be used.

Example of Common Unit Designations:

Rainfall amount in inches (in)
Drainage area in acres (ac)

Attachments

1. Black & Veatch Drawings SS1002, SS-3001, SS-3201 and SS-3050
2. Reference 2 – Select Pages
3. Reference 3 – Drawing No. B-166
4. Reference 4 – Select Pages
5. Reference 5 – Select Pages
6. Email Communications

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	C. Kantola	
PLANT	Oakley Generating	Unit No.	DATE	15-Jun-2010	
PROJECT NO.	163994	File No. 52.5406.1008	CKD BY	PLN	
TITLE	IMP Sizing		DATE	6/18/10	
			PAGE	3	OF 19

Summary:

Three ~~Four~~ bioswales will be constructed within the plant area to collect and infiltrate stormwater.
Based on the Stormwater C.3 requirements (Ref 2), the required bioswale surface area and volume for each bioswale are listed in the following table. The design bioswale length, shape, design surface area and volume are presented in the following table. The design bioswales in the plant area have sufficient surface areas and volume to satisfy the Stormwater C.3 requirements.

IMP ID	Shape	Length (feet)	Side Slope	Bottom Width (feet)	Design Surface Area (ft^2)	Design Volume (ft^3)	Required Surface Area (ft^2)	Required Volume (ft^3)
Bioswale #1-2	Trapezoidal	1,323	3 (h) to 1 (v)	2	26,460	43,659	13,042	10,806
Rev 1 Deleted Bioswale 3 ~~Bioswale #3~~	~~Trapezoidal~~	~~187~~	~~3 (h) to 1 (v)~~	~~2~~	~~2,618~~	~~2,092~~	~~500~~	~~415~~
Bioswale #4	Trapezoidal	391	3 (h) to 1 (v)	2	7,820	12,903	7,598	6,296
Bioswale #5	Trapezoidal	385	3 (h) to 1 (v)	10 ft for first ~~265~~ 145 ft long section; ~~8 ft for remaining 120 ft long section~~	10,105	16,714	9,910	8,211

Note: Treatment to meet C.3 requirements is provided within proposed detention basin for Bioswales #4 + 5. Bioswale #1-2 will remain
See Pages 9a-9c for basin sizing calculations

Rev 1
9/13/10 ✓ PLN 9/17/10
CAK

IMP Sizing for Plant Area

The generation area primarily consists of two combustion turbines, two heat recovery steam generators (HRSG), one air cooled condenser (ACC), three switchyards, one water treatment building, one warehouse building, two water storage tanks, one administration building, and other miscellaneous equipment/facilities. See B&V Drawing SS-1002 for plant general arrangement (Attachment 1). Plant loop road and major equipment access roads will be constructed within the plant. The areas adjacent to the buildings and equipment will have gravel surfacing. Other areas will be covered with vegetated grass. See B&V Drawing SS-3001 for proposed site surfacing of the plant (Attachment 1). The existing trees on this project site will be preserved.

~~Four~~ Three bioswales and a detention pond will be constructed within the plant site to collect and infiltrate stormwater. See Page 5 for the locations of bioswales and delineated drainage area for each bioswale and pond. Drop and/or outlet control structures will be installed at the end of each bioswale such that sufficient depth (volume) of stormwater has to be collected ~~in the bioswale~~ before downstream discharge can occur. Low flow orifices are provided to maintain hydration of the existing wetland PLN 9/17/10

An existing natural gas distribution facility is located west of the project and is outside the project limits. This area is generally covered by gravel surfacing. From the topography, most of the natural gas facility drains towards the wetland. After constructing the plant access road from Bridgehead Road, this area will continue to drain towards the wetland via a culvert being installed underneath the access road. The natural gas facility will be included in the IMP sizing for bioswale #5 since the stormwater from this area will flow to and accumulate in this bioswale.

NRCS Soil Group

Based on the soil survey information from the US Department of Agriculture Natural Resources Conservation Service (NRCS), the project site in Contra Costa County, California is covered by "Delhi Sand". See Attachment 4. From the description of "Delhi Sand" by NRCS, this soil layer is "somewhat excessively drained"; the capacity of the most limiting layer to transmit water is "high to very high (5.95 to 19.98 in/hr)". Per Ref. 5, this type of soil can be classified as Hydrologic Soil Group A soil.

BIOSWALE #3

POND

BIOSWALE #1-2

BIOSWALE #5

BIOSWALE #4

DRAINAGE AREA FOR EA. BIOSWALE (TYP)

CONSERVATION EASEMENT

SLOPE TO MATCH BRIDGEHEAD ROAD

BRIDGEHEAD ROAD

CL BIOSWALE

SEE NOTE (TYP)

SEE NOTE 8

MATCHLINE E 6202810 – SEE DWG SS-3002 FOR CONTINUATION

N 2193000

N 2192750

N 2192500

N 2192250

N 2192000

E 6201500

E 6201750

E 6202000

E 6202250

E 6202500

E 6202750

ALL BACKCIRCLED CHANGES PER ECN-N-S-00XX

OPEN
05/27/10

Scale 1" = 125'

VOID CAK 9/13/10
Superseded See page 5a

page 5 of 19
Redbeck Ernst
Oakley Project
Proj # 163934
File 52.5406.1008
By: C. Kautola
Date: 6/15/10
Checked by: PLN
Date: 6/17/10

ABBRE

APPROX
ASPH
AVG
BND
BLDG
B/MH
BOC
BOD
BOP
BU
C
CB
CD
CHDPE
CL
CLR
CMH
CND
CONC
CO
CS
CW
DB
DBC
DET
DIA
DIP
DWG
DWP
EC
ECC
EF
EHH
EL
EMH
EW
FC
FDN
FF
FRP
GR
HDM
HDPE
HP
HYD
ID
INV
JBX
L
LP

1 S3000

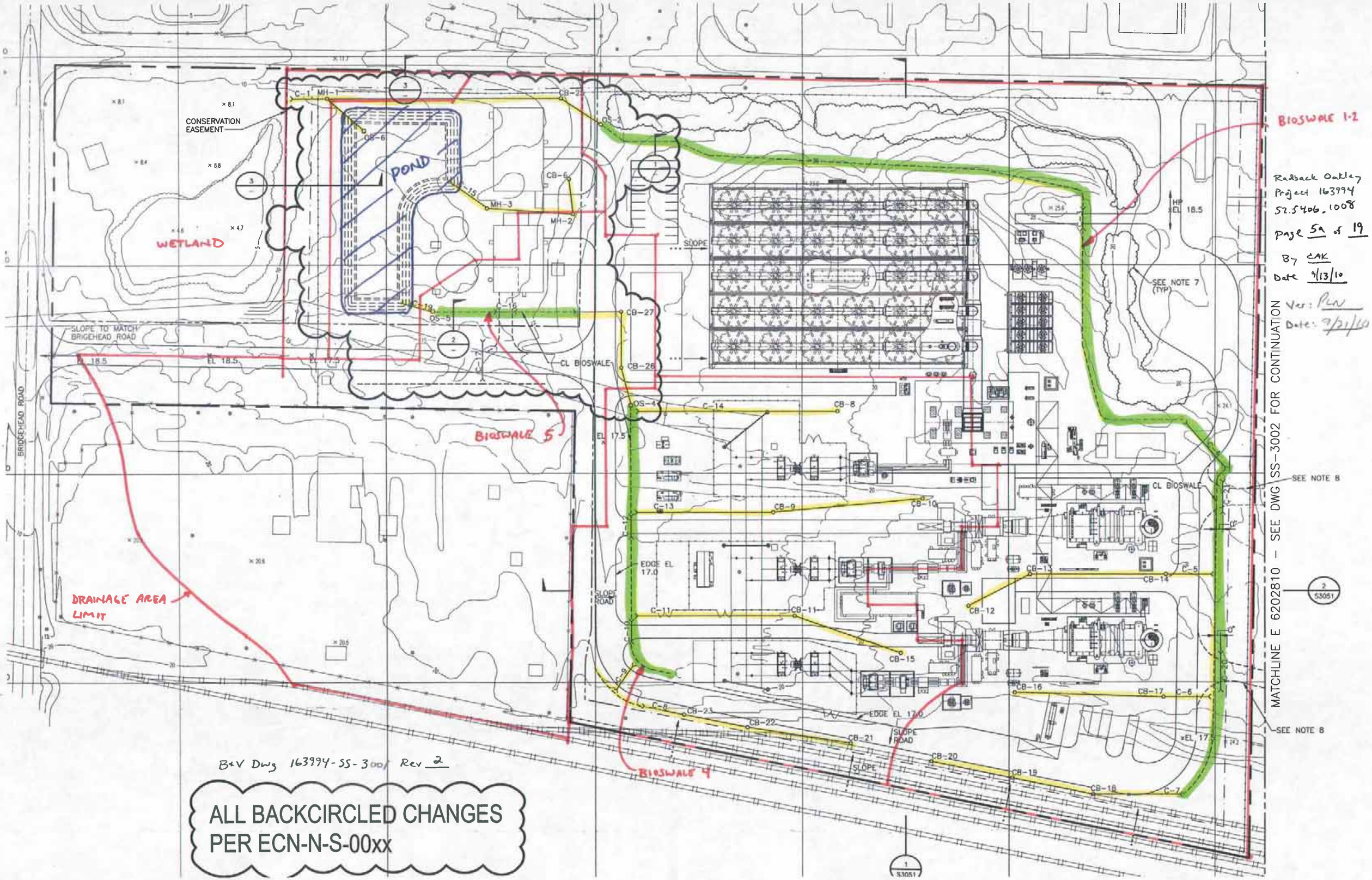
326.5

BM-1

TR-1

N

1. COORDINATE NGVD 29 D THE FLAGPO DATUM ELEV PHOTOGRAPI ASSOCIATES
2. NEW GRADE INDICATE FI
3. ALL CUT AN NOTED OTHI
4. SEE DWG S AND OUTLET
5. TOP OF CO EL 18.0. FI
6. CL OF ALL
7. TREES TO F
8. TEMPORARY CONSTRUCTI



Radback Oakley
Project 163994
52.5406.1008
Page 5a of 19
By CAK
Date 9/13/10
Ver: PLN
Date: 9/21/10

ALL BACKCIRCLED CHANGES PER ECN-N-S-00xx

IMP Sizing for Bioswale #1-2

Refer to Page 5, the total drainage area for bioswale #1-2 is measured to be: 491,168 ft^2 (11.28 ac). The bioswale is measured to be 1,323 feet long.

Six drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; (5) Transformer Containment; and (6) Open-Graded Aggregates (ACC Area).

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	54,900
DMA-2	Asphalt Pavement	65,113
DMA-3	Gravel Surfacing	100,200
DMA-4	Grass/Landscape	198,264
DMA-5	Transformer Containment	4,491
DMA-6	Open-Graded Aggregates	68,200

Runoff Coefficients

Dense-graded aggregate (Caltran Class 2 aggregate) will be utilized as the materials for aggregate surfacing. After being compacted, the dense-graded aggregate is estimated to have a runoff coefficient of 0.5 to 0.7. See communications with Contra Costa County Clean Water Program (Attachment 6). Use 0.6 in this calculation.

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Open Graded Aggregates" will have a runoff coefficient of 0.1. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (54{,}900 \times 1 + 65{,}113 \times 1 + 100{,}200 \times 0.6 + 198{,}264 \times 0.1 + 4{,}491 \times 0 + 68{,}200 \times 0.1)$$

$$= 206{,}779\ ft^2.$$

IMP Sizing Factors

Since the project site is covered by hydrologic group A soil, the subsurface reservoir volume (V_2) is not needed per Stormwater C.3 Guidebook. From this guidebook, for "treatment and flow control", the IMP sizing factor for the area (A) of bioswale is 0.07. The IMP sizing factor for the surface reservoir volume (V_1) of bioswale is 0.058. (Ref. 2, Table 4-6).

Rain Adjustment Factor

Per the Isohyetal Map by Contra Costa County Public Works, Figure B-166 (Ref. 3), the mean annual precipitation (MAP) at the project site is 12.5 inches. Consequently, for group A soils,

$$\text{Rain Adjustment Factor} = \frac{0.0009 \times (MAP - 20.2) + 0.07}{0.07} \qquad \text{(Ref. 2, Equation 4-3)}$$

$$= \frac{0.0009 \times (12.5 - 20.2) + 0.07}{0.07}$$

$$= 0.901.$$

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

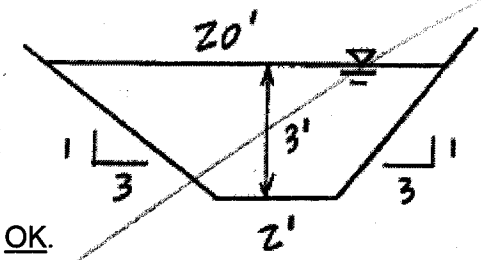
$$= 206{,}779 \times 0.07 \times 0.901 = 13{,}041 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 206{,}779 \times 0.058 \times 0.901 = 10{,}806 \text{ ft}^3.$$

The proposed bioswale #1 is 1,323 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.5. Outlet structure OS-3 will be installed at the end of bioswale #1. See B&V Drawing SS-3001 (Attachment 1). The top of grate elevation of OS-3 will be at EL 15.5 (see Drawing SS-3050). The effective depth of the bioswale is: 15.5 – 12.5 = 3 feet.



The surface area of bioswale #1 is:

$20 \times 1{,}323 = 26{,}460\ ft^2 > 13{,}041\ ft^2$, OK.

The volume of bioswale #1 is:

$\frac{2+20}{2} \times 3 \times 1{,}323 = 43{,}659\ ft^3 > 10{,}806\ ft^3$, OK.

Conclusion: The proposed size of bioswale #1 is sufficient to meet the Stormwater C.3 requirements.

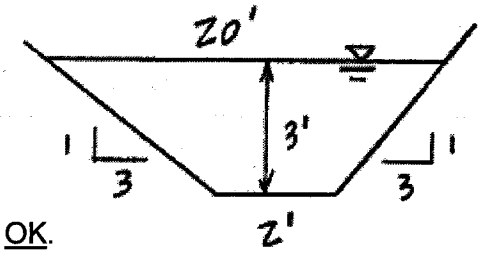
Orifices starting approximately 9" above the bottom of the bioswale will be installed in the outlet control structure to discharge stormwater runoff from less intensive storm events to the wetland to maintain hydration of the wetland.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

SUPERSEDED 9/13/10
See pg 8A

The surface area of bioswale #1 is:

$20 \times 1{,}323 = 26{,}460\ ft^2 > 13{,}041\ ft^2$, OK.



The volume of bioswale #1 is:

$$\frac{2+20}{2} \times 3 \times 1{,}323 = 43{,}659\ ft^3 > 10{,}806\ ft^3, \text{ OK.}$$

Conclusion: The proposed size of bioswale #1 is sufficient to meet the Stormwater C.3 requirements.

Low-flow orifices will be installed starting at the bottom of the outlet control structure to discharge stormwater runoff from less intensive storm events to the wetland, to maintain hydration of the wetland.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	C. Kantola	
PLANT	Oakley Generating	Unit No.	DATE	15-Jun-2010	
PROJECT NO.	163994	File No. 52.5406.1008	CKD BY	PLN	
TITLE	IMP Sizing		DATE	6/17/10	
			PAGE	9	OF 19

Soil Type	IMP Name
A	Bioswale #1-2

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
DMA-1	54,900	Equipment / Roofs	1.00	54,900					
DMA-2	65,113	Asphalt Pavement	1.00	65,113					
DMA-3	100,200	Gravel Surfacing	0.60	60,120					
DMA-4	198,264	Landscape, Group A Soil	0.10	19,826					
DMA-5	4,491	Transformer Containment	0.00	0					
DMA-6	68,200	Open Graded Aggregates	0.10	6,820					
			Total:	206,779	0.070	0.901	13,042	26,460	IMP Area (ft^2)
					0.058	0.901	10,806	43,659	V_1 (ft^3)
					NA	0.901	NA	NA	V_2 (ft^3)
								Orifice Size:	NA

IMP Sizing for Detention Basin

Contra Costa's Clean Water Program (CCCWP) allows volume-based treatment facilities to be used for providing treatment for stormwater runoff from development sites. Due to limited space on site, bioswales of sufficient size and volume cannot be installed for all areas of the site and therefore a portion of the site will have stormwater treatment provided within the proposed detention basin. CCCWP provides a "Unit Basin Storage Size for 80% Capture" chart showing the relationship of several site parameters and the required storage volume required to meet the treatment goal.

The input parameters that are required to use the Unit Basin chart are the mean annual precipitation, directly connected impervious areas (DCIA – the relative coverage of land by impervious surfaces), and the acreage of the project site draining to the treatment facility (i.e. the detention basin). The relative coverage of land by impervious surfaces can be determined by estimating the areas of each surface type within the drainage area. Several surface types are anticipated for the project site and are summarized in the table below. The areas draining to the detention basin are from "Bioswale 4", "Bioswale 5", and "Direct to Pond".

Typically, impervious surface types are limited to buildings and paved areas. As discussed with Mr. Mark Lindley, PE in a telephone conversation on September 3, 2010, the proposed gravel surfaces should be accounted for, in the estimation of the DCIA value. For purposes of estimating DCIA, it is assumed that a factor of 50% of the total gravel area be included in DCIA since runoff from the gravel areas will be greater than the lawn but less than fully impervious areas. The table below summarizes the values for those areas to determine the DCIA used for the Unit Basin sizing. Data was obtained from B&V Calc 52.5406.1006.

Summary of Post-Construction Drainage Areas to Basin (in acres)

Surface Type	Bio 4	Bio 5	Pond	Total	Impervious Factor	DCIA Acreage
Gravel	2.51	2.87	0.1	5.48	50%	2.74
Railroad Yard	-	0.94	-	0.94	50%	0.47
Lawn	0.54	0.95	1.28	2.77	0%	0
Impervious	1.21	1.32	0.30	2.83	100%	2.83
Total Acres:	4.26	6.08	1.68	12.02	-	6.04

%DCIA = 6.04 ac. / 12.02 ac. = 50.2%, therefore interpolate between values of 45% and 60% on Unit Basin chart.

Per CCC Drawing B-166 in Reference 3, the mean precipitation is 12.5 inches.

For a mean precipitation value of 12.5 inches and %DCIA = 50%, the Unit Basin Storage Size for 80% Capture on the left side of the chart shows a value of 0.025 feet. See Page 9c.

Determine the treatment volume (water quality volume) required for the drainage area:

12.02 acres (draining to pond) x 0.025 feet (per chart) = 0.30 ac-ft WQV

The proposed detention basin storage table is shown below. Interpolating from the cumulative storage column, the minimum treatment volume is met at EL 9.34 ft, well below the pond overflow elevation which is at EL 12.0.

Pond Elevation – Area – Storage Summary

Elevation (ft)	Pond Area (acres)	Incremental Storage (ac-ft)	Cumulative Storage (ac-ft)
8.5	0.33	-	-
9.0	0.35	0.17	0.17
10.0	0.41	0.38	0.55
11.0	0.48	0.44	0.99
12.0	0.54	0.51	1.50
13.0	0.61	0.57	2.08

Conclusion: The proposed size of the detention basin is sufficient to meet the Stormwater C.3 requirements using the Unit Basin Sizing chart methodology.

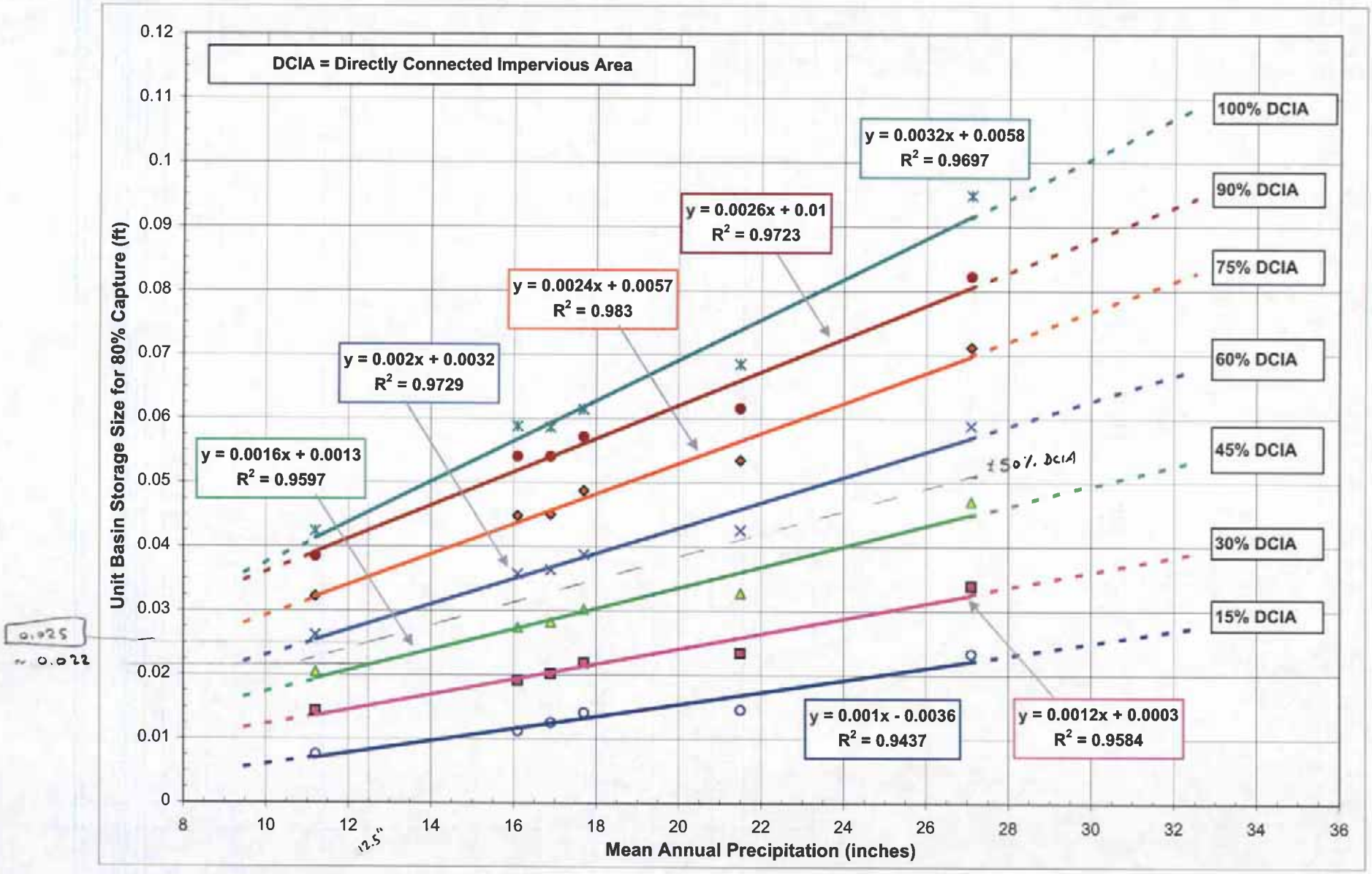
Low-flow orifices starting approximately 3" above the bottom of the pond (EL 8.75') will be installed in the outlet structure to drain the WQV in 24-48 hours.

Average head for the orifice equation is 2/3 of the maximum head of 9.34'-8.75' = 0.39'
The target dewatering time is 24 hours for the WQV. Therefore the average flow rate

Q = (0.3 ac-ft x 43560 sf/ac) / (24 hr x 3600 s/hr) = 0.151 cfs

Orifice equation: $Q=CA\sqrt{(2gh)}$ for 0.151 cfs with h=0.39' and C=0.62, yields A = 0.0486 sf
Eight 1-inch orifices can be used to provide an area of 0.044 sf (use in orifice equation)
Actual average release rate = $0.62 \times 0.044 \times \sqrt{(2 \times 32.2 \times 0.39')}$ = 0.137 cfs

Time to drain WQV: (0.3 ac-ft x 43,560 sf/ac) / (0.137 cfs x 3600 s/hr) = 26.5 hours
This is less than the recommended 48-hour maximum time.



Radback Energy
Oakley Gen Station
Proj 163994

File 52.5406.1008
By: C. Kantola
Date: 9/13/10
Rev 1

Pg 9e of 19
Verified PLN
Date 9/21/10

IMP Sizing for Bioswale #3

Refer to Page 5, the total drainage area for bioswale #3 is measured to be: 25,711 ft^2 (0.59 ac). The bioswale #3 is measured to be 187 feet long.

Three drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; and (3) Grass/Landscape.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	3,873
DMA-2	Asphalt Pavement	2,086
DMA-3	Grass/Landscape	19,752

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Consequently,

VOID

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (3{,}873 \times 1.0 + 2{,}086 \times 1.0 + 19{,}752 \times 0.1)$$

$$= 7{,}934\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Removed 9/13/10

$$= 7{,}934 \times 0.07 \times 0.901 = 500 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

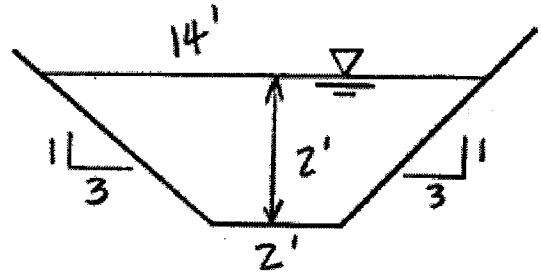
$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 7{,}934 \times 0.058 \times 0.901 = 415 \text{ ft}^3.$$

The proposed bioswale #3 is 187 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 11.0. Drop structure DS-1 will be installed at the end of bioswale #3. See B&V Drawing SS-3001. The top of grate elevation of DS-1 will be at EL 13.0 (see Drawing SS-3050). The effective depth of the bioswale is: 13.0 – 11.0 = 2 feet.

The surface area of bioswale #3 is:

$14 \times 187 = 2{,}618 \text{ ft}^2 > 500 \text{ ft}^2$, OK.



The volume of bioswale #3 is:

VOID

$$\frac{2+14}{2} \times 2 \times 187 = 2992 \text{ ft}^3 > 415 \text{ ft}^3, \text{ OK.}$$

Conclusion: The proposed size of bioswale #3 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

Removed 9/13/10

BLACK & VEATCH	OWNER	Radback Energy		COMP'D BY	C. Kantola
	PLANT	Oakley Generating	Unit No.	DATE	15-Jun-2010
	PROJECT NO.	163994	File No. 52.5406.1008	CKD BY	PLN
	TITLE	IMP Sizing		DATE	6/18/10
				PAGE	18 OF 19

Soil Type	IMP Name
A	Bioswale #3

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA-1	3,873	Equipment / Roofs	1.00	3,873
DMA-2	2,086	Asphalt Pavement	1.00	2,086
DMA-3	19,752	Landscape, Group A Soil	0.10	1,975
			Total:	7,934

IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
0.070	0.901	500	2,618	IMP Area (ft^2)
0.058	0.901	415	2,992	V_1 (ft^3)
NA	0.901	NA	NA	V_2 (ft^3)
			Orifice Size:	NA

VOID

Removed 9/13/10

IMP Sizing for Bioswale #4

Refer to Page 5, the total drainage area for bioswale #4 is measured to be: 190,955 ft^2 (4.38 ac). The bioswale #4 is measured to be 391 feet long.

Five drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; (4) Grass/Landscape; and (5) Transformer Containment.

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	19,314
DMA-2	Asphalt Pavement	33,262
DMA-3	Gravel Surfacing	109,208
DMA-4	Grass/Landscape	23,692
DMA-5	Transformer Containment	5,479

VOID

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0. The "Transformer Containment" will have no runoff since all the runoff will go to oil-water separator which discharges to the sanitary sewer and will not be discharged on site.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (19{,}314\text{x}1.0+33{,}262\text{x}1.0+109{,}208\text{x}0.6+23{,}692\text{x}0.1+5{,}479\text{x}0)$$

$$= 120{,}470\ ft^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Removed 9/13/10

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 120{,}470 \times 0.07 \times 0.901 = 7{,}598 \text{ ft}^2.$$

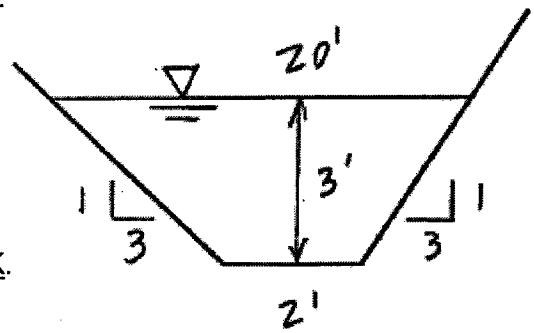
The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 120{,}470 \times 0.058 \times 0.901 = 6{,}296 \text{ ft}^3.$$

VOID

The proposed bioswale #4 is 391 feet long. The bioswale cross section will be trapezoidal. Bottom width = 2 feet. Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.5. Outlet structure OS-4 will be installed at the end of bioswale #4. See B&V Drawing SS-3001. The top of grate elevation of OS-4 will be at EL 15.5 (see Drawing SS-3050). The effective depth of the bioswale is: 15.5 – 12.5 = 3 feet.



The surface area of bioswale #4 is:

$20 \times 391 = 7{,}820 \text{ ft}^2 > 7{,}598 \text{ ft}^2$, OK.

The volume of bioswale #4 is:

$\frac{2+20}{2} \times 3 \times 391 = 12{,}903 \text{ ft}^3 > 6{,}296 \text{ ft}^3$, OK.

Conclusion: The proposed size of bioswale #4 is sufficient to meet the Stormwater C.3 requirements.

Orifices starting approximately 9" above the bottom of the bioswale will be installed in the outlet control structure to discharge stormwater runoff from less intensive storm events to the wetland to maintain hydration of the wetland.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

Removed 9/13/10

BLACK & VEATCH					
OWNER	Radback Energy		COMP'D BY	C. Kantola	
PLANT	Oakley Generating	Unit No.	DATE	15-Jun-2010	
PROJECT NO.	163994	File No. 52.5406.1008	CKD BY	PCN	
TITLE	IMP Sizing		DATE	6/17/10	
			PAGE	15	OF 19

Soil Type	IMP Name
A	Bioswale #4

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA-1	19,314	Equipment / Roofs	1.00	19,314
DMA-2	33,262	Asphalt Pavement	1.00	33,262
DMA-3	109,208	Gravel Surfacing	0.60	65,525
DMA-4	23,692	Landscape, Group A Soil	0.10	2,369
DMA-5	5,479	Transformer Containment	0.00	0
			Total:	120,470

IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
0.070	0.901	7,598	7,820	IMP Area (ft^2)
0.058	0.901	6,296	12,903	V_1 (ft^3)
NA	0.901	NA	NA	V_2 (ft^3)
			Orifice Size:	NA

NID

Revised 9/13/10

IMP Sizing for Bioswale #5

Refer to Page 5, the total drainage area for bioswale #5 is measured to be: 290,529 ft^2 (6.67 ac) (natural gas facility included). The bioswale #5 is measured to be 385 feet long total.

Four drainage management areas (DMA) were identified based on the type of ground covers: (1) Equipment/Roofs; (2) Asphalt Pavement; (3) Gravel Surfacing; and (4) Grass/Landscape.

Including Railroad yard
PW 6/17/10

The measured areas are shown in the following table. The measurements were made by using AutoCAD.

DMA Name	Post-Project Surface Type	DMA Area (ft^2)
DMA-1	Equipment/Roofs	12,670
DMA-2	Asphalt Pavement	25,905
DMA-3	Gravel Surfacing	186,725
DMA-4	Grass/Landscape	65,229

VOID

Runoff Coefficients

From Table 4-2 of the Stormwater C.3 Guidebook, the "Grass/Landscape" will have a runoff coefficient of 0.1 for Group A Soil for treatment and flow control. The "Equipment/Roofs" and "Asphalt Pavement" will have a runoff coefficient of 1.0.

Use 0.6 for dense-graded aggregate surfacing (see Page 6).

Consequently,

$$\sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} = (12{,}670\text{x}1.0+25{,}905\text{x}1.0+186{,}725\text{x}0.6+89{,}695\text{x}0.1)$$

$$= 157{,}133 \text{ ft}^2.$$

IMP sizing factor = 0.07 for the area (A) of bioswale; IMP sizing factor = 0.058 for the surface reservoir volume (V_1). See Page 7.

Rain adjustment factor = 0.901. See Page 7.

Removed 9/13/10

Minimum Area and Minimum Volume of IMP

Per Ref. 2, Equation 4-7, the required minimum area (A) of the bioswale is:

$$\text{Min. IMP Area A} = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 157{,}133 \times 0.07 \times 0.901 = 9{,}910 \text{ ft}^2.$$

The required minimum surface reservoir volume (V_1) of the bioswale is:

$$\text{Min. IMP Volume } (V_1) = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

$$= 157{,}133 \times 0.058 \times 0.901 = 8{,}211 \text{ ft}^3.$$

The proposed bioswale #5 is 385 feet long total. The bioswale cross section will be trapezoidal. Bottom width = 10 feet for the first 265 feet long section (Section 2 on SS-3001) and 8 feet for the remaining 120 feet long section (Section 2A on SS-3001). Side slope = 3 (h) to 1 (v). The bottom of the bioswale is at EL 12.0 for Section 2 and EL 11.0 for Section 2A. Outlet structure OS-5 will be installed at the end of bioswale #5. See B&V Drawing SS-3001. The top of grate elevation of OS-5 will be at EL 15.0 (see Drawing SS-3050). The effective depth of the bioswale is: 14.5 – 11.0 = 3.5 feet for Section 2A and 14.5 – 12.0 = 2.5 feet for Section 2. See Dwg SS-3001 in Attachment 1.

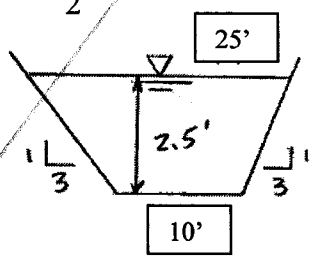
VOID

The surface area of bioswale #5 is:

$25 \times 265 + 29 \times 120 = 10{,}105 \text{ ft}^2 > 9{,}910 \text{ ft}^2$, OK.

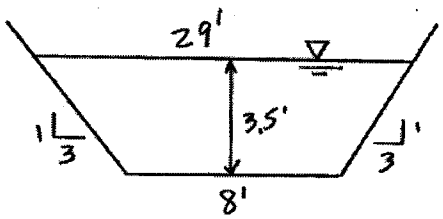
The volume of bioswale #5 is:

$$\frac{2+25}{2} \times 2.5 \times 265 + \frac{8+29}{2} \times 3.5 \times 120 = 16{,}714 \text{ ft}^3 > 8{,}211 \text{ ft}^3, \text{ OK.}$$



Section 2

DWG SS-3001



Section 2A

DWG SS-3001

Removed 9/13/10

An orifice will be installed in the outlet structure for bioswale #5 to discharge stormwater runoff from less intensive storm events to the wetland to allow the wetland continue to have water. See Dwg SS-3001 (Attachment 1).

Conclusion: The proposed size of bioswale #5 is sufficient to meet the Stormwater C.3 requirements.

A spreadsheet was prepared for the above calculations to follow the format by Contra Costa County Clean Water Program. See next page.

VOID

Removed 9/13/10

BLACK & VEATCH					
OWNER	Radback Energy			COMP'D BY	C. Kantola
PLANT	Oakley Generating	Unit No.		DATE	15-Jun-2010
PROJECT NO.	163994	File No. 52.5406.1008		CKD BY	PLN
TITLE	IMP Sizing			DATE	6/17/10
				PAGE	19 OF 19

Soil Type	IMP Name
A	Bioswale #5

DMA Name	DMA Area (ft^2)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA-1	12,670	Equipment / Roofs	1.00	12,670
DMA-2	25,905	Asphalt Pavement	1.00	25,905
DMA-3	186,725	Gravel Surfacing	0.60	112,035
DMA-4	65,229	Landscape, Group A Soil	0.10	6,523
			Total:	157,133

IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume	
0.070	0.901	9,910	10,105	IMP Area (ft^2)
0.058	0.901	8,211	16,714	V_1 (ft^3)
NA	0.901	NA	NA	V_2 (ft^3)
			Orifice Size:	NA

VOID

Removed 9/13/10

Radback Oakley Project

CAK 6/15/10

163994 File # 52.5406.1008

pgs 5

IMP sizing for plant area

Attachment 1

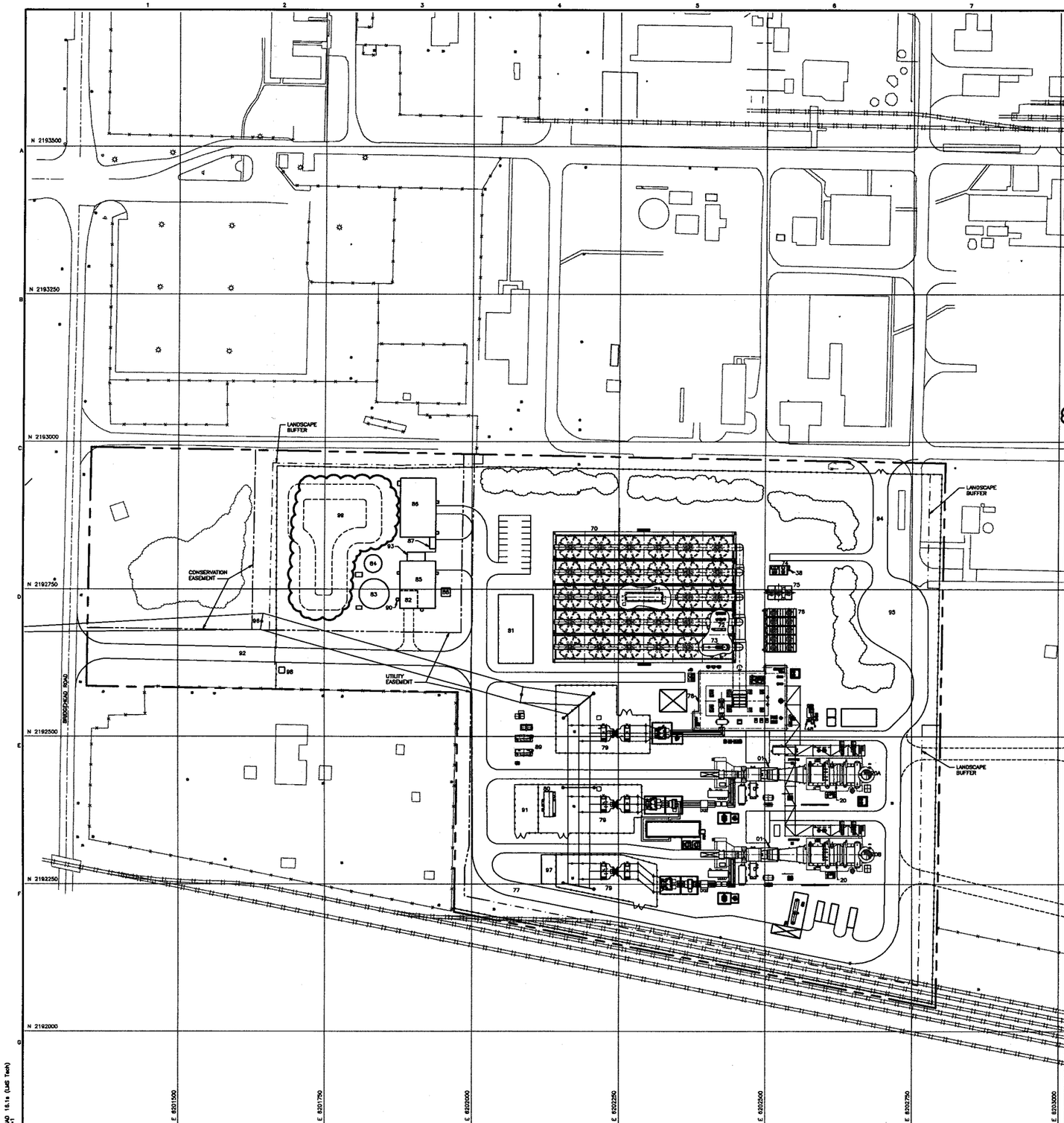
Black & Veatch Dwgs

SS-1002

-3001

-3201

-3050



FACILITIES LEGEND

ID	FACILITY	STRUCTURE HEIGHT	TIEDOWN LOCATION NORTH	TIEDOWN LOCATION EAST	REMARKS
01	COMBUSTION TURBINE	70'	–	–	–
20	HEAT RECOVERY STEAM GENERATOR (HRSG)	103'	–	–	–
20A	HRSG EXHAUST STACK A	155'	2192438.00	6202683.00	CL EXHAUST STACK
20B	HRSG EXHAUST STACK B	155'	2192300.00	6202683.00	CL EXHAUST STACK
38	SAFETY SHOWER EYEWASH STATION	–	–	–	–
48	AUXILIARY BOILER	50'	2192527.61	6202572.26	CL EXHAUST STACK
70	AIR COOLED CONDENSER (ACC)	124'	–	–	–
71	ACC ELECTRICAL ENCLOSURE	14'	–	–	–
72	CONDENSER AIR EXTRACTION SKIDS	8'	–	–	–
73	ACC CONDENSATE COLLECTION TANK	28'	–	–	–
74	WET SURFACE AIR COOLER CHEMICAL FEED SKIDS	8'	–	–	–
75	WET SURFACE AIR COOLER	23'	2192744.67	6202523.00	CL COOLER
76	CLOSED CYCLE COOLING WATER HEAT EXCHANGER	19'	–	–	–
77	LOOP ROAD	–	–	–	–
78	STEAM TURBINE FOUNDATION	–	–	–	–
79	SWITCHYARD	18' & 45'	–	–	–
80	SWITCHYARD CONTROL ENCLOSURE	12'	–	–	–
81	CONTROL & ADMIN BUILDING	14'	–	–	–
82	FIRE WATER PUMP ROOM	20'	–	–	–
83	FIRE/SERVICE WATER STORAGE TANK	32'	–	–	–
84	DEMIN WATER STORAGE TANK	24'	–	–	–
85	WATER TREATMENT BUILDING	20'	–	–	–
86	WAREHOUSE/MAINTENANCE BUILDING	16'	–	–	–
87	LUBRICANT STORAGE SHED	10'	–	–	–
88	WASTE WATER LIFT STATION (IF REQUIRED)	–	–	–	–
89	GAS COMPRESSORS & GAS CONDITIONING	13'	–	–	–
90	DIESEL FIRE PUMP EXHAUST	16'	2192732.52	6201874.72	CL EXHAUST STACK
91	GAS METERING STATION	–	–	–	–
92	ACCESS ROAD	–	–	–	–
93	LEASED MIX BED EXCHANGER CONCRETE SLAB	–	–	–	–
94	EMERGENCY ACCESS ROAD	–	–	–	–
95	CUL DA SAC (TURNAROUND)	–	–	–	–
96	230KV POWER POLE	108'	–	–	–
97	OUTAGE MAINTENANCE TRAILERS AREA	–	–	–	–
98	GUARD HOUSE	–	–	–	–
99	STORM WATER POND	–	–	–	–

NOTES

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 545", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.168 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCIATES, INC.
2. SEE PLANT ARRANGEMENT DRAWING SM-2001, FOR LEGEND OF MAIN POWER BLOCK.
3. PROPERTY AND EASEMENT BOUNDARY INFORMATION IS BASED UPON DRAWING EXHIBIT D, BY RONALD GREENWELL & ASSOCIATES, INC. REVISION DATED 05/FEB/08.

GENERAL LEGEND

- NEW FENCE
- EXISTING FENCE
- PROPERTY BOUNDARY (SEE NOTE 3)
- EASEMENT BOUNDARY (SEE NOTE 3)
- LANDSCAPE BUFFER

ALL BACKCIRCLED CHANGES PER ECN-N-S-0004

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
3	18/JUN/10	ISSUED FOR PERMITTING	RJS	CAK		PLN	DVW
2	16/APR/09	ISSUED PER ECN-N-S-0003	NAW	PLN		PLN	DVW
1	30/MAR/09	ISSUED PER ECN-N-S-0001	NAW	PLN		PLN	DVW
0	13/MAR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1" =60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION

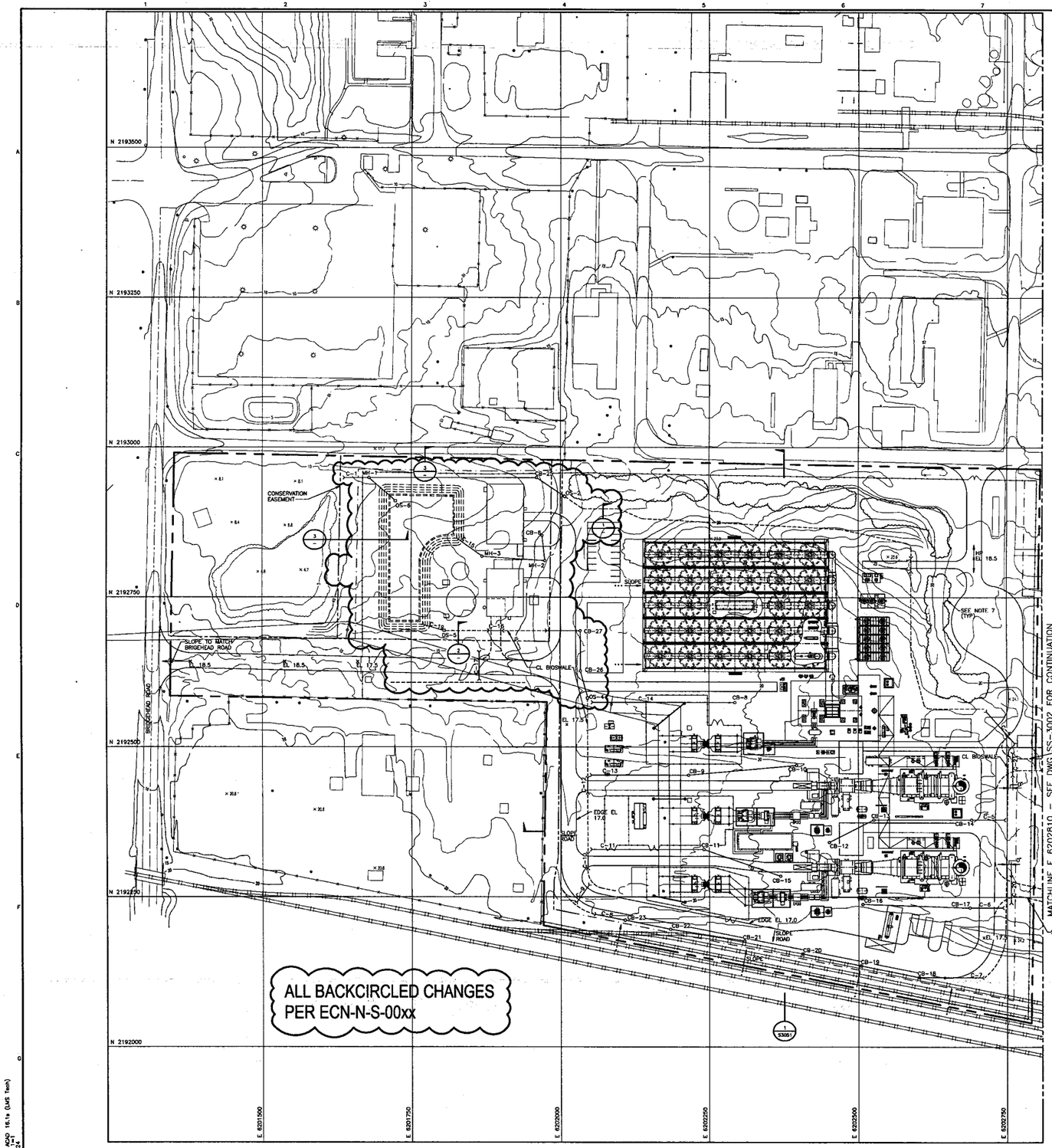
ENGINEER PLN DRAWN NAW
CHECKED DATE

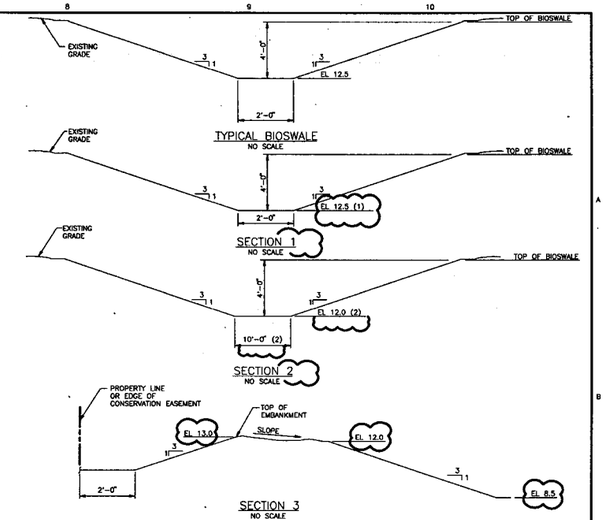
CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

GENERAL ARRANGEMENT SITE

PROJECT DRAWING NUMBER: 163994-SS-1002
REV: 3
CODE
AREA

SCALE 1:1 ACAD 16.1s (LMS Tech) ATPL/07 07-MAR-2007 08/8/10 07:44:52





ABBREVIATIONS APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

APPROX	–	APPROXIMATE	LTR	–	LATER
ASPH	–	ASPHALT	MAX	–	MAXIMUM
AVG	–	AVERAGE	MH	–	MANHOLE
BND	–	BEND	MIN	–	MINIMUM
BLDG	–	BUILDING	MJ	–	MECHANICAL JOINT
B/MH	–	BOTTOM OF MANHOLE ELEVATION	MSL	–	MEAN SEA LEVEL
BOC	–	BOTTOM OF CONDUIT ELEVATION	NO.	–	NUMBER
BOD	–	BOTTOM OF DUCTBANK ELEVATION	NTS	–	NOT TO SCALE
BOP	–	BOTTOM OF PIPE ELEVATION	OD	–	OUTSIDE DIAMETER
BU	–	BELL-UP	OWS	–	OIL WATER SEPARATOR
C	–	CULVERT	OWMH	–	OILYWASTE MANHOLE
CB	–	CATCH BASIN	PC	–	POINT OF CURVATURE
CD	–	CABLE DUCT	PE	–	PLAIN END
CHDPE	–	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	PI	–	POINT OF INTERSECTION
			PLCS	–	PLACES
CL	–	CENTERLINE	PM	–	PLANT MANHOLE
CLR	–	CLEAR	POT	–	POINT OF TANGENT
CMH	–	CHEMICAL MANHOLE	PT	–	PIPE TERMINATION
CND	–	CONDUIT	PVC	–	POLYVINYL CHLORIDE PIPE
CONC	–	CONCRETE	QTY	–	QUANITY
CO	–	CLEAN OUT	R	–	RADIUS
CS	–	CARBON STEEL	RCP	–	REINFORCED CONCRETE PIPE
CW	–	CIRCULATING WATER	RD	–	ROOF DRAIN
DB	–	DUCTBANK	REV	–	REVISION
DBC	–	DIRECT BURIED CABLE	RGS	–	RIGID GALVANIZED STEEL
DET	–	DETAIL	RR	–	RAILROAD
DIA	–	DIAMETER	SECT	–	SECTION
DIP	–	DUCTILE IRON PIPE	SIM	–	SIMILAR
DWG	–	DRAWING	SLS	–	SANITARY LIFT STATION
DWP	–	DOUBLE WALL PIPE	SMH	–	SANITARY MANHOLE
EC	–	ELECTRICAL CONDUIT	STMH	–	STORM MANHOLE
ECC	–	ECCENTRIC	STRL	–	STRUCTURAL
EF	–	EACH FACE	T/C	–	TOP OF CONCRETE ELEVATION
EHH	–	ELECTRICAL HANDHOLE	T/G	–	TOP OF GRADE ELEVATION
EL	–	ELEVATION	THH	–	TELEPHONE SERVICE HANDHOLE
EMH	–	ELECTRICAL MANHOLE	T/MH	–	TOP OF MANHOLE ELEVATION
EW	–	EACH WAY	T/P	–	TOP OF PAVEMENT ELEVATION
FC	–	FIELD CHECK	TP	–	MECH PIPE TERMINAL POINT
FDN	–	FOUNDATION	TYP	–	TYPICAL
FF	–	FLAT FACE	UGL	–	UNDERGROUND LIGHTING CONDUIT
FRP	–	FIBERGLASS REINFORCED PIPE	UNO	–	UNLESS NOTED OTHERWISE
GR	–	GRADE	VERT	–	VERTICAL
HDM	–	HOT DRAIN MANHOLE	WGT	–	WEIGHT
HDPE	–	HIGH DENSITY POLYETHYLENE PIPE	WTR	–	WATER
HP	–	HIGH POINT	W/	–	WITH
HYD	–	HYDRANT	W/O	–	WITHOUT
ID	–	INSIDE DIAMETER	WP	–	WORK POINT
INV	–	INVERT	XFMR	–	TRANSFORMER
JBX	–	JUNCTION BOX			
L	–	LENGTH			
LP	–	LOW POINT			

LEGEND APPLICABLE TO ALL S3000 DRAWINGS

	NEW CULVERT		NEW SLIDE GATE
	CL BIOSWALE		NEW SWING GATE
1 / S3000	SECTION OR DETAIL NUMBER / DRAWING DESIGNATION NUMBER		EXISTING POWER POLE
× 328.5	FINISHED SPOT ELEVATIONS	CB-101	NEW CATCH BASIN
			NEW DROP STRUCTURE
BM-1	SURVEY MONUMENT/CONTROL POINT		PROPERTY LINE
	EXISTING FENCE		BOUNDARY LINE
	NEW SECURITY FENCE	126	EXISTING CONTOURS
	TEMPORARY CONSTRUCTION FENCE		GRADE TO DRAIN (DIRECTION OF ARROW)
TR-1	EROSION CONTROL METHOD		

NOTES APPLICABLE TO ALL SS-3000 SERIES DRAWINGS

1. COORDINATES ARE BASED ON CALIFORNIA COORDINATE SYSTEM CCS83, ZONE 3. ELEVATION ARE BASED ON, NGVD 29 DATUM. BENCHMARK IS NATIONAL GEODETIC SURVEY BENCH MARK "W 563", LOCATED ADJACENT TO THE FLAGPOLE AT THE DUPONT PLANT ENTRANCE, ELEVATION = 11.188 FEET. TO OBTAIN DUPONT PLANT DATUM ELEVATION, ADD 0.70 FEET TO THE ELEVATIONS SHOWN. TOPOGRAPHIC DATA IS BASED ON AERIAL PHOTOGRAPH DATED JUNE 11, 2001. AERIAL SURVEY INFORMATION WAS OBTAINED BY RONALD GREENWELL & ASSOCATES, INC.
2. NEW GRADE ELEVATIONS SHOWN ON THE SITE GRADING AND DRAINAGE PLANS INDICATE FINISH GRADE UNLESS NOTED OTHERWISE.
3. ALL CUT AND FILL SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER, UNLESS NOTED OTHERWISE.
4. SEE DWG SS-3050 FOR GRADING AND DRAINAGE DETAILS INCLUDING CULVERT, CATCH BASIN, DROP AND OUTLET STRUCTURE CHARTS.
5. TOP OF CONCRETE ELEVATIONS AND FINISH FLOOR ELEVATIONS FOR ALL EQUIPMENT AND BUILDINGS IS EL 18.0. FINISH GRADE ADJACENT TO ALL FOUNDATIONS IS EL 17.5.
6. CL OF ALL PAVED ROADS IS EL 17.5 UNO.
7. TREES TO REMAIN. GRADE TO REMAIN UNCHANGED WITHIN 20' OF TREE BASE.
8. TEMPORARY ROAD FROM LAYDOWN AREA. ROAD AND CULVERT UNDER ROAD TO BE REMOVED AT END OF CONSTRUCTION.

OPEN
09/22/10

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
2	OPEN		ARS	CAK		PLN	DVW
1	18/JUN/10	ISSUED FOR PERMITTING	RUS	CAK		PLN	DVW
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

SCALE: 1" =60' (60' 30' 0 60' 120')

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

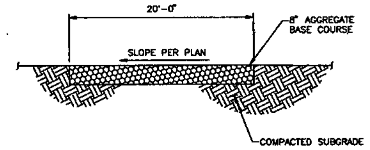
BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

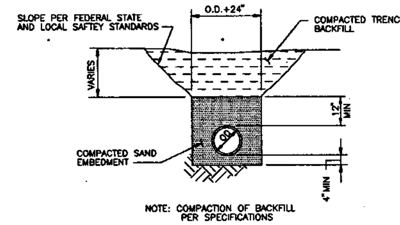
GRADING AND DRAINAGE – SITE PLAN – SHEET 1

PROJECT / DRAWING NUMBER: 163994–SS–3001
REV: 1
CODE
AREA

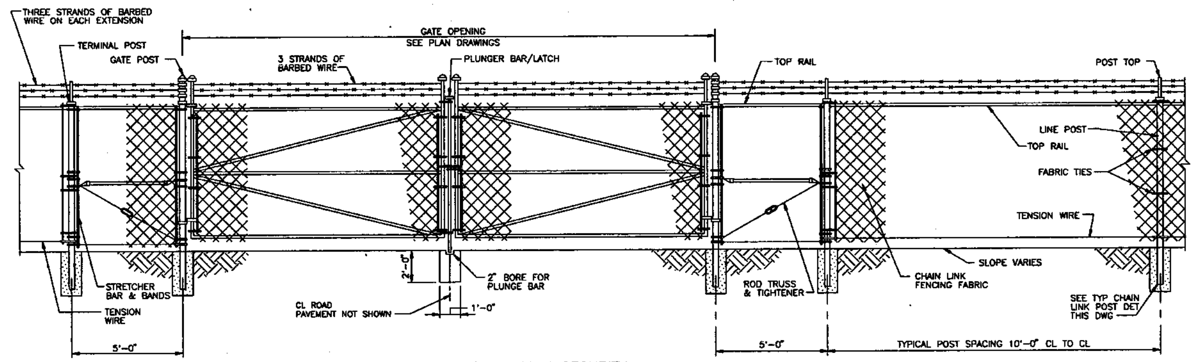
BLS:30576 ACAD 18.1s (LMS Tech)
03/25/10 ED:16.34
03/25/10 ED:16.34=1



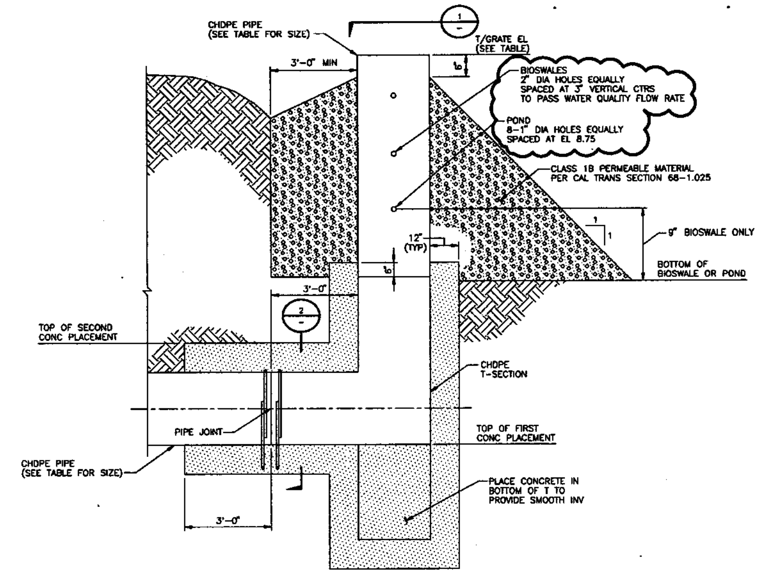
TYPICAL CONSTRUCTION LAYDOWN ROAD
NO SCALE



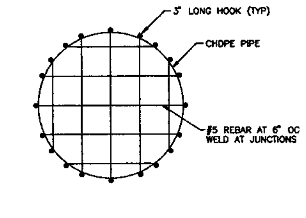
TYPICAL PIPE EMBEDMENT
NO SCALE



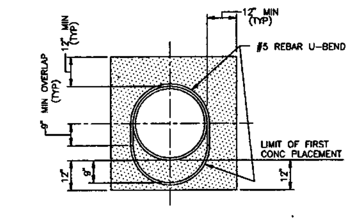
TYPICAL CHAIN LINK SECURITY FENCE AND GATE DETAIL
NO SCALE



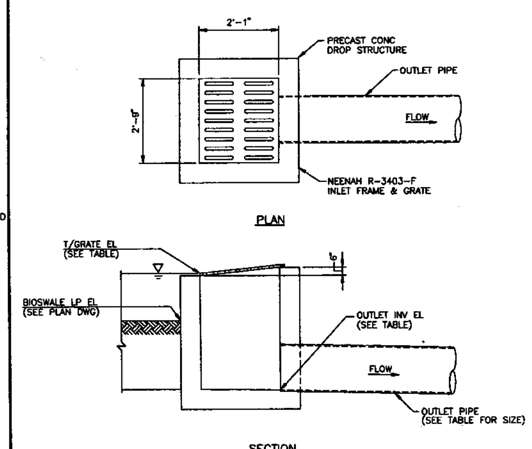
TYPICAL OUTLET STRUCTURE DETAIL
NO SCALE



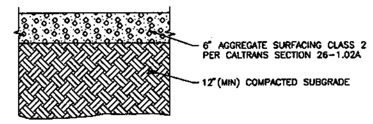
SECTION 1
NO SCALE



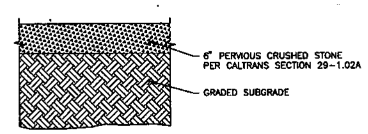
SECTION 2
NO SCALE



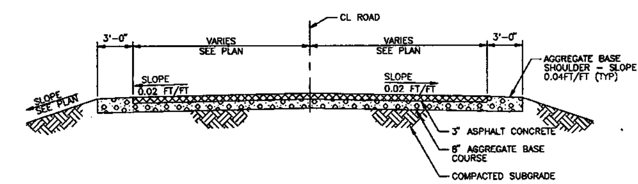
TYPICAL BIOSWALE DROP STRUCTURE DETAIL
NO SCALE



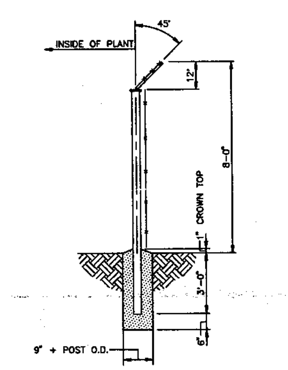
TYPICAL AGGREGATE SURFACING SECTION
NO SCALE



TYPICAL PERVIOUS CRUSHED STONE SURFACING SECTION
NO SCALE



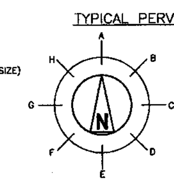
TYPICAL PAVED ROAD
NO SCALE
SEE DWG SS-3201



TYPICAL SECURITY FENCE POST DETAIL
NO SCALE

CULVERT TABLE

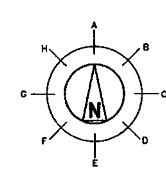
CULVERT NO.	INLET INV ELEVATION	OUTLET INV ELEVATION	LENGTH	PIPE DIAMETER	PIPE MATERIAL	REMARKS
C-1	8.2	8.0	–	24"	–	
C-2						NOT USED
C-3	13.0	13.0	–	18"	–	
C-4	13.2	13.0	–	18"	–	
C-5	13.1	12.9	–	12"	–	
C-6	13.1	12.9	–	12"	–	
C-7	13.3	13.0	–	12"	–	
C-8	13.2	13.0	–	12"	–	
C-9	13.0	13.0	–	12"	–	
C-10	13.0	13.0	–	15"	–	
C-11	13.4	12.6	–	12"	–	
C-12	13.0	13.0	–	18"	–	
C-13	13.4	12.6	–	12"	–	
C-14	13.5	12.5	–	12"	–	
C-15	10.3	10.0	–	18"	–	
C-16	12.5	12.5	–	18"	–	
C-17	14.7	14.4	–	12"	–	
C-18	12.8	12.5	–	18"	–	
C-19	10.5	10.0	–	18"	–	
C-20	13.0	13.0	–	18"	–	
C-21	13.0	13.0	–	18"	–	



CATCH BASIN AND MAN HOLE TABLE

STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
				A		B		C		D		E		F		G		H		
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
CB-6	–	–	16.0	–	–	–	–	–	–	–	–	12.3	18"	–	–	–	–	–	–	
CB-7	NOT USED																			
CB-8	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.5	12"	
CB-9	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-10	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–	
CB-11	–	–	17.0	–	–	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	
CB-12	–	–	17.0	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	–	–	
CB-13	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	13.4	12"	–	–	–	–	
CB-14	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–	
CB-15	–	–	17.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	
CB-16	–	–	17.0	–	–	–	–	13.4	12"	–	–	–	–	–	–	–	–	–	–	
CB-17	–	–	17.0	–	–	–	–	13.1	12"	–	–	–	–	–	–	13.1	12"	–	–	
CB-18	–	–	16.5	–	–	13.2	12"	–	–	–	–	–	–	–	–	13.2	12"	–	–	
CB-19	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-20	–	–	16.5	–	–	–	–	13.6	12"	–	–	–	–	–	–	–	–	–	–	
CB-21	–	–	16.5	–	–	–	–	–	–	–	–	–	–	–	–	13.6	12"	–	–	
CB-22	–	–	16.5	–	–	–	–	13.4	12"	–	–	–	–	–	–	13.4	12"	–	–	
CB-23	–	–	16.5	–	–	–	–	13.2	12"	–	–	–	–	–	–	13.2	12"	–	–	
CB-24	NOT USED																			
CB-25	–	–	15.0	–	–	–	–	–	–	11.6	18"	–	–	–	–	11.8	18"	–	–	
CB-26	–	–	16.0	13.2	18"	–	–	–	–	–	–	13.2	18"	–	–	–	–	–	–	
CB-27	–	–	16.5	–	–	–	–	–	–	–	–	12.8	18"	–	–	12.8	18"	–	–	
MH-1	–	–	13.0	–	–	–	–	8.2	24"	8.7	18"	–	–	–	–	8.2	24"	–	–	
MH-2	–	–	17.0	11.2	18"	–	–	–	–	–	–	–	–	–	–	11.0	18"	–	–	
MH-3	–	–	16.5	–	–	–	–	10.3	18"	–	–	–	–	–	–	–	–	10.3	18"	

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST



DROP (DS) AND OUTLET (OS) STRUCTURE TABLE

STRUCTURE NO.	CENTERLINE COORDINATES		TOP OF GRATE ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
				A		B		C		D		E		F		G		H		
	NORTH	EAST		INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
DS-1	NOT USED	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
OS-2	–	–	15.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11.8	18"	
OS-3	NOT USED																			
OS-4	–	–	15.5	13.5	18"	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
OS-5	–	–	14.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10.5	18"	
OS-6	–	–	14.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.5	24"	

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
FOR PIPELINE MATERIAL SEE PIPELINE LIST

OPEN
09/22/10

ALL BACKCIRCLED CHANGES PER ECN-N-S-00xx

NOTES

1. FILTER FABRIC SHALL BE UV-STABILIZED NONWOVEN GEOTEXTILE HAVING A MINIMUM WEIGHT OF 135 g/M^2 PER CALTRANS SS 88-1.03.
2. SEE DWG SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION
THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
2	OPEN		ARE	CAK		PLN	DVW
1	18/JUN/10	ISSUED FOR PERMITTING	RJS	CAK		PLN	DVW
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN	DVW

60' 30' 0 60' 120'
SCALE: 1"=60'

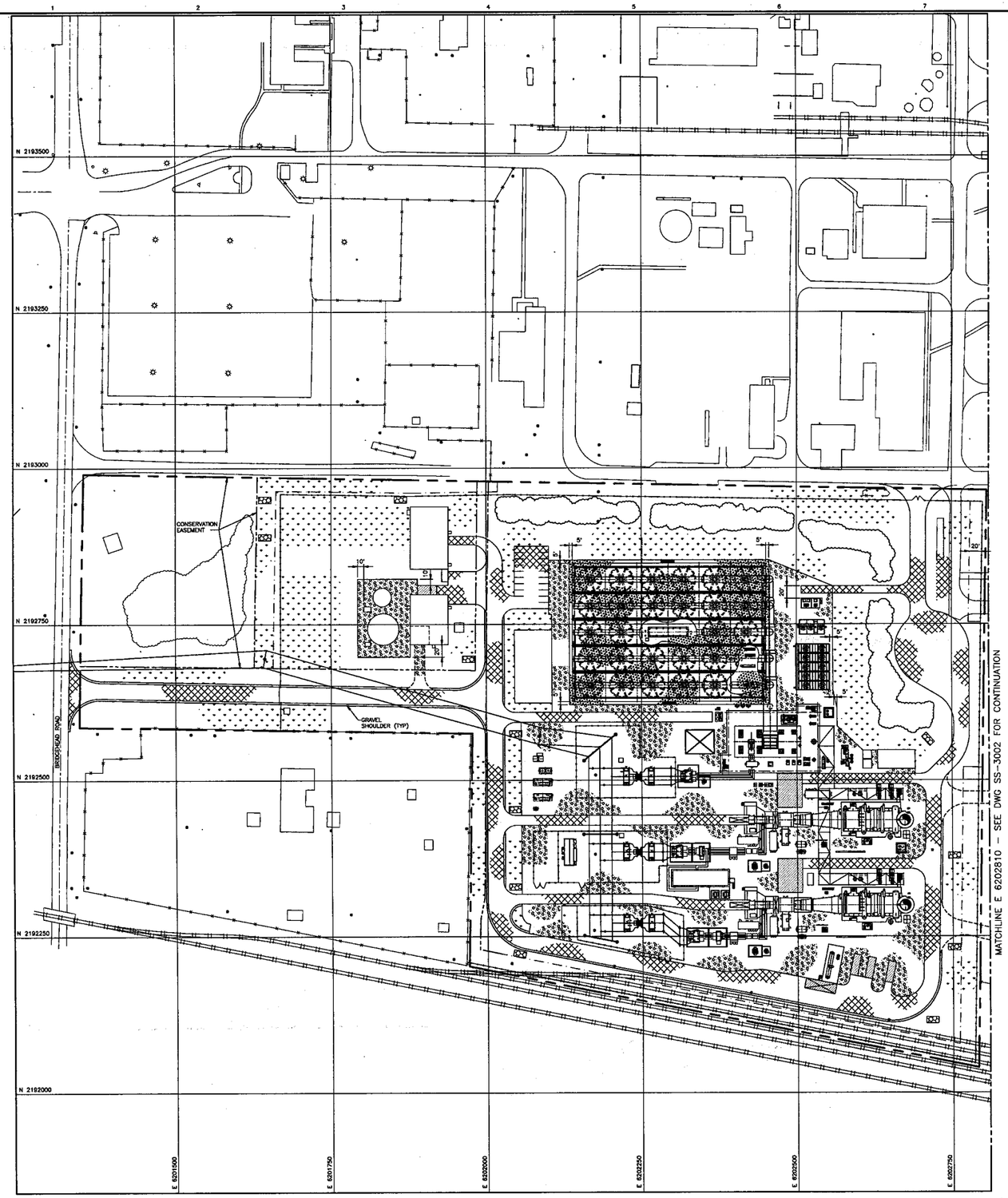
I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION
ENGINEER PLN DRAWN NAW
CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY
SITE
SECTIONS AND DETAILS

PROJECT DRAWING NUMBER 163994-SS-3050 REV 1
CODE
AREA

BEL30576 E1 ACAD 16.1s (LMS Tech)
A1APL017 1=1
09/22/10 10:11:40



SITE SURFACING LEGEND

- ASPHALT SURFACING
- AGGREGATE SURFACING
- CONCRETE
- GRASS
- OPEN GRADED STONE SURFACING
- RIPRAP
- EXISTING FACILITY
- NEW FACILITY
- NATURAL SOIL

NOTES

1. SEE DRAWING SS-3001 FOR GENERAL NOTES AND LEGEND.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THIS NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRAWN	CHK	DSN	APP
0	16/APR/09	ISSUED FOR PERMITTING	NAW	PLN		PLN/DVW

SCALE: 1" = 60'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA

SIGNED _____ DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION

ENGINEER PLN DRAWN NAW CHECKED DATE

CONTRA COSTA GENERATING STATION LLC
CONTRA COSTA COMBINED CYCLE FACILITY

SURFACING/FENCING/ROADWAY – SITE PLAN – SHEET 1

PROJECT DRAWING NUMBER: 163994–SS–3201 REV: 0

CODE

AREA

SPU37162 ACAD 16.1s (LMS Tech)
A1APL019 E1
04/16/09 15:11:38 1=1

CAK 6/15/10

pgs 5

Radback Oakley Project

163994 File # 52.5406.1008

IMP Sizing for plants area

Attachment 2

~~Black & Veatch Bugs~~

Reference 2

Select Pages

(Runoff factor) x (tributary area) ≤ 2 x (self-retaining area) *Equation 4-1*

For treatment-only sites, and

(Runoff factor) x (tributary area) ≤ 1 x (self-retaining area) *Equation 4-2*

for sites subject to flow-control requirements. Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors to be used when sizing IMPs.

Surface	Treatment and Flow Control	Treatment only
Roofs	1.0	1.0
Concrete or Asphalt	1.0	1.0
Pervious Concrete	0.1	0.1
Porous Asphalt	0.1	0.1
Grouted Unit Pavers	1.0	1.0
Solid Unit Pavers	0.5	0.2
Crushed Aggregate	0.1	0.1
Turfblock	0.1	0.1
Landscape, Group A Soil	0.1	0.1
Landscape, Group B Soil	0.3	0.1
Landscape, Group C Soil	0.5	0.1
Landscape, Group D Soil	0.7	0.1

Areas draining to IMPs are used to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

The CCCWP has developed sizing factors (ratios of IMP area to impervious DMA area). For each IMP design, factors are provided for:

TABLE 4-6. Sizing Factors

Treatment and Flow Control	NRCS Soil Group			
IMP	**A**	**B**	**C**	**D**
Bioretention Facility				
A	0.07	0.11	0.06	0.05
V_1	0.058	0.092	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Flow-through Planter				
A	N/A	N/A	0.06	0.05
V_1	N/A	N/A	0.050	0.042
V_2	N/A	N/A	0.066	0.055
Dry Well				
A	0.05	0.06	N/A	N/A
V	0.130	0.204	N/A	N/A
Cistern + bioretention facility				
A (bioretention facility)	*0.04*	*0.04*	*0.04*	*0.04*
V (cistern)	0.193	0.228	0.088	0.060

* Cistern sized for flow control when used in conjunction with a treatment IMP. IMP underdrain required in B, C and D soils.

Treatment Only

Bioretention Facility				
A	*0.04*	*0.04*	*0.04*	*0.04*
Flow-through Planter				
A	*0.04*	*0.04*	*0.04*	*0.04*
Dry Well (treatment only)				
A	0.02	0.04	N/A	N/A
V	0.068	0.136	N/A	N/A

Units Notes:
A = ft^2 of IMP footprint per ft^2 of tributary impervious area (unitless)
V, V_1, V_2 = ft^3 per ft^2 of equivalent tributary impervious area (ft.)

STEP 5: OBTAIN SIZING AND RAIN ADJUSTMENT FACTORS FOR EACH IMP

For each of the IMPs, obtain the appropriate **area** sizing factor from Table 4-6.

Sizing factors for treatment-only IMPs (in *italics*) do not require any adjustment for differing rainfall patterns.

Both area (A) and volume (V_1, V_2) sizing factors for treatment-plus-flow-control IMPs, however, must be adjusted to account for the effects of differing rainfall patterns on pre-project and post-project runoff.

Use the equations below to compute the rainfall adjustment:

Equation 4-3

$$\text{For Group A soils, } Rain\ Adjustment = \frac{0.0009 \times \left(MAP_{project\ site} - 20.2\right) + 0.07}{0.07}$$

Equation 4-4

$$\text{For Group B soils, } Rain\ Adjustment = \frac{-0.0005 \times \left(MAP_{project\ site} - 20.2\right) + 0.11}{0.11}$$

Equation 4-5

$$\text{For Group C soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.06}{0.06}$$

Equation 4-6

$$\text{For Group D soils, } Rain\ Adjustment = \frac{-0.0022 \times \left(MAP_{project\ site} - 20.2\right) + 0.05}{0.05}$$

where *MAP* is the mean annual precipitation at the site as shown on the isohyetal map, Contra Costa County Public Works Figure B-166, available on the CCCWP C.3 web pages.

► STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

The minimum area and storage volumes of each IMP are found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

$$Min.\ IMP\ Area\ or\ Volume = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Bioretention facilities and flow-through planters have two storage volumes. V_1 is the floodable volume above the soil layer. V_2 is the storage volume below the soil layer, calculated by multiplying the volume of gravel by an assumed porosity of 0.4. See Figure 4-6. Note these volumes can be configured in a variety of practical combinations of depth and area to best fit into your landscape design.

Cisterns and dry wells have a single storage volume (V).

V is calculated using Equation 4-8:

Equation 4-8

$$Min.V = \sum \begin{pmatrix} DMA & DMA \\ Square & \times Runoff \\ Footage & Factor \end{pmatrix} \times \begin{pmatrix} IMP\,Volume \\ Sizing \\ Factor \end{pmatrix} \times \begin{pmatrix} Rain \\ Adjustment \\ Factor \end{pmatrix}$$

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes of the receiving IMP:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas and Volumes

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*	*Soil Type:*	*IMP Name*			
					IMP Sizing factor	*Rain Adjust-ment Factor*	*Minimum Area or Volume*	*Proposed Area or Volume*	
			Total						***IMP Area***
									V or V1
									V2
								Orifice Size:	

► STEP 7: DETERMINE IF IMP AREA AND VOLUME ARE ADEQUATE

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1–6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the Provision C.3 sizing requirements. If not, revise the plan accordingly. Revisions may include:

Radback Oakley Project

CAK 6/15/10

163994 File # 52.5406.1008

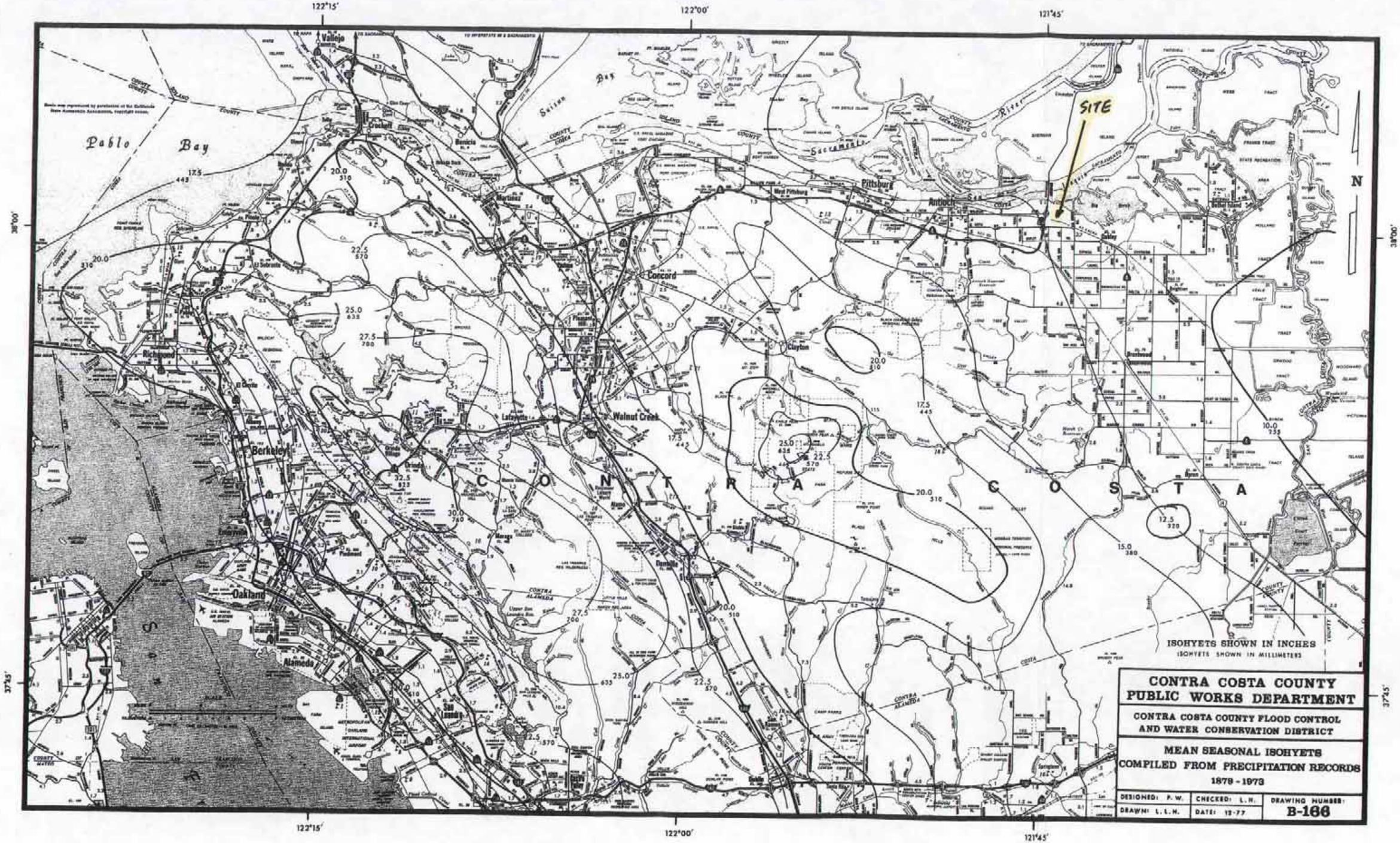
pgs 2

IMP sizing for plant area

Attachment 3

Reference 3

Dwg No B-166


122°15'
122°00'
121°45'
38°00'
37°45'
Pablo Bay
Suisun Bay
Sacramento River
SITE
N
Vallejo
Crockett
Benicia
Martinez
Pittsburg
Antioch
Concord
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Danville
Richmond
El Cerrito
Berkeley
Emeryville
Piedmont
Oakland
Alameda
San Leandro
Brentwood
Byron
Bethel Island
C O N T R A C O S T A
ISOHYETS SHOWN IN INCHES
ISOHYETS SHOWN IN MILLIMETERS
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
MEAN SEASONAL ISOHYETS
COMPILED FROM PRECIPITATION RECORDS
1879 - 1973
DESIGNED: F. W.
DRAWN: L. L. H.
CHECKED: L. H.
DATE: 12-77
DRAWING NUMBER:
B-166

Radback Oakley Project

CAK 6/15/10

163994 File # 52.5406.1008

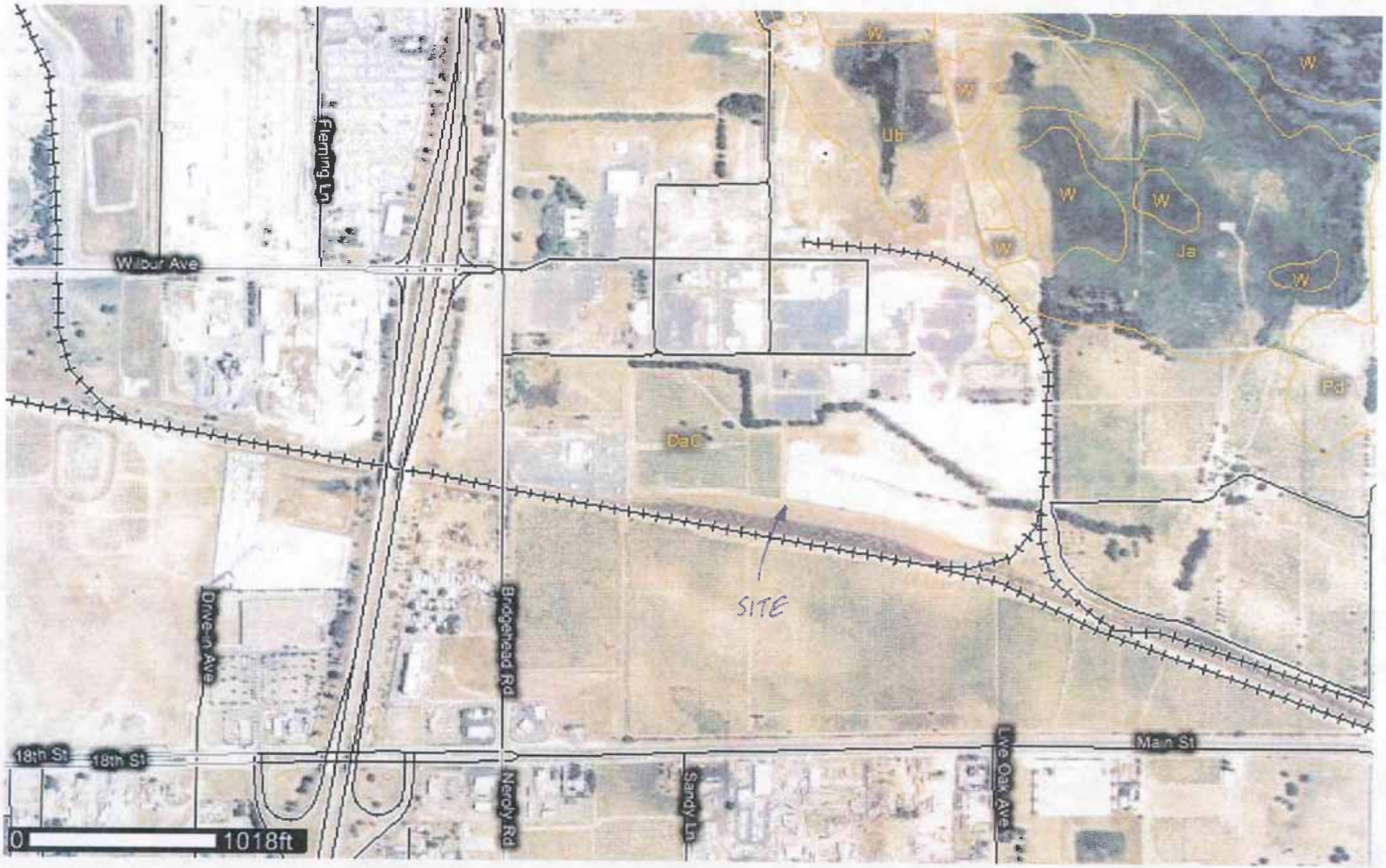
pgs 4

IMP sizing for plant area

Attachment 4

Reference 4

Select Pages


Wilbur Ave
Flaming Ln
Drive-in Ave
Bridgehead Rd
Neroly Rd
Sandy Ln
Live Oak Ave
Main St
18th St
18th St
SITE
W
Ub
Ja
Pd
DaC
0
1018ft

Contra Costa County, California

DaC—DELHI SAND, 2 TO 9 PERCENT SLOPES

Map Unit Setting

Elevation: 10 to 150 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 260 to 300 days

Map Unit Composition

Delhi and similar soils: 85 percent
Minor components: 15 percent

Description of Delhi

Setting

Landform: Flood plains, terraces, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from igneous and sedimentary rock

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Sand
5 to 60 inches: Sand

Minor Components

Unnamed

Percent of map unit: 12 percent

Laugenour

Percent of map unit: 3 percent

Data Source Information

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Radback Oakley Project

CAK 6/15/10

163994 File # 52.5406.1008

pgs 2

IMP sizing for plant area

Attachment 5

Reference 5

select page

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be co siderably altered and the listed group classification n no longer apply. In these circumstances, use the follc ing to determine HSG according to the texture of the new surface soil, provided that significant compactic has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silt clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a hig water table that creates a drainage problem. Once tl soils are effectively drained, they are placed in a dif ent group. For example, Ackerman soil is classified A/D. This indicates that the drained Ackerman soil i group A and the undrained soil is in group D.

Radback Oakley Project

163994 File # 52.5406.1008

IMP sizing for plant area

CAK 6/15/10

Pgs 3

Attachment 6

E-Mail communication w/ Contra Costa County Clean Water Program

Zhong, Jimmy

From: Dan Cloak [dan@dancloak.com]
Sent: Monday, March 02, 2009 3:54 PM
To: 'Tom Dalziel'; Zhong, Jimmy
Subject: RE: Stormwater C.3 Question

Hi,

It is correct that dense-graded aggregates are not very pervious. Why not use an open-graded aggregate, such as ½ in. crushed rock? Be sure to use a rigid frame around the gravel area.

"Porous Pavements" by Bruce Ferguson is a good reference for porous pavement design.

If dense-graded aggregate is used, I would suggest a runoff coefficient of 0.5 to 0.7, depending on slope.

Dan

From: Tom Dalziel [mailto:tdalz@pw.cccounty.us]
Sent: Monday, March 02, 2009 11:04 AM
To: Zhong, Jimmy; Dan@dancloak.com
Subject: RE: Stormwater C.3 Question

Hi Dan,

Can you review and respond, as appropriate, to Jimmy on my behalf?

Thanks.

Tom Dalziel
Assistant Program Manager
Contra Costa Clean Water Program
tdalz@pw.cccounty.us
Ph. (925) 313-2392, Fax (925) 313-2301

From: Zhong, Jimmy [mailto:ZhongJ@bv.com]
Sent: Wednesday, February 25, 2009 1:11 PM
To: Tom Dalziel
Subject: Stormwater C.3 Question

Tom,

I talked to you and Dan this morning regarding runoff factor for Class 2 aggregates (Caltran Standard Specification Section 26). After our phone call, I had a discussion with my supervisor. He indicated that this type of material is **dense-graded** aggregate which is typically used as pavement base material. After being compacted, this type of material is not that pervious based on his experience. Dense-graded aggregates have much lower porosity than open-graded aggregates after compaction. As such, my supervisor thinks the runoff factor of 0.1 can apply to open-graded aggregate but may not be able to apply to dense-graded aggregate. Would you please forward this email to Dan and ask him again if a runoff factor of 0.1 can still applied to Class 2 aggregates (compacted)? If not, what kind of runoff factor should be used?

I apologize if I did not communicate clearly this morning on the type of material we are using and for any confusions it caused.

Thanks again for your help.

Jimmy Zhong, P.E.
Geotechnical/Civil Engineer
Energy Division
Black & Veatch Corporation
3550 Green Court, Ann Arbor, MI 48105
P: (734) 622-8533 F: (734) 622-8700

Appendix F
Risk Level 1 Requirements

ATTACHMENT C
RISK LEVEL 1 REQUIREMENTS

A. Effluent Standards

1. Narrative – Risk Level 1 dischargers shall comply with the narrative effluent standards listed below:

a. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

b. Dischargers shall minimize or prevent pollutants in storm water discharges and authorized non-storm water discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

2. Numeric – Risk Level 1 dischargers are not subject to a numeric effluent standard.

B. Good Site Management "Housekeeping"

1. Risk Level 1 dischargers shall implement good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged. At a minimum, Risk Level 1 dischargers shall implement the following good housekeeping measures:

a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).

c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).

d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

e. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.

2. Risk Level 1 dischargers shall implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:

a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.

b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.

c. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.

d. Cover waste disposal containers at the end of every business day and during a rain event.

e. Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

f. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.

g. Implement procedures that effectively address hazardous and nonhazardous spills.

h. Develop a spill response and implementation element of the SWPPP prior to commencement of construction activities. The SWPPP shall require that:

i. Equipment and materials for cleanup of spills shall be available on site and that spills and leaks shall be cleaned up immediately and disposed of properly; and

ii. Appropriate spill response personnel are assigned and trained.

i. Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

3. Risk Level 1 dischargers shall implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:

a. Prevent oil, grease, or fuel to leak in to the ground, storm drains or surface waters.

b. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate BMPs.

c. Clean leaks immediately and disposing of leaked materials properly.

4. Risk Level 1 dischargers shall implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:

a. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.

b. Contain fertilizers and other landscape materials when they are not actively being used.

c. Discontinue the application of any erodible landscape material within 2 days before a forecasted rain event or during periods of precipitation.

d. Apply erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.

e. Stack erodible landscape material on pallets and covering or storing such materials when not being used or applied.

5. Risk Level 1 dischargers shall conduct an assessment and create a list of potential pollutant sources and identify any areas of the site where additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. This potential pollutant list shall be kept with the SWPPP and shall identify all non-visible pollutants which are known, or should be known, to occur on the construction site. At a minimum, when developing BMPs, Risk Level 1 dischargers shall do the following:

a. Consider the quantity, physical characteristics (e.g., liquid, powder, solid), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.

b. Consider the degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.

c. Consider the direct and indirect pathways that pollutants may be exposed to storm water or authorized non-storm water discharges. This shall include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.

d. Ensure retention of sampling, visual observation, and inspection records.

e. Ensure effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

6. Risk Level 1 dischargers shall implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations. Such particulates can include, but are not limited to, sediment, nutrients, trash, metals, bacteria, oil and grease and organics.

C. Non-Storm Water Management

1. Risk Level 1 dischargers shall implement measures to control all nonstorm water discharges during construction.
2. Risk Level 1 dischargers shall wash vehicles in such a manner as to prevent non-storm water discharges to surface waters or MS4 drainage systems.
3. Risk Level 1 dischargers shall clean streets in such a manner as to prevent unauthorized non-storm water discharges from reaching surface water or MS4 drainage systems.

D. Erosion Control

1. Risk Level 1 dischargers shall implement effective wind erosion control.
2. Risk Level 1 dischargers shall provide effective soil cover for inactive[1] areas and all finished slopes, open space, utility backfill, and completed lots.
3. Risk Level 1 dischargers shall limit the use of plastic materials when

more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

E. Sediment Controls

1. Risk Level 1 dischargers shall establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.
2. On sites where sediment basins are to be used, Risk Level 1 dischargers shall, at minimum, design sediment basins according to the method provided in CASQA's Construction BMP Guidance Handbook.

F. Run-on and Runoff Controls

Risk Level 1 dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off site shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this General Permit.

G. Inspection, Maintenance and Repair

1. Risk Level 1 dischargers shall ensure that all inspection, maintenance repair and sampling activities at the project location shall be performed or supervised by a Qualified SWPPP Practitioner (QSP) representing the discharger. The QSP may delegate any or all of these activities to an employee trained to do the task(s) appropriately, but shall ensure adequate deployment.
2. Risk Level 1 dischargers shall perform weekly inspections and observations, and at least once each 24-hour period during extended

[1] Inactive areas of construction are areas of construction activity that have been disturbed and are not scheduled to be re-disturbed for at least 14 days.

storm events, to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. Inspectors shall be the QSP or be trained by the QSP.
3. Upon identifying failures or other shortcomings, as directed by the QSP, Risk Level 1 dischargers shall begin implementing repairs or design changes to BMPs within 72 hours of identification and complete the changes as soon as possible.
4. For each inspection required, Risk Level 1 dischargers shall complete an inspection checklist, using a form provided by the State Water Board or Regional Water Board or in an alternative format.
5. Risk Level 1 dischargers shall ensure that checklists shall remain onsite with the SWPPP and at a minimum, shall include:

a. Inspection date and date the inspection report was written.

b. Weather information, including presence or absence of precipitation, estimate of beginning of qualifying storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall in inches.

c. Site information, including stage of construction, activities completed, and approximate area of the site exposed.

d. A description of any BMPs evaluated and any deficiencies noted.

e. If the construction site is safely accessible during inclement weather, list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list the results of visual inspections at all relevant outfalls, discharge points, downstream locations and any projected maintenance activities.

f. Report the presence of noticeable odors or of any visible sheen on the surface of any discharges.

g. Any corrective actions required, including any necessary changes to the SWPPP and the associated implementation dates.

h. Photographs taken during the inspection, if any.

i. Inspector’s name, title, and signature.

H. Rain Event Action Plan

Not required for Risk Level 1 dischargers.

Appendix G
Construction Schedule

Construction Schedule

Construction of the generating facility, from site preparation and grading to commercial operation is expected to take place from the first quarter of 2011 to the fourth quarter of 2013 (33 months total). Major milestones are listed in Table 2.4. A copy of this schedule is in Appendix G.

TABLE 2.4
Project Schedule Major Milestones

Activity	Date
Begin/Demolition	First quarter 2011
Startup and Test	Second quarter 2013
Commercial Operation	Fourth quarter 2013

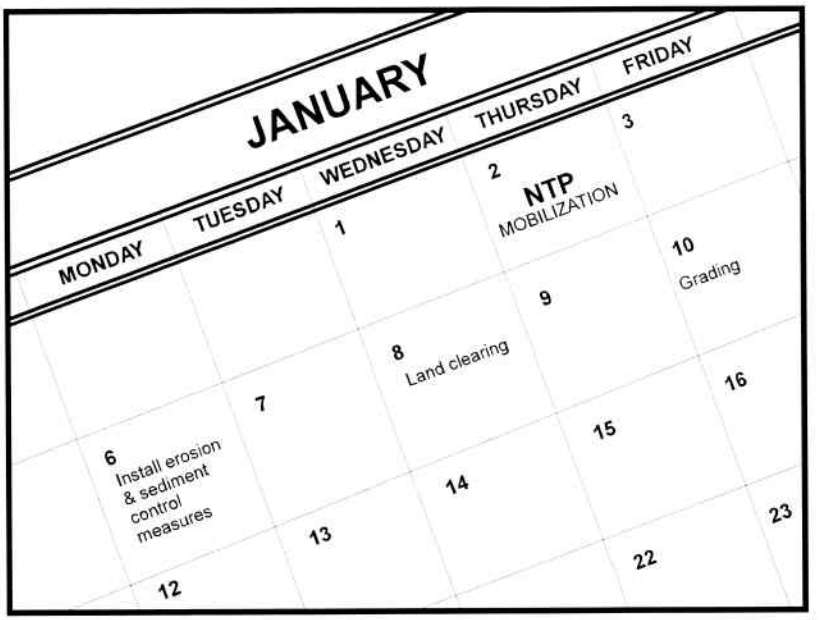
There will be an average and peak workforce of approximately 303 and 729, respectively, of construction craft people, supervisory, support, and construction management personnel on site during construction. The peak construction site workforce level is expected to last from month 10 through month 30 of the 33-month construction period, with the peak being month 23.

Typically, noisy construction will be scheduled to occur between 6:00 a.m. and 7:00 p.m. Monday through Saturday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities (for example, pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the startup phase of the project, some activities will continue 24 hours per day, 7 days per week.

Appendix H
CASQA BMP Handbook Fact Sheets

Scheduling

EC-1



Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.
- Plan the project and develop a schedule showing each phase

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

of construction. Clearly show how the rainy season relates to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

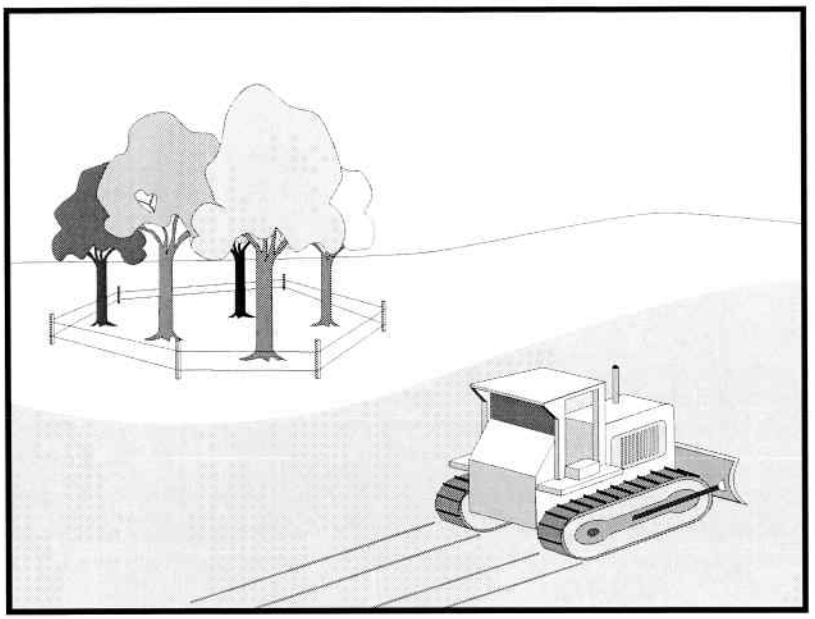
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Preservation Of Existing Vegetation EC-2



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

Limitations

- Requires forward planning by the owner/developer,

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

contractor, and design staff.

- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

References

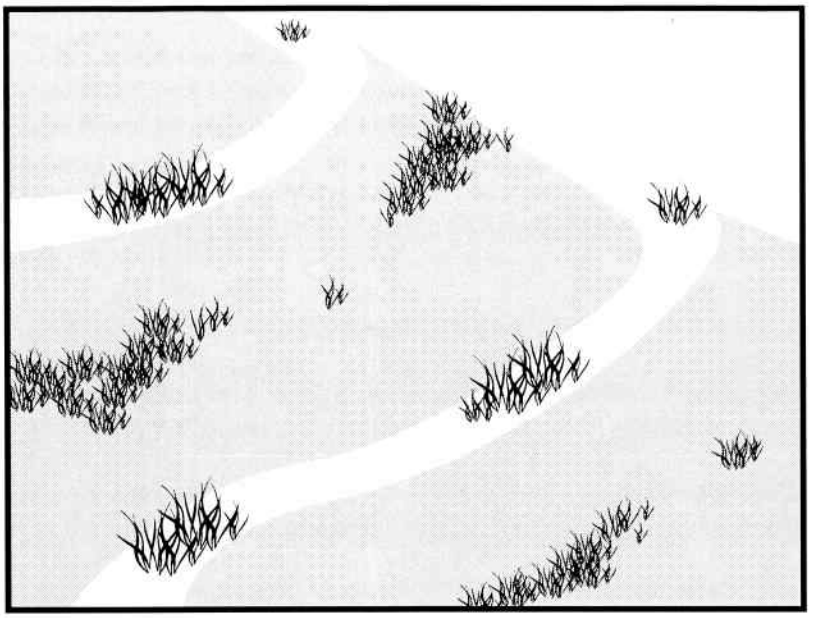
County of Sacramento Tree Preservation Ordinance, September 1981.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydroseeding EC-4



Description and Purpose

Hydroseeding typically consists of applying a mixture of a hydraulic mulch, seed, fertilizer, and stabilizing emulsion with a hydraulic mulcher, to temporarily protect exposed soils from erosion by water and wind. Hydraulic seeding, or hydroseeding, is simply the method by which temporary or permanent seed is applied to the soil surface.

Suitable Applications

Hydroseeding is suitable for disturbed areas requiring temporary protection until permanent stabilization is established, for disturbed areas that will be re-disturbed following an extended period of inactivity, or to apply permanent stabilization measures. Hydroseeding without mulch or other cover (e.g. EC-7, Erosion Control Blanket) is not a stand-alone erosion control BMP and should be combined with additional measures until vegetation establishment.

Typical applications for hydroseeding include:

- Disturbed soil/graded areas where permanent stabilization or continued earthwork is not anticipated prior to seed germination.
- Cleared and graded areas exposed to seasonal rains or temporary irrigation.
- Areas not subject to heavy wear by construction equipment or high traffic.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

EC-14 Compost Blanket

EC-16 Non-Vegetative Stabilization

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Availability of hydroseeding equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Hydraulic seed should be applied with hydraulic mulch or a stand-alone hydroseed application should be followed by one of the following:
    - Straw mulch (see Straw Mulch EC-6)
    - Rolled erosion control products (see Geotextiles and Mats EC-7)
    - Application of Compost Blanket (see Compost Blanket EC-14)

  Hydraulic seed may be used alone only on small flat surfaces when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control.
- Hydraulic seed without mulch does not provide immediate erosion control.
- Temporary seeding may not be appropriate for steep slopes (i.e., slopes readily prone to rill erosion or without sufficient topsoil).
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation may not be appropriate for short term inactivity (i.e. less than 3-6 months).

Implementation

In order to select appropriate hydraulic seed mixtures, an evaluation of site conditions should be performed with respect to:

- Soil conditions
- Site topography and exposure (sun/wind)
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS) is an excellent source of information on appropriate seed mixes.

The following steps should be followed for implementation:

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying (See EC-15, Soil Preparation) the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.

- Avoid use of hydraulic seed in areas where the BMP would be incompatible with future earthwork activities.
- Hydraulic seed can be applied using a multiple step or one step process.
  - In a multiple step process, hydraulic seed is applied first, followed by mulch or a Rolled Erosion Control Product (RECP).
  - In the one step process, hydraulic seed is applied with hydraulic mulch in a hydraulic matrix. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate should be increased to compensate for all seeds not having direct contact with the soil.
- All hydraulically seeded areas should have mulch, or alternate erosion control cover to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds should be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag should be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container should be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed should be pellet inoculated. Inoculant sources should be species specific and should be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer should conform to the requirements of the California Food and Agricultural Code, which can be found at http://www.leginfo.ca.gov/.html/fac_table_of_contents.html. Fertilizer should be pelleted or granular form.
- Follow up applications should be made as needed to cover areas of poor coverage or germination/vegetation establishment and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Costs

Average cost for installation and maintenance may vary from as low as $1,900 per acre for flat slopes and stable soils, to $4,000 per acre for moderate to steep slopes and/or erosive soils. Cost of seed mixtures vary based on types of required vegetation.

BMP	Installed Cost per Acre
Hydraulic Seed	$1,900-$4,000

Source: Caltrans Soil Stabilization BMP Research for Erosion and Sediment Controls, July 2007

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems should be inspected for complete coverage and adjusted as needed to maintain complete coverage.

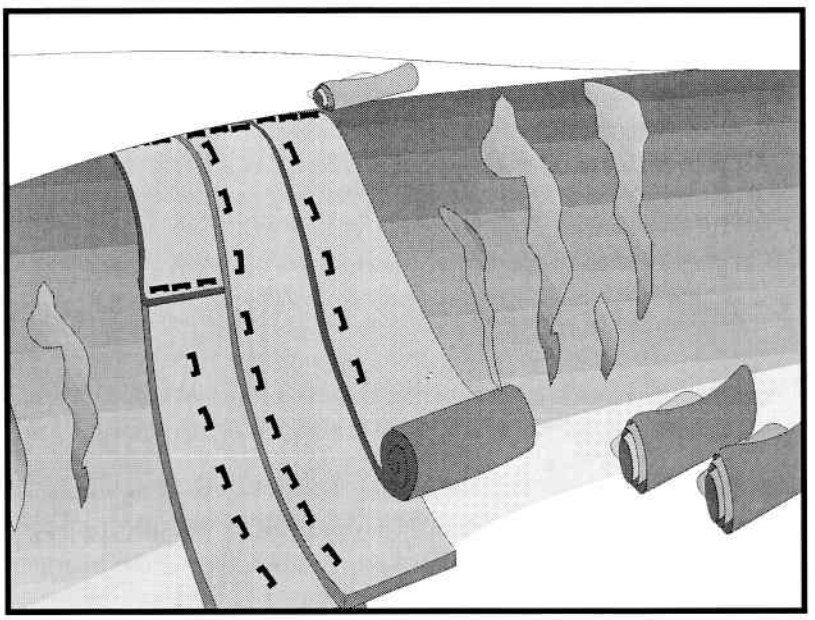
References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Geotextiles and Mats EC-7



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

Description and Purpose

Mattings, or Rolled Erosion Control Products (RECPs), can be made of natural or synthetic materials or a combination of the two. RECPs are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, RECPs may be used to stabilize soils until vegetation is established or to reinforce non-woody surface vegetation.

Suitable Applications

RECPs are typically applied on slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks, swales and other drainage channels where moving water at velocities between 3 ft/s and 6 ft/s are likely to cause scour and wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. RECPs may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). RECPs should be considered when the soils are fine grained and potentially erosive. RECPs should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop

- Channels with flows exceeding 3.3 ft/s
- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies

Limitations

- RECP installed costs are generally higher than other erosion control BMPs, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- RECPs may delay seed germination, due to reduction in soil temperature.
- RECPs are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers). If a staple or pin cannot be driven into the soil because the underlying soil is too hard or rocky, then an alternative BMP should be selected.
- If used for temporary erosion control, RECPs should be removed and disposed of prior to application of permanent soil stabilization measures.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until more environmentally friendly measures, such as seeding and mulching, may be installed.
    - Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
    - Plastic sheeting results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- RECPs may have limitations based on soil type, slope gradient, or channel flow rate; consult the manufacturer for proper selection.
- Not suitable for areas that have foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.
- RECPs that incorporate a plastic netting (e.g. straw blanket typically uses a plastic netting to hold the straw in place) may not be suitable near known wildlife habitat. Wildlife can become trapped in the plastic netting.
- RECPs may have limitations in extremely windy climates. However, when RECPs are properly trenched at the top and bottom and stapled in accordance with the manufacturer's recommendations, problems with wind can be minimized.

Implementation

Material Selection

- Natural RECPs have been found to be effective where re-vegetation will be provided by re-seeding. The choice of material should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

- The following natural and synthetic RECPs are commonly used:

Geotextiles

- Material can be a woven or a non-woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Generally plastic sheeting should only be used as stockpile covering or for very small graded areas for short periods of time (such as through one imminent storm event). If plastic sheeting must be used, choose a plastic that will withstand photo degradation.

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope (when used as a temporary slope protection) and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil (when used as a temporary slope protection).

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable RECPs are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable. See typical installation details at the end of this fact sheet.

- **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. The performance of jute as a stand-alone RECP is low. Most other RECPs outperform jute as a temporary erosion control product and therefore jute is not commonly used. It is designed to be used in conjunction with vegetation. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

  - **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips,

which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper soil preparation is essential to ensure complete contact of the RECP with the soil. Soil Roughening is not recommended in areas where RECPs will be installed.
- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding/Planting

Seed the area before blanket installation for erosion control and re-vegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all areas disturbed during blanket installation must be re-seeded. Where soil filling is specified for turf reinforcement mats (TRMs), seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots shall be installed as required by the manufacturer.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the seedbed should be friable, made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft (or greater, per manufacturer's specifications).
- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2. Check manufacturer's specifications to determine if a higher density staple pattern is required.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.

- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.
- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement mat (TRM))

Installation should be in accordance with the manufacturer's recommendations. Typical installation guidelines are as follows:

- After seeding, spread and lightly rake ½-3/4 inches of fine topsoil into the TRM apertures to completely fill TRM thickness. Use backside of rake or other flat implement.
- Alternatively, if allowed by product specifications, spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.
- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Installed costs can be relatively high compared to other BMPs. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre (2000)[1]	Estimated Cost per Acre (2009)[2]
Biodegradable	Jute Mesh	$6,000-$7,000	$6,600-$7,700
	Curled Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Straw	$8,000-$10,500	$8,800-$11,050
	Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Coconut Fiber	$13,000-$14,000	$14,300-$15,400
	Coconut Fiber Mesh	$30,000-$33,000	$33,000-$36,300
	Straw Coconut Fiber	$10,000-$12,000	$11,000-$13,200
Non-Biodegradable	Plastic Netting	$2,000-$2,200	$2,200-$2,220
	Plastic Mesh	$3,000-$3,500	$3,300-$3,850
	Synthetic Fiber with Netting	$34,000-$40,000	$37,400-$44,000
	Bonded Synthetic Fibers	$45,000-$55,000	$49,500-$60,500
	Combination with Biodegradable	$30,000-$36,000	$33,000-$39,600

1. Source: Erosion Control Pilot Study Report, Caltrans, June 2000.

2. 2009 costs reflect a 10% escalation over year 2000 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- RECPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.

References

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

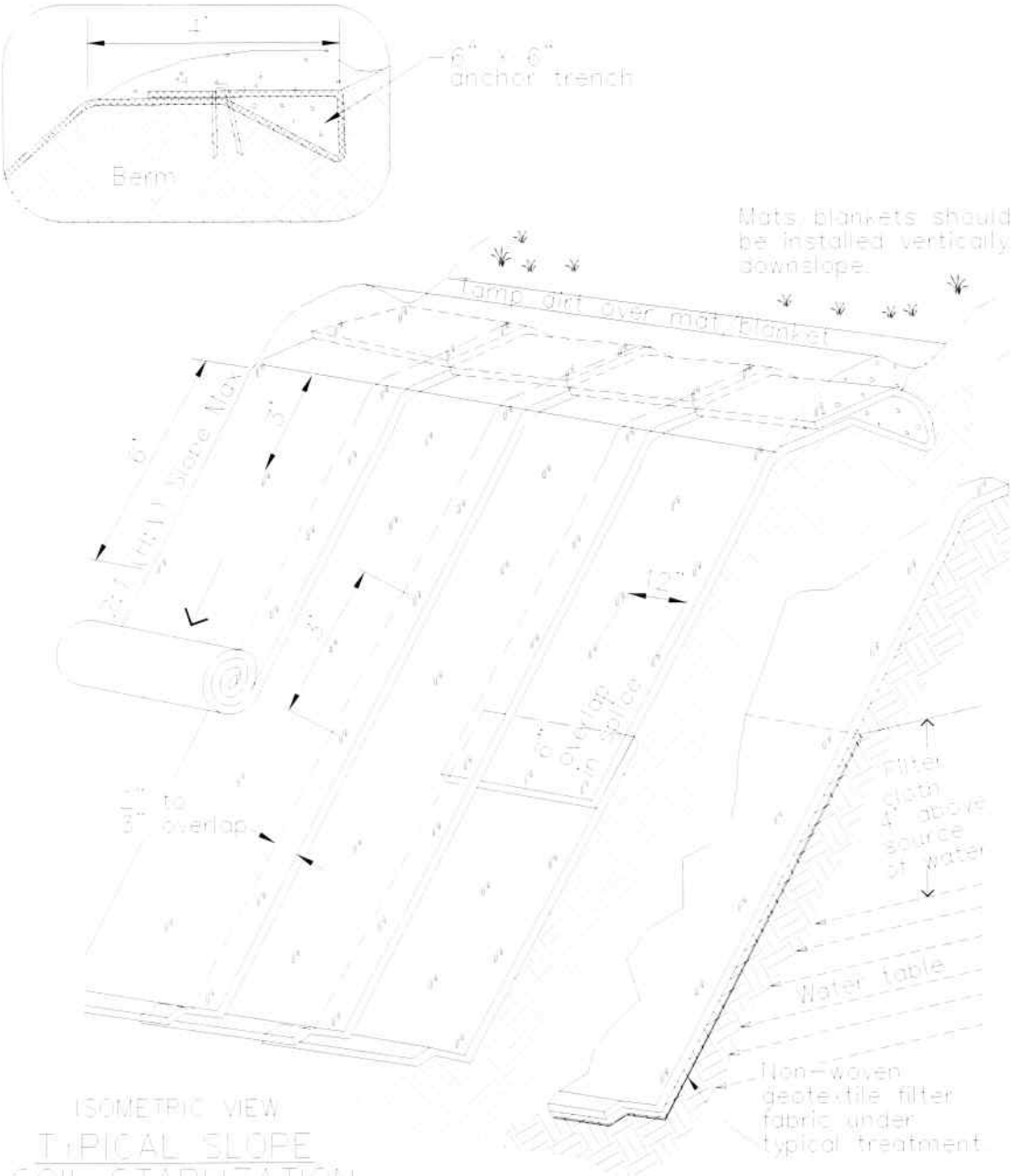
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



ISOMETRIC VIEW

TYPICAL SLOPE SOIL STABLIZATION

NTS

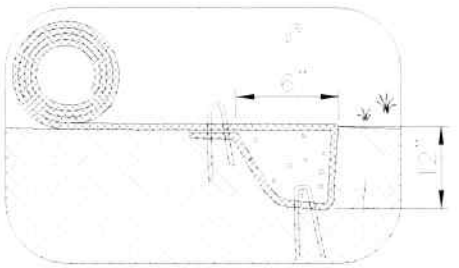
WET SLOPE LINING

NTS

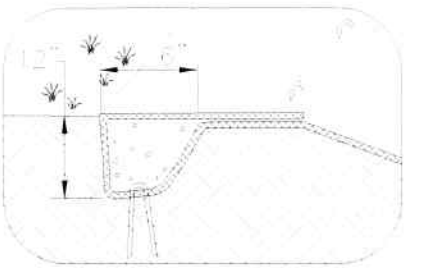
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations.

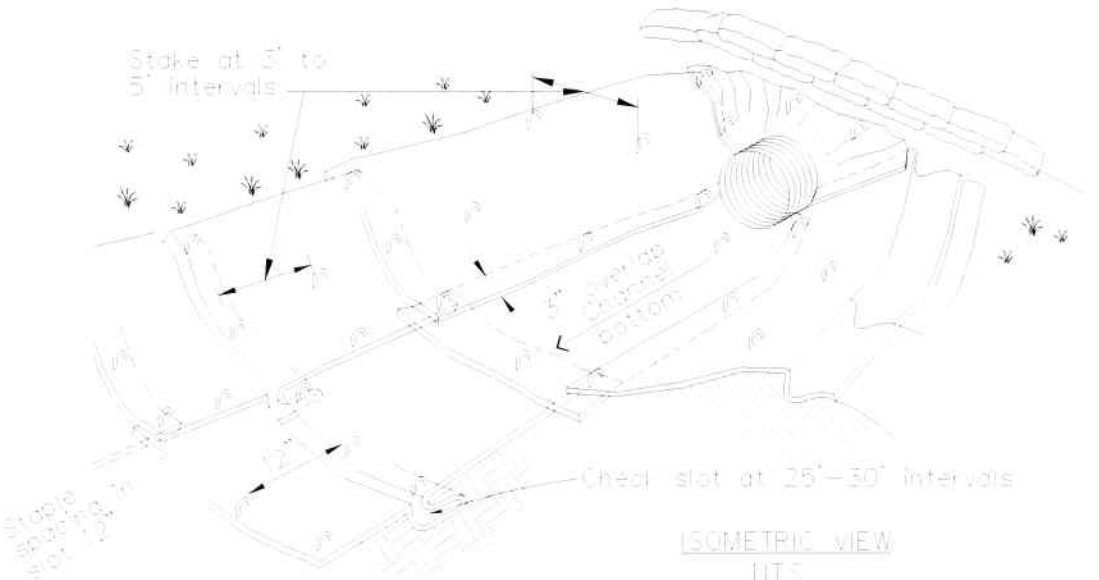
TYPICAL INSTALLATION DETAIL



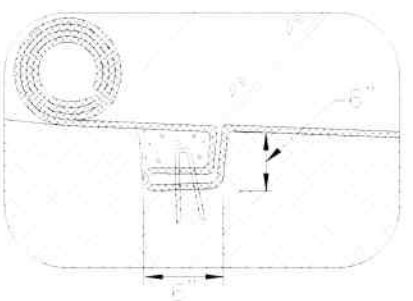
INITIAL CHANNEL ANCHOR TRENCH
NTS



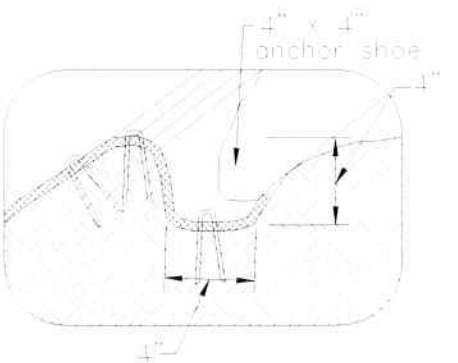
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS



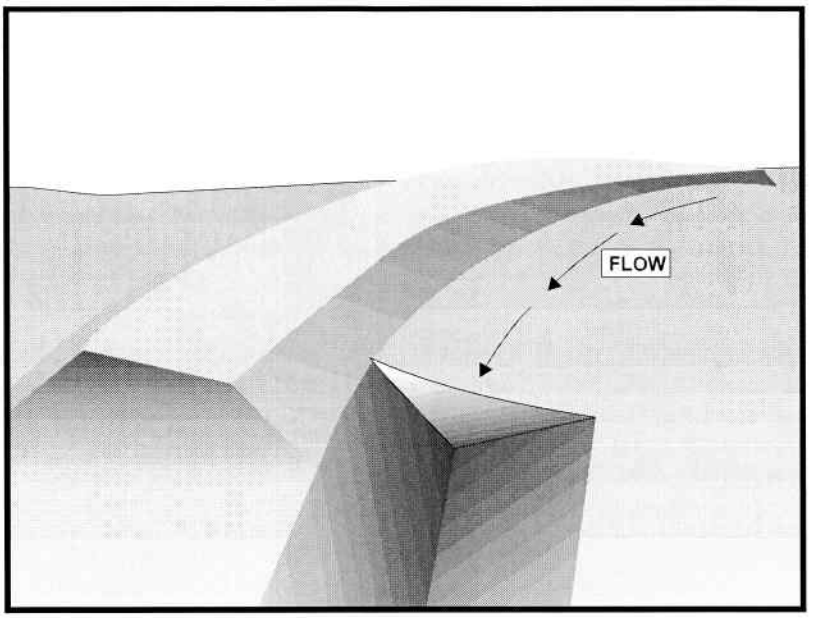
LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations.

TYPICAL INSTALLATION DETAIL

Earth Dikes and Drainage Swales EC-9



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in drainage swales.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert

runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin

(SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.

- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.
- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd^3.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

References

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursetynsky, P.E., McGraw Hill Book Company, 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

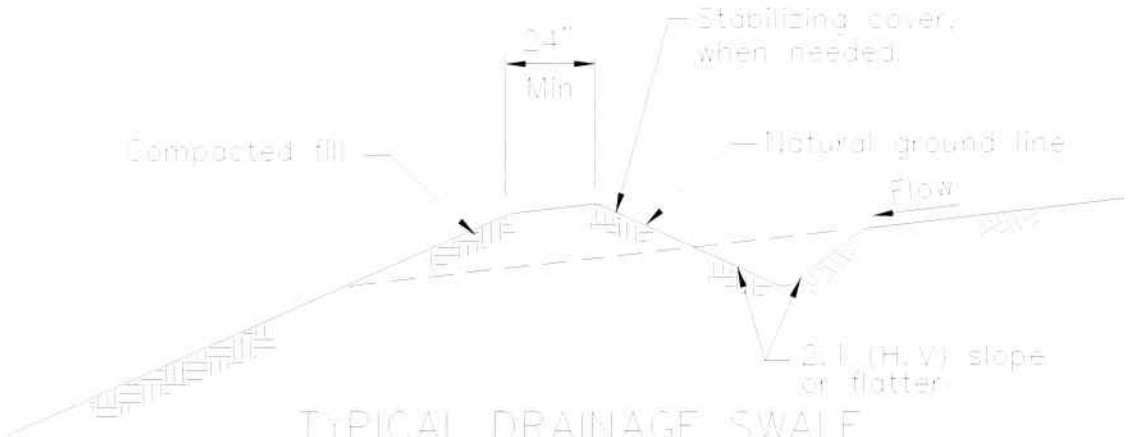
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

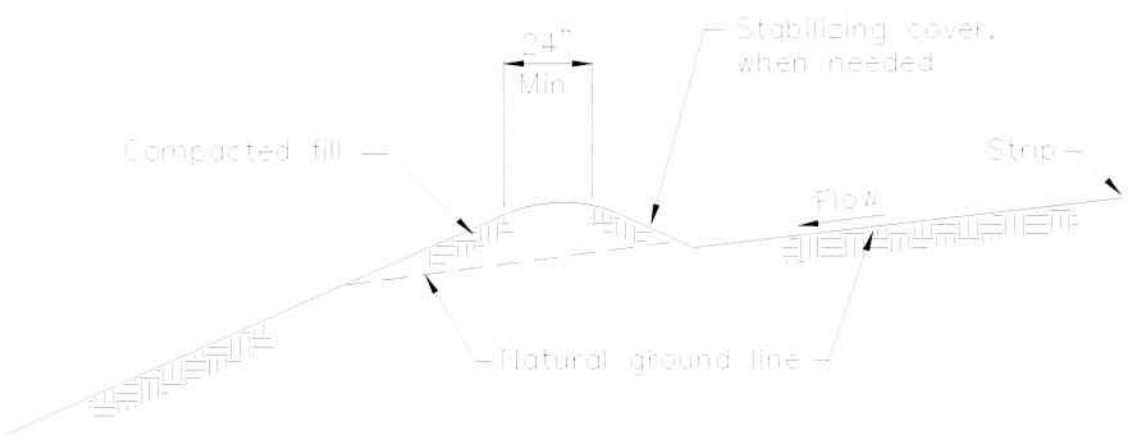
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade



TYPICAL EARTH DIKE
NOT TO SCALE

Soil Preparation/Roughening EC-15

Description and Purpose

Soil Preparation/Roughening involves assessment and preparation of surface soils for BMP installation. This can include soil testing (for seed base, soil characteristics, or nutrients), as well as roughening surface soils by mechanical methods (including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting) to prepare soil for additional BMPs, or to break up sheet flow. Soil Preparation can also involve tilling topsoil to prepare a seed bed and/or incorporation of soil amendments, to enhance vegetative establishment.

Suitable Applications

Soil preparation: Soil preparation is essential to proper vegetative establishment. In particular, soil preparation (i.e. tilling, raking, and amendment) is suitable for use in combination with any soil stabilization method, including RECPs or sod. Soil preparation should not be confused with roughening.

Roughening: Soil roughening is generally referred to as track walking (sometimes called imprinting) a slope, where treads from heavy equipment run parallel to the contours of the slope and act as mini terraces. Soil preparation is most effective when used in combination with erosion controls. Soil Roughening is suitable for use as a complementary process for controlling erosion on a site. Roughening is not intended to be used as a stand-alone BMP, and should be used with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness. Roughening is intended to only affect surface soils and should not compromise slope stability or overall compaction. Suitable applications for soil roughening include:

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-5 Soil Binders

EC-7 Geotextiles and Mats

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Along any disturbed slopes, including temporary stockpiles, sediment basins, or compacted soil diversion berms and swales.
- Roughening should be used in combination with hydraulically applied stabilization methods, compost blanket, or straw mulch; but should not be used in combination with RECPs or sod because roughening is intended to leave terraces on the slope.

Limitations

- Preparation and roughening must take place prior to installing other erosion controls (such as hydraulically applied stabilizers) or sediment controls (such as fiber rolls) on the faces of slopes.
- In such cases where slope preparation is minimal, erosion control/revegetation BMPs that do not require extensive soil preparation - such as hydraulic mulching and seeding applications - should be employed.
- Consideration should be given to the type of erosion control BMP that follows surface preparation, as some BMPs are not designed to be installed over various types of tillage/roughening, i.e., RECPs (erosion control blankets) should not be used with soil roughening due to a "bridging" effect, which suspends the blanket above the seed bed.
- Surface roughness has an effect on the amount of mulch material that needs to be applied, which shows up as a general increase in mulch material due to an increase in surface area (Topographic Index -see EC-3 Hydraulic Mulching).

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

General

A roughened surface can significantly reduce erosion. Based on tests done at the San Diego State Erosion Research Laboratory, various roughening techniques on slopes can result in a 12 - 76% reduction in the erosion rate versus smooth slopes.

Materials

Minimal materials are required unless amendments and/or seed are added to the soil. The majority of soil roughening/preparation can be done with equipment that is on hand at a normal construction site, such as bull dozers and compaction equipment.

Installation Guidelines

Soil Preparation

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Based upon soil testing conducted, apply additional soil amendments (e.g. fertilizers, additional seed) to the soil to help with germination. Follow EC-4, Hydroseeding, when selecting and applying seed and fertilizers.

Cut Slope Roughening:

- Stair-step grade or groove the cut slopes that are steeper than 3:1.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet (0.6 m) high in soft materials or more than 3 feet (0.9 m) high in rocky materials.
- Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

Fill Slope Roughening:

- Place on fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches (0.2 m), and make sure each lift is properly compacted.
- Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches (0.1-0.2 m) deep.
- Use grooving or tracking to roughen the face of the slopes, if necessary.
- Do not blade or scrape the final slope face.

Roughening for Slopes to be Mowed:

- Slopes which require mowing activities should not be steeper than 3:1.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 inches), and not less than 1 inch deep, and perpendicular to the direction of runoff (i.e., parallel to the slope contours).
- Excessive roughness is undesirable where mowing is planned.

Roughening With Tracked Machinery:

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Costs

Costs are based on the additional labor of tracking or preparation of the slope plus the cost of any required soil amendment materials.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.
- Inspect BMPs weekly during normal operations, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Non-Vegetative Stabilization EC-16

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Non-vegetative stabilization methods are used for temporary or permanent stabilization of areas prone to erosion and should be used only where vegetative options are not feasible; examples include:

- Areas of vehicular or pedestrian traffic such as roads or paths;
- Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
- Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
- Areas where vegetation will not grow adequately within the construction time frame.

There are several non-vegetative stabilization methods and selection should be based on site-specific conditions.

Decomposed Granite (DG) is a permanent erosion protection method that consists of a layer of stabilized decomposed granite placed over an erodible surface.

Degradable Mulches of various types (see EC-3, EC-6, EC-8) can be used for temporary non-vegetative stabilization; examples include straw mulch, compost, wood chips or hydraulic mulch.

Geotextiles and Mats can be used for temporary non-vegetative stabilization (see EC-7). These BMPs are typically manufactured

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

from degradable or synthetic materials and are designed and specified based on their functional longevity, i.e., how long they will persist and provide erosion protection. All geotextiles and mats should be replaced when they exceed their functional longevity or when permanent stabilization methods are instituted.

Gravel Mulch is a non-degradable erosion control product that is composed of washed and screened coarse to very coarse gravel, 16 mm to 64 mm (0.6" - 2.5"), similar to an AASHTO No. 3 coarse aggregate.

Rock Slope Protection consists of utilizing large rock or rip-rap (4"- 24") to stabilize slopes with a high erosion potential and those subject to scour along waterways.

Soil Binders can be used for temporary non-vegetative stabilization (see EC-5). The key to their use is functional longevity. In most cases, the soil binder will need to be routinely monitored and re-applied to maintain an erosion-resistant coverage.

Suitable Applications

Non-vegetated stabilization methods are suitable for use on disturbed soil areas and on material stockpiles that need to be temporarily or permanently protected from erosion by water and wind. Non-vegetated stabilization should only be utilized when vegetation cannot be established in the required timeframe, due to soil or climactic conditions, or where vegetation may be a potential fire hazard.

Decomposed Granite (DG) and Gravel Mulch are suitable for use in areas where vegetation establishment is difficult, on flat surfaces, trails and pathways, and when used in conjunction with a stabilizer or tackifier, on shallow slopes (i.e., 10:1 [H:V]). DG and gravel can also be used on shallow rocky slopes where vegetation cannot be established for permanent erosion control.

Degradable Mulches can be used to cover and protect soil surfaces from erosion both in temporary and permanent applications. In many cases, the use of mulches by themselves requires routine inspection and re-application. See EC-3 Hydraulic Mulch, EC-6 Straw Mulch, EC-8 Wood Mulch, or EC-14 Compost Blankets for more information.

Geotextiles and Mats can be used as a temporary stand-alone soil stabilization method. Depending on material selection, geotextiles and mats can be a short-term (3 mos – 1 year) or long-term (1-2 years) temporary stabilization method. For more information on geotextiles and mats see EC-7 Geotextiles and Mats.

Rock Slope Protection can be used when the slopes are subject to scour or have a high erosion potential, such as slopes adjacent to flowing waterways or slopes subject to overflow from detention facilities (spillways).

Soil Binders can be used for temporary stabilization of stockpiles and disturbed areas not subject to heavy traffic. See EC-5 Soil Binders for more information.

Limitations

General

- Refer to EC-3, EC-6, EC-8, and EC-14 for limitations on use of mulches. Refer to EC-7 for limitations on use of geotextiles and mats. Refer to EC-5 for limitations on use of Soil Binders.

Decomposed Granite

- Not available in some geographic regions.
- If not tackified, material may be susceptible to erosion even on slight slopes (e.g., 30:1 [H:V]).
- Installed costs may be more expensive than vegetative stabilization methods.

Gravel Mulch

- Availability is limited in some geographic regions.
- If not properly screened and washed, can contain fine material that can erode and/or create dust problems.
- If inadequately sized, material may be susceptible to erosion on sloped areas.
- Pore spaces fill with dirt and debris over time; may provide a growing medium for weeds.

Rock Slope Protection

- Installation is labor intensive.
- Installed costs can be significantly higher than vegetative stabilization methods.
- Rounded stones may not be used on slopes greater than 2:1 [H:V].

Implementation

General

Non-vegetated stabilization should be used in accordance with the following general guidance:

- Should be used in conjunction with other BMPs, including drainage, erosion controls and sediment controls.
- Refer to EC-3, EC-6, EC-8, and EC-14 for implementation details for mulches. Refer to EC-7 for implementation details for geotextiles and mats. Refer to EC-5 for implementation details for soil binders.
- Non-vegetated stabilization measures should be implemented as soon as the disturbance in the areas they are intended to protect has ceased.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Decomposed Granite Stabilization

- If used for a road or path should be installed on a prepared base.

- Should be mixed with a stabilizer if used for roads or pathways, or on slope applications.
- Though porous it is recommended to prevent standing water on or next to a decomposed granite road or pathway.

Gravel Mulch

- Should be sized based on slope, rainfall, and upgradient run-on conditions. Stone size should be increased as potential for erosion increases (steeper slopes, high intensity rainfall).
- If permanent, a weed control fabric should be placed prior to installation.
- Should be installed at a minimum 2" depth.
- Should completely cover all exposed surfaces.

Rock Slope Protection

- Rock slope protection installation should follow Caltrans Standard Specification 72-2: Rock Slope Protection. Refer to the specification for rock conformity requirements and installation methods.
- When using rock slope protection, rock size and installation method should be specified by an Engineer.
- A geotextile fabric should be placed prior to installation.

Costs

- Costs are highly variable depending not only on technique chosen, but also on materials chosen within specific techniques. In addition, availability of certain materials will vary by region/location, which will also affect the cost. Costs of mulches, geotextiles and mats, and soil binders are presented in their respective fact sheets. Costs for decomposed granite, gravel mulch stabilization and rock slope protection may be higher depending on location and availability of materials. Caltrans has provided an estimate for gravel mulch of \$10 - \$15/yd^2 in flat areas and \$11 - \$23/yd^2 on side slopes.

Inspection and Maintenance

General

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- For permanent installation, require inspection periodically and after major storm events to look for signs of erosion or damage to the stabilization.
- All damage should be repaired immediately.
- Refer to EC-3, EC-6, EC-8, and EC-14 for inspection and maintenance requirements for mulches. Refer to EC-7 for inspection and maintenance requirements for geotextiles and mats. Refer to EC-5 for inspection and maintenance requirements for soil binders.

Decomposed Granite and Gravel Mulch Stabilization

- Rake out and add decomposed granite or gravel as needed to areas subject to rill erosion. Inspect upgradient drainage controls and repair/modify as necessary.
- Should remain stable under loose surface material. Any significant problem areas should be repaired to restore uniformity to the installation.

References

Arid Zone Forestry: A Guide for Field Technicians. Food and Agriculture Organization of the United Nations, 1989.

Design of Roadside Channels with Flexible Linings, Hydraulic Engineering Circular Number 15, Third Edition, Federal Highway Administration, 2007.

Design Standards for Urban Infrastructure - Soft Landscape Design, Department of Territory and Municipal Services - Australian Capital Territory http://www.tams.act.gov.au/work/standards_and_procedures/design_standards_for_urban_infrastructure

Erosion and Sediment Control Handbook: A Guide for Protection of State Waters through the use of Best Management Practices during Land Disturbing Activities, Tennessee Department of Environment and Conservation, 2002.

Gravel Mulch, Landscape Architecture Non-Standard Specification 10-2, California Department of Transportation (Caltrans), http://www.dot.ca.gov/hq/LandArch/roadside/detail-gm.htm

Maine Erosion and Sediment Control BMPs, DEPLW0588, Maine Department of Environmental Protection: Bureau of Land and Water Quality, 2003.

National Menu of Best Management Practices, US Environmental Protection Agency, 2006.

Standard Specification 72-2: Rock Slope Protection. California Department of Transportation, 2006.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Water Conservation Practices NS-1

Categories		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and the transport of pollutants offsite. These practices can reduce or eliminate non-stormwater discharges.

Suitable Applications

Water conservation practices are suitable for all construction sites where water is used, including piped water, metered water, trucked water, and water from a reservoir.

Limitations

- None identified.

Implementation

- Keep water equipment in good working condition.
- Stabilize water truck filling area.
- Repair water leaks promptly.
- Washing of vehicles and equipment on the construction site is discouraged.
- Avoid using water to clean construction areas. If water must be used for cleaning or surface preparation, surface should be swept and vacuumed first to remove dirt. This will minimize amount of water required.
- Direct construction water runoff to areas where it can soak

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

into the ground or be collected and reused.

- Authorized non-stormwater discharges to the storm drain system, channels, or receiving waters are acceptable with the implementation of appropriate BMPs.
- Lock water tank valves to prevent unauthorized use.

Costs

The cost is small to none compared to the benefits of conserving water.

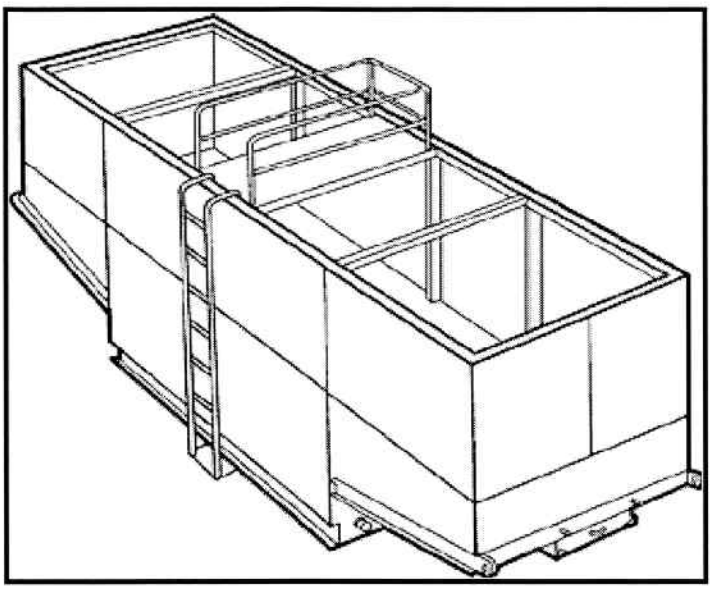
Inspection and Maintenance

- Inspect and verify that activity based BMPs are in place prior to the commencement of authorized non-stormwater discharges.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges are occuring.
- Repair water equipment as needed to prevent unintended discharges.
  - Water trucks
  - Water reservoirs (water buffalos)
  - Irrigation systems
  - Hydrant connections

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Dewatering Operations NS-2



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation (stormwater) must be removed from a work location to proceed with construction work or to provide vector control.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Discharges from dewatering operations can contain high levels of fine sediment that, if not properly treated, could lead to exceedences of the General Permit requirements.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area to facilitate construction.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (stormwater) from depressed areas at a construction site.

Stormwater mixed with non-stormwater should be managed as non-stormwater.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Dewatering operations will require, and should comply with applicable local and project-specific permits and regulations. In some areas, all dewatering activities, regardless of the discharge volume, require a dewatering permit.
- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this fact sheet primarily address sediment. Other secondary pollutant removal benefits are discussed where applicable.
- The controls detailed in this fact sheet only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Avoid dewatering discharges where possible by using the water for dust control.

Implementation

- A Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP).
- Regional Water Quality Control Board (RWQCB) Regions may require notification and approval prior to any discharge of water from construction sites.
- The destination of discharge from dewatering activities will typically determine the type of permit required by the discharger. For example, when discharging to a water of the U.S., a groundwater extraction permit will be required through the site's governing RWQCB. When discharging to a sanitary sewer or Municipal Separate Storm Sewer System (MS4), a permit may need to be obtained through the owner of the sanitary sewer or MS4 in addition to obtaining an RWQCB dewatering permit. Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.
- Dewatering discharges should not cause erosion at the discharge point. Appropriate BMPs should be implemented to maintain compliance with all applicable permits.
- Maintain dewatering records in accordance with all local and project-specific permits and regulations.

Sediment Treatment

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The sediment particle size and permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate. Use of other enhanced treatment methods (i.e., introduction of chemicals or electric current to enhance flocculation and removal of sediment) must comply with: 1) for storm drain or surface water discharges, the requirements for Active Treatment Systems (SE-11); or 2) for sanitary sewer discharges, the requirements of applicable sanitary sewer discharge permits.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3) and have a designed outlet structure.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, silt, some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.
- Temporary sediment basins should be fenced if safety is a concern.
- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outlet, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2) and do not have a designed outlet (but do have a spillway or overflow).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

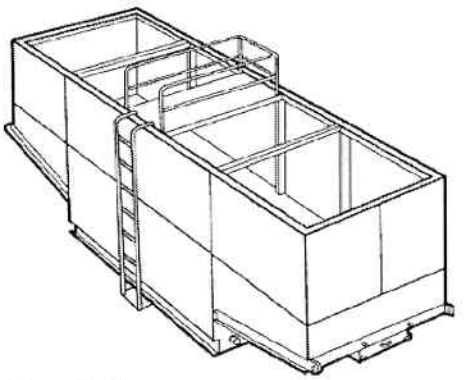
Implementation:

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

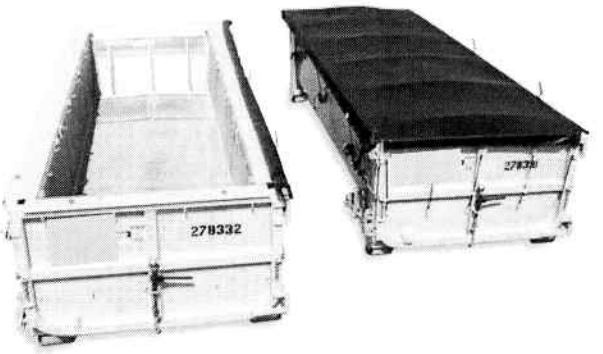
Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.
- Treatment capacity (i.e., volume and number of tanks) should provide at a minimum the required volume for discrete particle settling for treatment design flows.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by a licensed waste disposal company.

Dewatering Tanks



Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

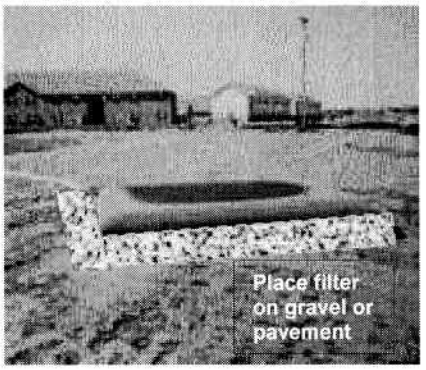
Implementation:

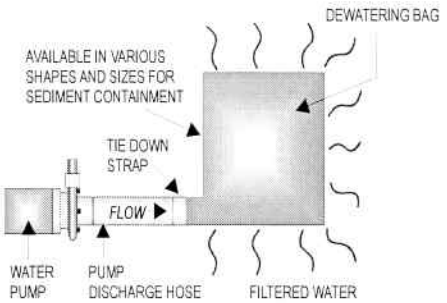
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by licensed waste disposal company.

Gravity Bag Filter





Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects gravel, sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, silt, and fines). Some metals are removed with the sediment.

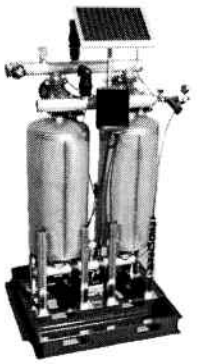
Implementation:

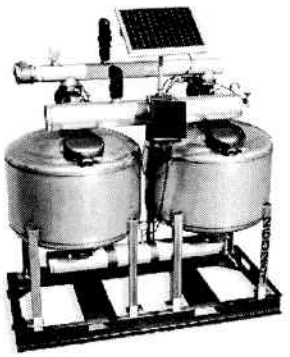
- Water is pumped into one side of the bag and seeps through the top, bottom, and sides of the bag.
- Place filter bag on pavement or a gravel bed or paved surface. Avoid placing a dewatering bag on unprotected bare soil. If placing the bag on bare soil is unavoidable, a secondary barrier should be used, such as a rock filter bed placed beneath and beyond the edges of the bag to, prevent erosion and capture sediments that escape the bag.
- Perimeter control around the downstream end of the bag should be implemented. Secondary sediment controls are important especially in the initial stages of discharge, which tend to allow fines to pass through the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier (as applicable) is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- Caution should be taken when removing and disposing of the bag, to prevent the release of captured sediment
- Properly dispose of the bag offsite. If sediment is removed from the bag prior to disposal (bags can potentially be reused depending upon their condition), dispose of sediment in accordance with the general maintenance procedures described at the end of this BMP Fact Sheet.

Sand Media Particulate Filter





Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

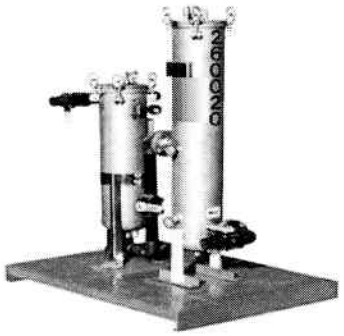
Implementation:

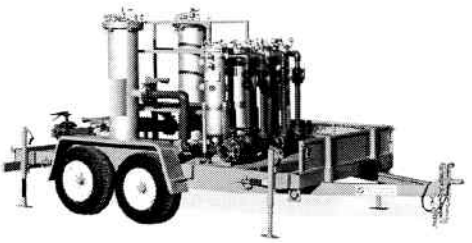
- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter





Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

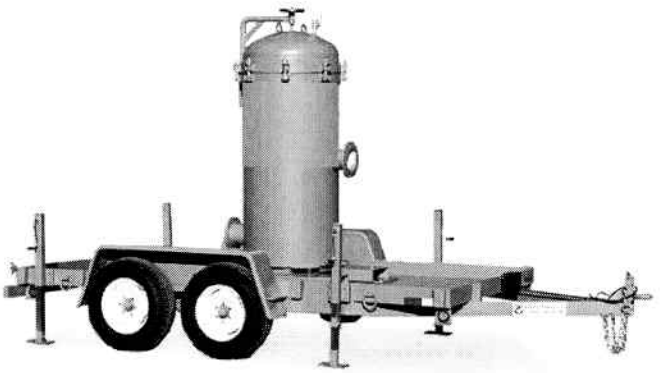
Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter



Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment control costs vary considerably depending on the dewatering and sediment treatment system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that dewatering BMPs are in place and functioning prior to the commencement of activities requiring dewatering.

- Inspect dewatering BMPs daily while dewatering activities are being conducted.

- Inspect all equipment before use. Monitor dewatering operations to ensure they do not cause offsite discharge or erosion.
- Sample dewatering discharges as required by the General Permit.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants should be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

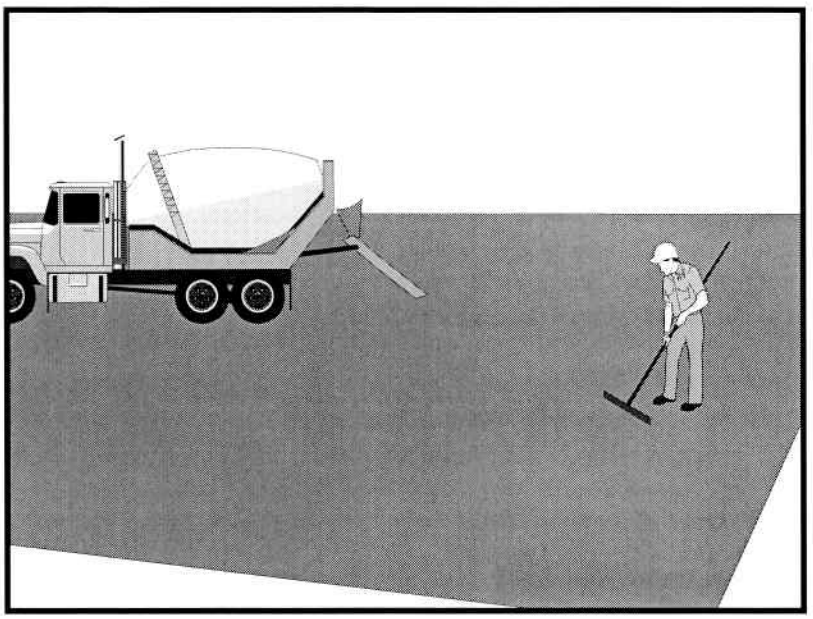
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003; Updated March 2004.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Paving and Grinding Operations NS-3



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☒

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH and turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials associated with paving and grinding operations, including mortar, concrete, and cement and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

Limitations

- Paving opportunities may be limited during wet weather.
- Discharges of freshly paved surfaces may raise pH to environmentally harmful levels and trigger permit violations.

Implementation

General

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is forecasted.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses. These materials should be stored consistent with WM-3, Stockpile Management.
- Disposal of PCC (Portland cement concrete) and AC (asphalt concrete) waste should be in conformance with WM-8, Concrete Waste Management.

Saw Cutting, Grinding, and Pavement Removal

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:
  - AC grindings, pieces, or chunks used in embankments or shoulder backing should not be allowed to enter any storm drains or watercourses. Install inlet protection and perimeter controls until area is stabilized (i.e. cutting, grinding or other removal activities are complete and loose material has been properly removed and disposed of)or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; SE-5, Fiber Rolls, or SE-13 Compost Socks and Berms
  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt should be recycled or disposed of properly.
- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by a vacuum attachment to the grinding machine, or by sweeping, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.
- Pavement removal activities should not be conducted in the rain.
- Collect removed pavement material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.

- If removed pavement material cannot be recycled, transport the material back to an approved storage site.

Asphaltic Concrete Paving

- If paving involves asphaltic cement concrete, follow these steps:
  - Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.
  - Old asphalt should be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

Portland Cement Concrete Paving

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect waste materials by dry methods, such as sweeping or shoveling, and return to aggregate base stockpile or dispose of properly. Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if authorized by the local wastewater authority.

Sealing Operations

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate should not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized (i.e. all sealing operations are complete and cured and loose materials have been properly removed and disposed).
- Inlet protection (SE-10, Storm Drain Inlet Protection) should be used during application of seal coat, tack coat, slurry seal, and fog seal.
- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

Paving Equipment

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials and dispose of in accordance with the applicable regulations. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.
- Substances used to coat asphalt transport trucks and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.
- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.
- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

Thermoplastic Striping

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move.
- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

Raised/Recessed Pavement Marker Application and Removal

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

Costs

- All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of paving and grinding operations.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sample stormwater runoff required by the General Permit.
- Keep ample supplies of drip pans or absorbent materials onsite.
- Inspect and maintain machinery regularly to minimize leaks and drips.

References

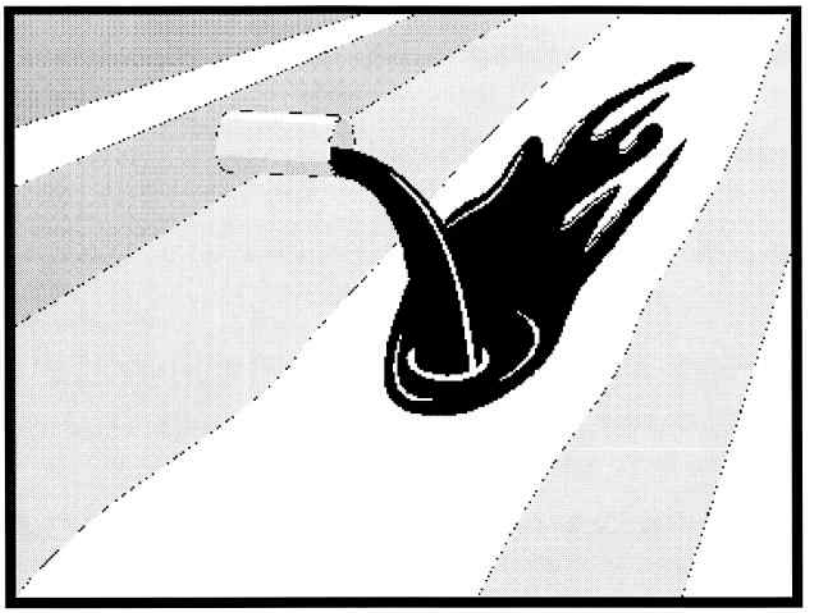
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Illicit Connection/Discharge NS-6



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

Implementation

Planning

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.
- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.
- Inspect site regularly during project execution for evidence

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

of illicit connections, illegal dumping or discharges.

- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

Identification of Illicit Connections and Illegal Dumping or Discharges

- **General** – unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

Reporting

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

Cleanup and Removal

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

Costs

Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

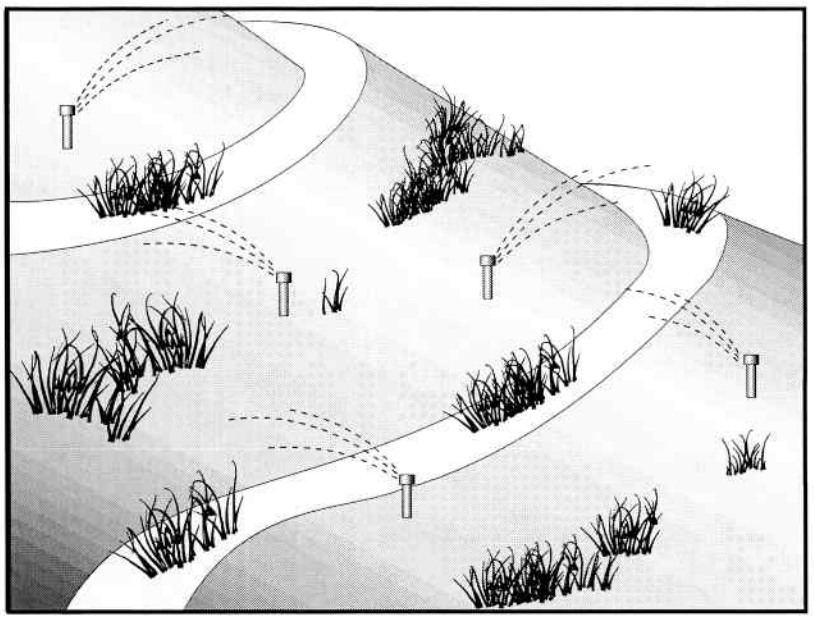
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Potable Water/Irrigation NS-7



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Potable Water/Irrigation consists of practices and procedures to manage the discharge of potential pollutants generated during discharges from irrigation water lines, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line flushing, and hydrant flushing.

Suitable Applications

Implement this BMP whenever potable water or irrigation water discharges occur at or enter a construction site.

Limitations

None identified.

Implementation

- Direct water from offsite sources around or through a construction site, where feasible, in a way that minimizes contact with the construction site.
- Discharges from water line flushing should be reused for landscaping purposes where feasible.
- Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow.
- Protect downstream stormwater drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.
- Inspect irrigated areas within the construction limits for

excess watering. Adjust watering times and schedules to ensure that the appropriate amount of water is being used and to minimize runoff. Consider factors such as soil structure, grade, time of year, and type of plant material in determining the proper amounts of water for a specific area.

Costs

Cost to manage potable water and irrigation are low and generally considered to be a normal part of related activities.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Repair broken water lines as soon as possible.
- Inspect irrigated areas regularly for signs of erosion and/or discharge.

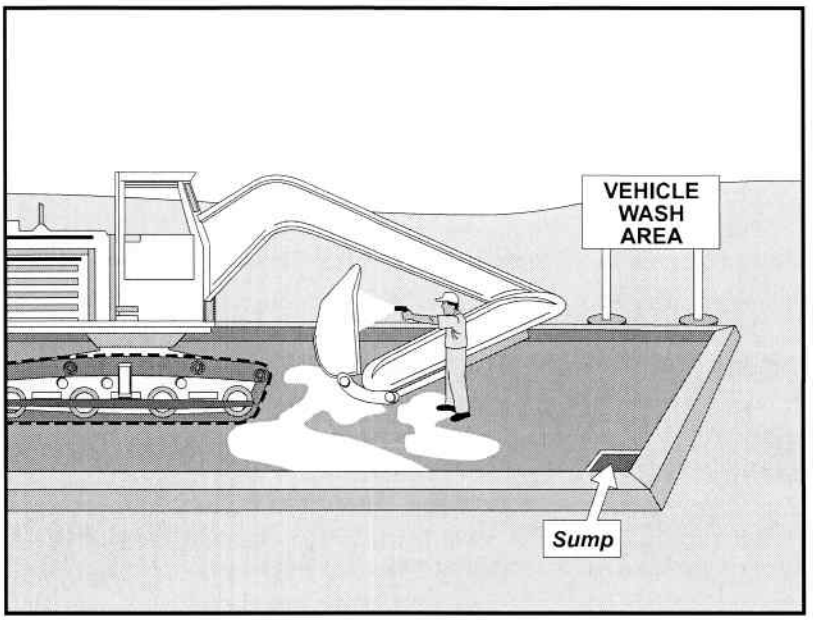
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle and Equipment Cleaning NS-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

Inspection and Maintenance

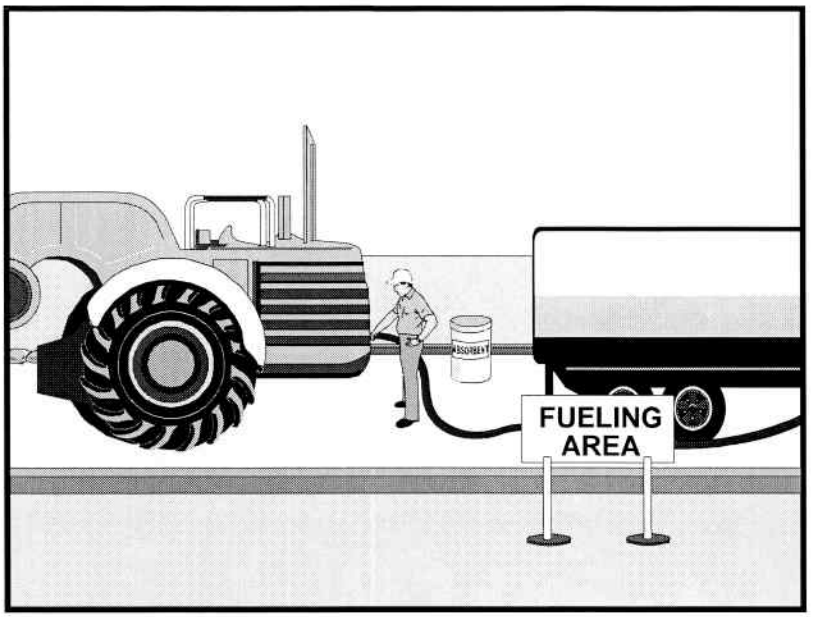
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

Vehicle and Equipment Fueling NS-9



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/ Exit.

Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.
- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should

be disposed of properly after use.

- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Inspection and Maintenance

- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

References

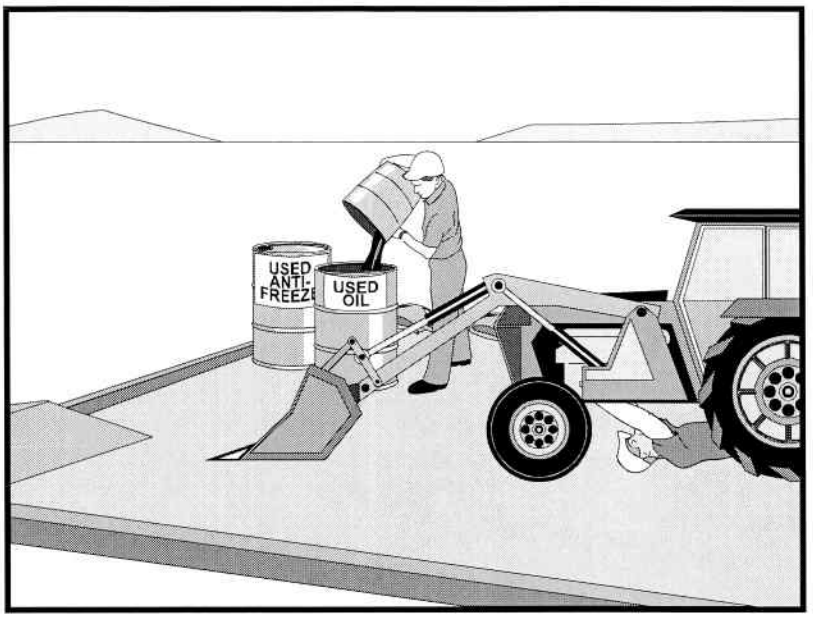
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle & Equipment Maintenance NS-10



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8, Vehicle and Equipment Cleaning, and NS-9, Vehicle and

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Equipment Fueling.

Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.

- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

Safer Alternative Products

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling and Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

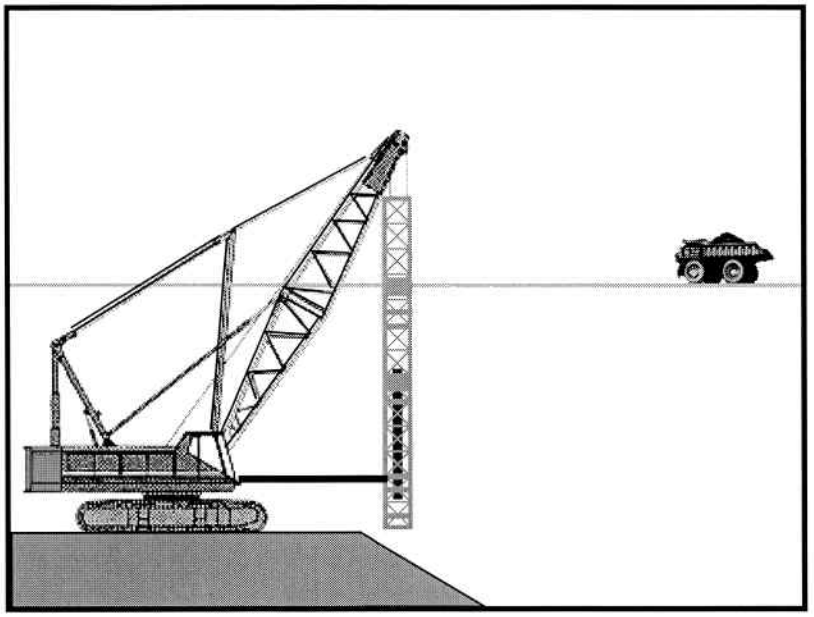
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Pile Driving Operations NS-11



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

The construction and retrofit of bridges and retaining walls often include driving piles for foundation support and shoring operations. Driven piles are typically constructed of precast concrete, steel, or timber. Driven sheet piles are also used for shoring and cofferdam construction. Proper control and use of equipment, materials, and waste products from pile driving operations will reduce or eliminate the discharge of potential pollutants to the storm drain system, watercourses, and waters of the United States.

Suitable Applications

These procedures apply to all construction sites near or adjacent to a watercourse or groundwater where permanent and temporary pile driving (impact and vibratory) takes place, including operations using pile shells as well as construction of cast-in-steel-shell and cast-in-drilled-hole piles.

Limitations

None identified.

Implementation

- Use drip pans or absorbent pads during vehicle and equipment operation, maintenance, cleaning, fueling, and storage. Refer to NS-8, Vehicle and Equipment Cleaning, NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.
- Have spill kits and cleanup materials available at all locations of pile driving. Refer to WM-4, Spill Prevention

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

and Control.

- Equipment that is stored or in use in streambeds, or on docks, barges, or other structures over water bodies should be kept leak free.
- Park equipment over plastic sheeting or equivalent where possible. Plastic is not a substitute for drip pans or absorbent pads. The storage or use of equipment in streambeds or other bodies of water must comply with all applicable permits.
- Implement other BMPs as applicable, such as NS-2, Dewatering Operations, WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.
- When not in use, store pile-driving equipment away from concentrated flows of stormwater, drainage courses, and inlets. Protect hammers and other hydraulic attachments from runon and runoff by placing them on plywood and covering them with plastic or a comparable material prior to the onset of rain.
- Use less hazardous products, e.g., vegetable oil, when practicable.

Costs

All of the above measures can be low cost.

Inspection and Maintenance

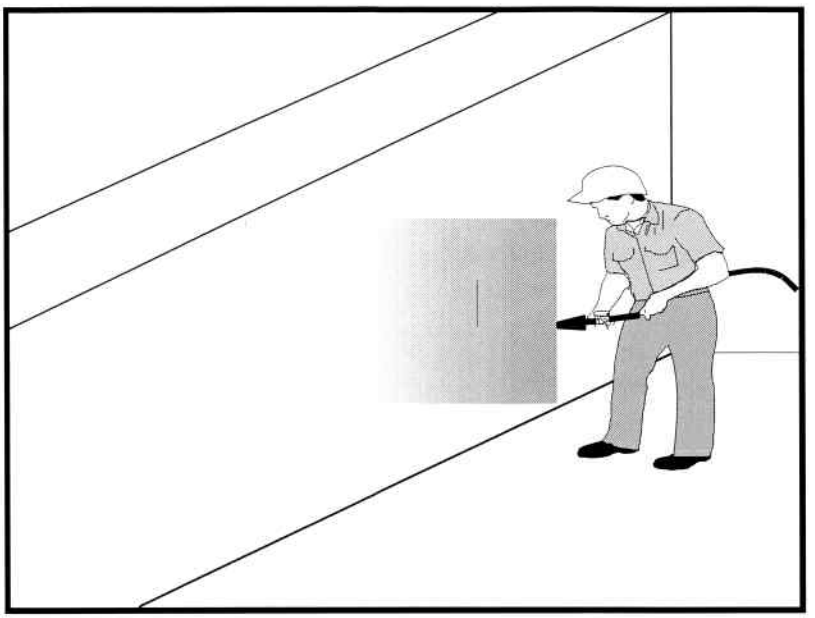
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect equipment every day at startup and repair equipment as needed (i.e., worn or damaged hoses, fittings, and gaskets). Recheck equipment at shift changes or at the end of the day and scheduled repairs as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Concrete Curing NS-12



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods.

Concrete and its associated curing materials have basic chemical properties that can raise the pH of water to levels outside of the permitted range. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Proper procedures and care should be taken when managing concrete curing materials to prevent them from coming into contact with stormwater flows, which could result in a high pH discharge.

Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

Chemical Curing

- Avoid over spray of curing compounds.
- Minimize the drift by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.
- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

Water Curing for Bridge Decks, Retaining Walls, and other Structures

- Direct cure water away from inlets and watercourses to collection areas for evaporation or other means of removal in accordance with all applicable permits. See WM-8 Concrete Waste Management.
- Collect cure water at the top of slopes and transport to a concrete waste management area in a non-erosive manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

Education

- Educate employees, subcontractors, and suppliers on proper concrete curing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete curing procedures.

Costs

All of the above measures are generally low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts uncured and partially cured concrete as required by the General Permit.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

References

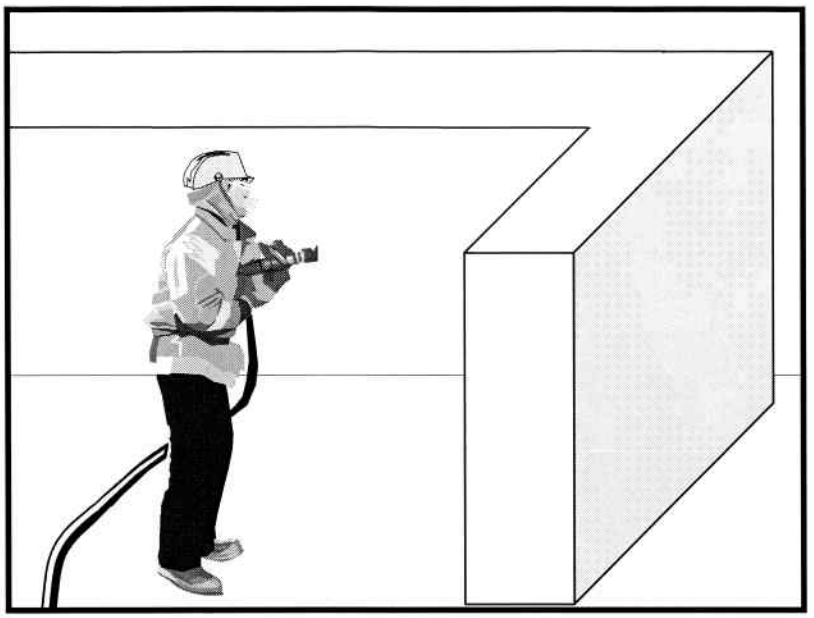
Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Concrete Finishing NS-13



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Concrete finishing methods are used for bridge deck rehabilitation, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Stormwater and non-stormwater exposed to concrete finishing by-products may have a high pH and may contain chemicals, metals, and fines. Proper procedures and implementation of appropriate BMPs can minimize the impact that concrete-finishing methods may have on stormwater and non-stormwater discharges.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Concrete and its associated curing materials have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures apply to all construction locations where concrete finishing operations are performed.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

- Collect and properly dispose of water from high-pressure water blasting operations.
- Collect contaminated water from blasting operations at the top of slopes. Transport or dispose of contaminated water while using BMPs such as those for erosion control. Refer to EC-9, Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering). Refer to NS-2 Dewatering Operations.
- Protect inlets during sandblasting operations. Refer to SE-10, Storm Drain Inlet Protection.
- Refer to WM-8, Concrete Waste Management for disposal of concrete debris.
- Minimize the drift of dust and blast material as much as possible by keeping the blasting nozzle close to the surface.
- When blast residue contains a potentially hazardous waste, refer to WM-6, Hazardous Waste Management.

Education

- Educate employees, subcontractors, and suppliers on proper concrete finishing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete finishing procedures.

Costs

These measures are generally of low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts concrete dust and debris as required by the General Permit.

- Sweep or vacuum up debris from sandblasting at the end of each shift.
- At the end of each work shift, remove and contain liquid and solid waste from containment structures, if any, and from the general work area.
- Inspect containment structures for damage prior to use and prior to onset of forecasted rain.

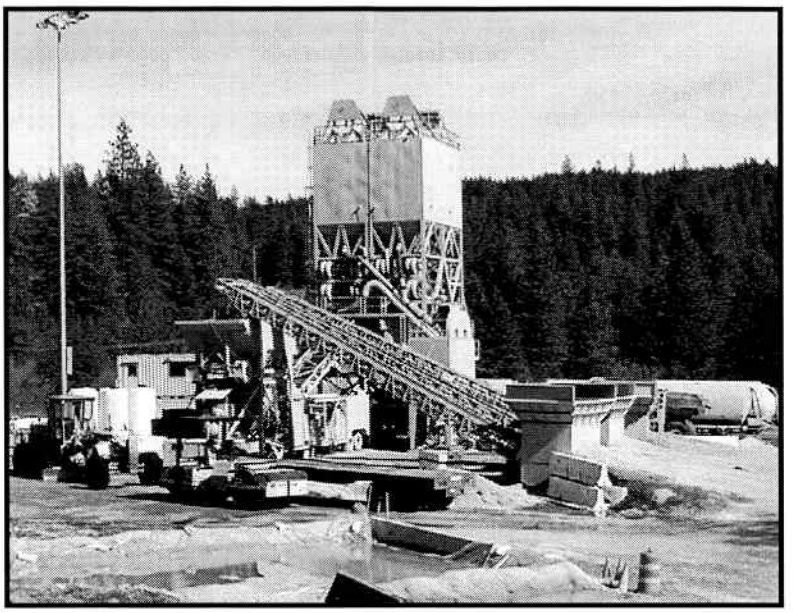
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Temporary Batch Plants NS-16



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

The construction of roads, bridges, retaining walls, and other large structures in remote areas, often requires temporary batch plant facilities to manufacture Portland Cement Concrete (PCC) or asphalt cement (AC). Temporary batch plant facilities typically consist of silos containing fly ash, lime, and cement; heated tanks of liquid asphalt; sand and gravel material storage areas; mixing equipment; above ground storage tanks containing concrete additives and water; and designated areas for sand and gravel truck unloading, concrete truck loading, and concrete truck washout. Proper control and use of equipment, materials, and waste products from temporary batch plant facilities will reduce the discharge of potential pollutants to the storm drain system or watercourses, reduce air emissions, and mitigate noise impacts.

The General Permit draft incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements). Many types of batch plant materials, including mortar, concrete, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows which may cause an exceedence of the General Permit Requirements.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Suitable Applications

These procedures typically apply to construction sites where temporary batch plant facilities are used; however, some of the practices described are applicable to construction sites with general concrete use.

Limitations

The General Permit for discharges of stormwater associated with industrial activities (General Industrial Permit) may be applicable to temporary batch plants.

Specific permit requirements or mitigation measures such as Air Resources Board (ARB), Air Quality Management District (AQMD), Air Pollution Control District (APCD, Regional Water Quality Control Board (RWQCB), county ordinances and city ordinances may require alternative mitigation measures for temporary batch plants. Contact the local regulatory agencies to determine if a permit is required.

Implementation

Planning

- Temporary batch plants may be subject to the General Industrial Permit. To obtain a copy of this permit and the application forms, visit http://www.waterboards.ca.gov or contact the State Water Resources Control Board.
- Proper planning, design, and construction of temporary batch plants should be implemented to minimize potential water quality, air pollution, and noise impacts associated with temporary batch plants.
- BMPs and a Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP). BMPs should be implemented, inspected, and maintained in accordance with these plans.
- Temporary batch plants should be managed to comply with AQMD Statewide Registration Program and/or local AQMD Portable Equipment Registration requirements.
- Construct temporary batch plants downwind of existing developments whenever possible.
- Placement of access roads should be planned to mitigate water and air quality impacts.

Layout and Design

- Temporary batch plants should be properly located and designed to mitigate water quality impacts to receiving water bodies. Batch plants should be located away from watercourses, drainage courses, and drain inlets. Batch plants should be located to minimize the potential for stormwater runon onto the site.
- Temporary batch plant facilities (including associated stationary equipment and stockpiles) should be located at least 300 ft from any recreational area, school, residence, or other structure not associated with the construction project.
- Construct continuous interior AC or PCC berms around batch plant equipment (mixing equipment, silos, concrete drop points, conveyor belts, admixture tanks, etc.) to facilitate

proper containment and cleanup of releases. Rollover or flip top curbs or dikes should be placed at ingress and egress points (SE-12, Temporary Silt Dike).

- Direct runoff from the paved or unpaved portion of the batch plant into a sump and pipe to a lined washout area or dewatering tank.
- Direct stormwater and non-stormwater runoff from unpaved portions of batch plant facility to catchment ponds or tanks.
- Construct and remove concrete washout facilities in accordance with WM-8, Concrete Waste Management.
- Layout of a typical batch plant and associated BMP is located at the end of this BMP fact sheet.

Operational Procedures

- Washout of concrete trucks should be conducted in a designated area in accordance with WM-8, Concrete Waste Management.
- Do not dispose of concrete into drain inlets, the stormwater drainage system, or watercourses.
- Washing of concrete mixing and transport equipment (including concrete truck washout) should occur in a designated area in accordance with WM-8, Concrete Waste Management.
- Washing equipment, tools, or vehicles to remove PCC should be conducted in accordance with NS-7, Potable Water/Irrigation, NS-8, Vehicle and Equipment Cleaning, and WM-8, Concrete Waste Management..
- All dry material transfer points should be ducted through a fabric or cartridge type filter unless there are no visible emissions from the transfer point.
- Equip all bulk storage silos, including auxiliary bulk storage trailers, with fabric or cartridge type filter(s).
- Maintain silo vent filters in proper operating condition.
- Equip silos and auxiliary bulk storage trailers with dust-tight service hatches.
- Fabric dust collection system should be capable of controlling particulate matter in accordance with the California Air Resources Control Board and local Air Pollution Control District Regulations.
- Fabric dust collectors (except for vent filters) should be equipped with an operational pressure differential gauge to measure the pressure drop across the filters.
- All transfer points should be equipped with a wet suppression system to control fugitive particulate emissions unless there are no visible emissions.
- All conveyors should be covered, unless the material being transferred results in no visible emissions.

- There should be no visible emissions beyond the property line, while the equipment is being operated.
- Collect dust emissions from the loading of open-bodied trucks, at the drip point of dry batch plants, or dust emissions from the drum feed for central mix plants.
- Equip silos and auxiliary bulk storage trailers with a visible and/or audible warning mechanism to warn operators that the silo or trailer is full.
- All open-bodied vehicles transporting material should be loaded with a final layer of wet sand and the truck should be covered with a tarp to reduce emissions.

Tracking Control

- Plant roads (batch truck and material delivery truck roads) and areas between stockpiles and conveyor hoppers should be stabilized (TC-2, Stabilized Construction Roadway), watered, treated with dust-suppressant chemicals (WE-1, Wind Erosion Control), or paved with a cohesive hard surface that can be repeatedly swept, maintained intact, and cleaned as necessary to control dust emissions.
- Trucks should not track PCC from plants onto public roads. Use appropriate practices from TC-1, Stabilized Construction Entrance/Exit, to prevent tracking.

Materials Storage

- WM-1, Material Delivery and Storage, should be implemented at all batch plants using concrete components or compounds. An effective strategy is to cover and contain materials.
- WM-2, Material Use should be conducted in a way to minimize or eliminate the discharge of materials to storm drain system or watercourse.
- Ensure that finer materials are not dispersed into the air during operations, such as unloading of cement delivery trucks.
- Stockpiles should be covered and enclosed with perimeter sediment barriers per WM-3, Stockpile Management. Uncovered stockpiles should be sprayed with water and/or dust-suppressant chemicals as necessary to control dust emissions, unless the stockpiled material results in no visible emissions. An operable stockpile watering system should be onsite at all times.
- Store bagged and boxed materials on pallets and cover or store in a completely enclosed storage area on non-working days and prior to rain.
- Minimize stockpiles of demolished PCC by recycling them in a timely manner.
- Provide secondary containment for liquid materials (WM-1, Material Delivery and Storage, WM-10, Liquid Waste Management). Containment should provide sufficient volume to contain precipitation from a 25-year storm plus 10% of the aggregate volume of all containers or plus 100% of the largest container, whichever is greater.
- Handle solid and liquid waste in accordance with WM-5, Solid Waste Management, WM-10, Liquid Waste Management, and WM-8, Concrete Waste Management.

- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.
- Immediately contain and clean up spilled cement and fly ash and contain.

Equipment Maintenance

- Equipment should be maintained to prevent fluid leaks and spills per NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.
- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.
- Incorporate other BMPs such as WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.

Costs

Costs will vary depending on the size of the facility and combination of BMPs implemented.

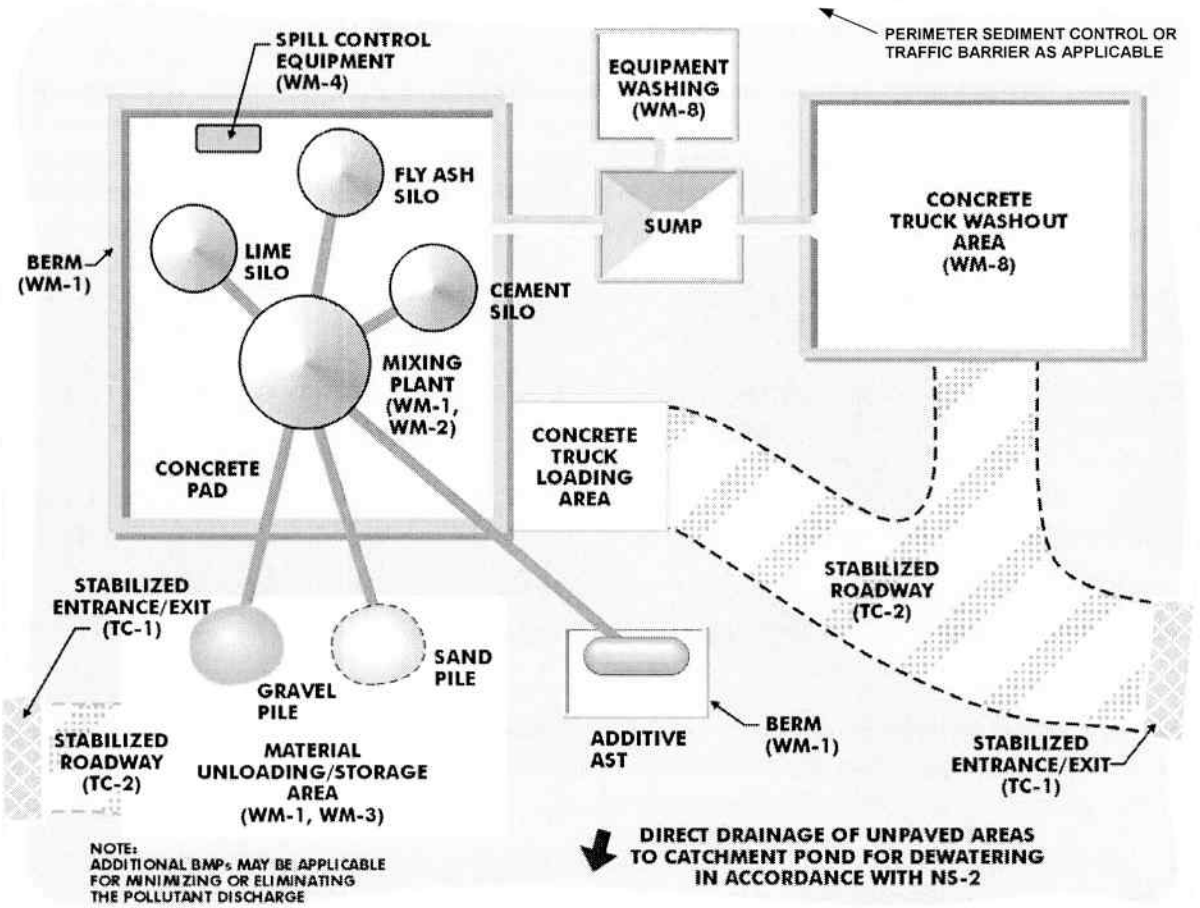
Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts cementitious materials or fly ash as required by the General Permit.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).
- Inspect and maintain a Stabilized Construction Entrance/Exit (TC-1) as needed.
- Inspect and maintain stabilized haul roads as needed (TC-2, Stabilized Construction Roadway).
- Inspect and maintain materials and waste storage areas as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



Typical Temporary Batch

Appendix H
CASQA BMP Handbook Fact Sheets

Silt Fence SE-1

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-10 Storm Drain Inlet Protection

SE-14 Biofilter Bags

Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (SE-10). Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard. Runoff typically ponds temporarily on the upstream side of silt fence.
- Do not use silt fence to divert water flows or place across any contour line. Fences not constructed on a level contour, or fences used to divert flow will concentrate flows resulting in additional erosion and possibly overtopping or failure of the silt fence.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Not effective unless trenched and keyed in.
- Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.
- The maximum slope perpendicular to the fence line should be 1:1.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.

- Silt fences should remain in place until the disturbed area is permanently stabilized, after which, the silt fence should be removed and properly disposed.
- Silt fence should be used in combination with erosion source controls up slope in order to provide the most effective sediment control.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Woven geotextile material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the slope of area draining to the silt fence is 4:1 (H:V) or less.
- Used for shorter durations, typically 5 months or less
- Area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Use is generally limited to 8 months or less.
- Area draining to fence produces moderate sediment loads.
- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
  - Fence fabric has higher tensile strength.
  - Fabric is reinforced with wire backing or additional support.
  - Posts are spaced closer than pre-manufactured, standard silt fence products.
  - Posts are metal (steel or aluminum)

Materials

<u>Standard Silt Fence</u>

- Silt fence material should be woven geotextile with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The

reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 sec^{-1} and 0.15 sec^{-1} in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts or bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement for health and safety purposes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench.

- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.

- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with native material and compacted.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where, due to specific site conditions, a 3 ft setback is not available, the silt fence may be constructed at the

toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and more difficult to maintain.

- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of $^1/_3$ and a maximum of ½ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the gerotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
    - Ease of installation (most often done with a 2 person crew). In addition, installation using static slicing has been found to be more efficient on slopes, in rocky soils, and in saturated soils.
    - Minimal soil disturbance.
    - Greater level of compaction along fence, leading to higher performance (i.e. greater sediment retention).
    - Uniform installation.
    - Less susceptible to undercutting/undermining.

Costs

- It should be noted that costs vary greatly across regions due to available supplies and labor costs.
- Average annual cost for installation using the traditional silt fence installation method (assumes 6 month useful life) is $7 per linear foot based on vendor research. Range of cost is $3.50 - $9.10 per linear foot.
- In tests, the slicing method required 0.33 man hours per 100 linear feet, while the trenched based systems required as much as 1.01 man hours per linear foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair undercut silt fences.

- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.
- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, and Inventory of Current Practices (Draft), UESPA, 1990.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

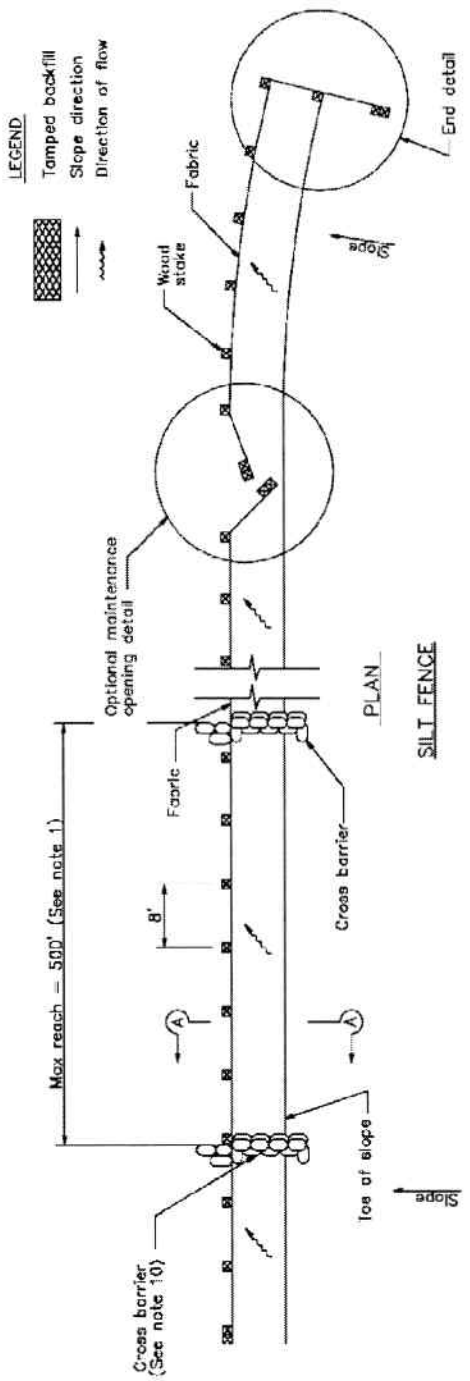
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

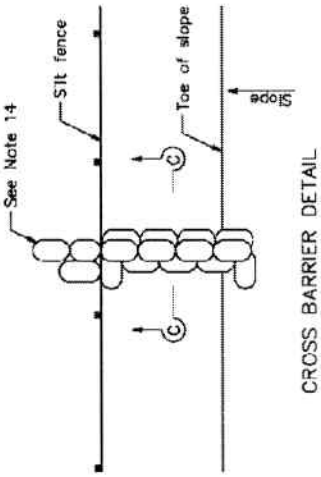
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

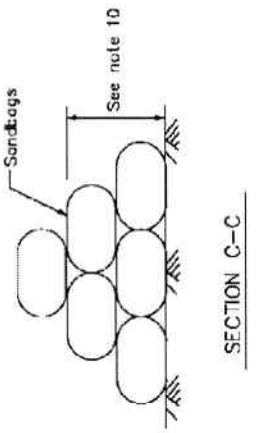
U.S. Environmental Protection Agency (USEPA). Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

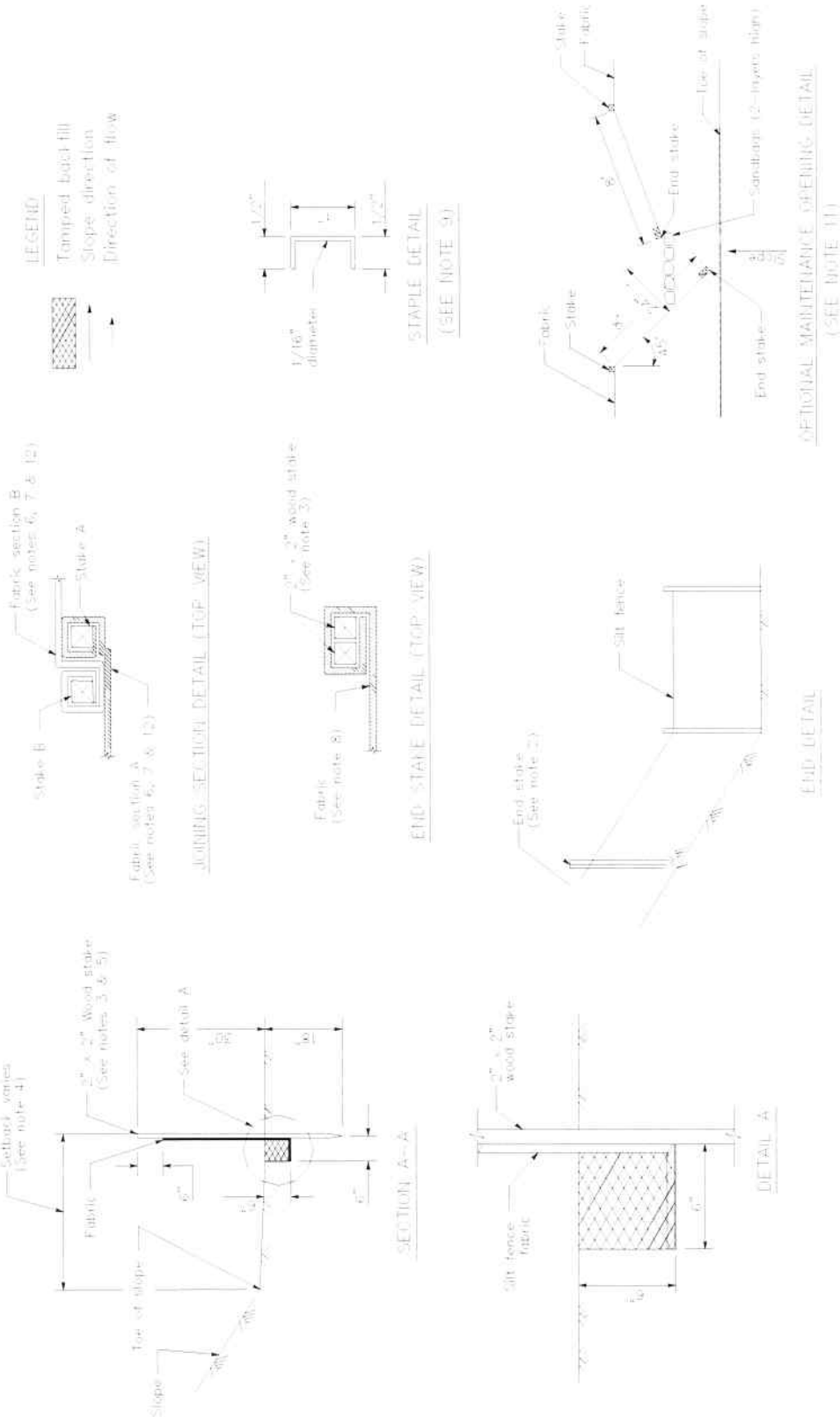




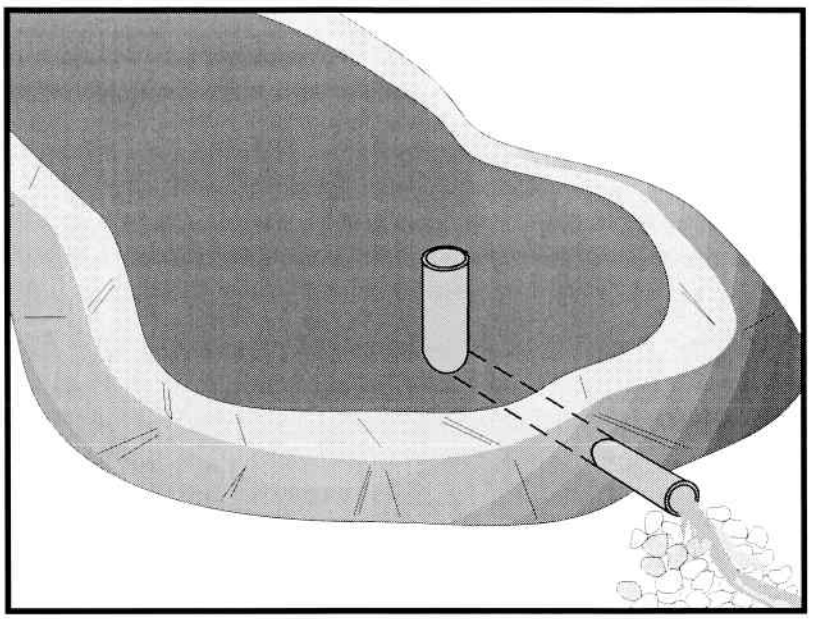


NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow–through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3–4 bags to cross barrier on downgradient side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.


LEGEND
Tamped backfill
Slope direction
Direction of flow
Fabric section B (See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A (See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake (See note 3)
Fabric (See note 8)
END STAKE DETAIL (TOP VIEW)
1/16" diameter
1/2"
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
End stake
Sandbags (2-layers high)
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Silt fence
End stake (See note 7)
END DETAIL
Setback varies (See note 4)
2" x 2" Wood stake (See notes 3 & 5)
See detail A
Fabric
Toe of slope
Slope
SECTION A-A
2" x 2" wood stake
Silt fence fabric
DETAIL A

Sediment Basin SE-2



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-3 Sediment Trap (for smaller areas)

Description and Purpose

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

Sediment basin design guidance presented in this fact sheet is intended to provide options, methods, and techniques to optimize temporary sediment basin performance and basin sediment removal. Basin design guidance provided in this fact sheet is not intended to guarantee basin effluent compliance with numeric discharge limits (numeric action levels or numeric effluent limits for turbidity). Compliance with discharge limits requires a thoughtful approach to comprehensive BMP planning, implementation, and maintenance. Therefore, optimally designed and maintained sediment basins should be used in conjunction with a comprehensive system of BMPs that includes:

- Diverting runoff from undisturbed areas away from the basin
- Erosion control practices to minimize disturbed areas on-site
  and to provide temporary stabilization and interim sediment controls (e.g., stockpile perimeter control, check dams, perimeter controls around individual lots) to reduce the basin's influent sediment concentration.

At some sites, sediment basin design enhancements may be required to adequately remove sediment. Traditional

(aka "physical") enhancements such as alternative outlet configurations or flow deflection baffles increase detention time and other techniques such as outlet skimmers preferentially drain flows with lower sediment concentrations. These "physical" enhancement techniques are described in this fact sheet. To further enhance sediment removal particularly at sites with fine soils or turbidity sensitive receiving waters, some projects may need to consider implementing Active Treatment Systems (ATS) whereby coagulants and flocculants are used to enhance settling and removal of suspended sediments. Guidance on implementing ATS is provided in SE-11.

Suitable Applications

Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

- Where sediment-laden water may enter the drainage system or watercourses
- On construction projects with disturbed areas during the rainy season
- At the outlet of disturbed watersheds between 5 acres and 75 acres and evaluated on a site by site basis
- Where post construction detention basins are required
- In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas

Limitations

Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

- As a general guideline, sediment basins are suitable for drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres. However, the tributary area should be evaluated on a site by site basis.
- Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
- Sediment basins designed according to this fact sheet are only effective in removing sediment down to about the silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical (or other appropriate method) treatment is used in addition to the sediment basin.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft or more must obtain approval from California Department of Water Resources Division of Safety of Dams (http://www.water.ca.gov/damsafety/).

- Water that stands in sediment basins longer than 96 hours may become a source of mosquitoes (and midges), particularly along perimeter edges, in shallow zones, in scour or below-grade pools, around inlet pipes, along low-flow channels, and among protected habitats created by emergent or floating vegetation (e.g. cattails, water hyacinth), algal mats, riprap, etc.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

Implementation

General

A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure expected to be used during active construction in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to convey runoff to the basin inlet.

Many development projects in California are required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution control. A temporary sediment basin may be constructed by rough grading the post-construction control basins early in the project.

Sediment basins if properly designed and maintained can trap a significant amount of the sediment that flows into them. However, traditional basins do not remove all inflowing sediment. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

Planning

To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. Locations best suited for a sediment basin are generally in lower elevation areas of the site (or basin tributary area) where site drainage would not require significant diversion or other means to direct water to the basin but outside jurisdictional waterways. However, as necessary, drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). . The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

Construct before clearing and grading work begins when feasible.

- Do not locate the basin in a jurisdictional stream.

- Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft must obtain approval from the Division of Dam Safety. Local dam safety requirements may be more stringent.
- Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
- The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

Design

When designing a sediment basin, designers should evaluate the site constraints that could affect the efficiency of the BMP. Some of these constraints include: the relationship between basin capacity, anticipated sediment load, and freeboard, available footprint for the basin, maintenance frequency and access, and hydraulic capacity and efficiency of the temporary outlet infrastructure. Sediment basins should be designed to maximize sediment removal and to consider sediment load retained by the basin as it affects basin performance.

Three Basin Design Options (Part A) are presented below along with a Typical Sediment/Detention Basin Design Methodology (Part B). Regardless of the design option that is selected, designers also need to evaluate the sediment basin capacity with respect to sediment accumulation (See "*Step 3. Evaluate the Capacity of the Sediment Basin*"), and should incorporate approaches identified in "*Step 4. Other Design Considerations*" to enhance basin performance.

A) Basin Design Options:

Option 1:

Design sediment basin(s) using the standard equation:

$$A_s = \frac{1.2Q}{V_s} \qquad \text{(Eq. 1)}$$

Where:

A_s = Minimum surface area for trapping soil particles of a certain size

V_s = Settling velocity of the design particle size chosen (V_s = 0.00028 ft/s for a design particle size of 0.01 mm at 68°F)

1.2 = Factor of safety recommended by USEPA to account for the reduction in basin efficiency caused due to turbulence and other non ideal conditions.

$Q = CIA$ (Eq.2)

Where

Q = Discharge rate measured in cubic feet per second

C = Runoff coefficient (unitless)

I = Peak rainfall intensity for the 10-year, 6-hour rain event (in/hr)

A = Area draining into the sediment basin in acres

The design particle size should be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the Vs used should be 100 percent of the calculated settling velocity.

This sizing basin method is dependent on the outlet structure design or the total basin length with an appropriate outlet. If the designer chooses to utilize the outlet structure to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a minimum of twice the basin width; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). If the designer chooses to utilize the basin length (with appropriate basin outlet) to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a specifically designed to capture 100% of the design particle size; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity).

The basin should be located on the site where it can be maintained on a year-round basis and should be maintained on a schedule to retain the 2 ft of capacity.

Option 2:

Design pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 1.

Option 3:

The use of an equivalent surface area design or equation provided that the design efficiency is as protective or more protective of water quality than Option 1.

B) Typical Sediment/Detention Basin Design Methodology:

Design of a sediment basin requires the designer to have an understanding of the site constraints, knowledge of the local soil (e.g., particle size distribution of potentially contributing soils), drainage area of the basin, and local hydrology. Designers should not assume that a sediment basin for location A is applicable to location B. Therefore, designers can use this factsheet as guidance but will need to apply professional judgment and knowledge of the site to design an effective and efficient sediment basin. The following provides a general overview of typical design methodologies:

Step 1. Hydrologic Design

- Evaluate the site constraints and assess the drainage area for the sediment basin. Designers should consider on- and off-site flows as well as changes in the drainage area associated with site construction/disturbance. To minimize additional construction during the course of the project, the designer should consider identifying the maximum drainage area when calculating the basin dimensions.

- If a local hydrology manual is not available it is recommended to follow standard rational method procedures to estimate discharge. The references section of this factsheet provides a reference to standard hydrology textbooks that can provide standard methodologies. If local rainfall depths are not available, values can be obtained from standard precipitation frequency maps from NOAA (downloaded from http://www.wrcc.dri.edu/pcpnfreq.html).

Step 2. Hydraulic Design

- Calculate the surface area required for the sediment basin using Equation 1. In which discharge is estimated for a 10-yr 6-hr event using rational method procedure listed in local hydrology manual and Vs is estimated using Stokes Law presented in Equation 3.

$$V_s = 2.81d^2 \qquad \text{(Eq.3)}$$

Where

V_s = Settling velocity in feet per second at 68°F

d = diameter of sediment particle in millimeters (smallest soil grain size determined by wet sieve analysis or fine silt (0.01 mm [or 0.0004 in.])

- In general the basin outlet design requires an iterative trial and error approach that considered the maximum water surface elevation, the elevation versus volume (stage-storage) relationship, the elevation verses discharge (stage-discharge) relationship, and the estimated inflow hydrograph. To adequately design the basins to settle sediment, the outlet configuration and associated outflow rates can be estimated by numerous methodologies. The following provides some guidance for design the basin outlet:

  - An outlet should have more than one orifice.

  - An outlet design typically utilizes multiple horizontal rows of orifices (approximately 3 or more) with at least 2 orifices per row (see Figures 1 and 2 at the end of this fact sheet).

  - Orifices can vary in shape.

  - Select the appropriate orifice diameter and number of perforations per row with the objective of minimizing the number of rows while maximizing the detention time.

- The diameter of each orifice is typically a maximum of 3-4 inches and a minimum of 0.25-0.5 inches.
- If a rectangular orifice is used, it is recommended to have minimum height of 0.5 inches and a maximum height of 6 inches.
- Rows are typically spaced at three times the diameter center to center vertically with a minimum distance of approximately 4 inches on center and a maximum distance of 1 foot on center.
- To estimate the outflow rate, each row is calculated separately based on the flow through a single orifice then multiplied by the number of orifices in the row. This step is repeated for each of the rows. Once all of the orifices are estimated, the total outflow rate versus elevation (stage-discharge curve) is developed to evaluate the detention time within the basin.
- Flow through a single orifice can be estimated using an Equation 4:

$$Q = BC' A(2gH)^{0.5} \qquad \text{(Eq.4)}$$

Where
Q = Discharge in ft^3/s
C′ = Orifice coefficient (unitless)
A = Area of the orifice (ft^2)
g = acceleration due to gravity (ft^3/s)
H = Head above the orifice (ft)
B = Anticipated Blockage or clogging factor (unitless), It is dependent on anticipated sediment and debris load, trash rack configuration etc, so the value is dependent on design engineers professional judgment and/or local requirements (B is never greater than 1 and a value of 0.5 is generally used)

  - Care must be taken in the selection of orifice coefficient ("C′"); 0.60 is most often recommended and used. However, based on actual tests, Young and Graziano (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:
    - C′ = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or
    - C′ = 0.80 when the material is thicker than the orifice diameter
- If different sizes of orifices are used along the riser then they have to be sized such that not more than 50 percent of the design storm event drains in one-third of the drawdown time (to provide adequate settling time for events smaller than the design storm event) and the entire volume drains within 96 hours or as regulated by the local vector control agency. If a basin fails to drain within 96 hours, the basin must be pumped dry.

- Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

- Floating Outlet Skimmer: The floating skimmer (see Figure 3 at the end of this fact sheet is an alternative outlet configuration (patented) that drains water from upper portion of the water column. This configuration has been used for temporary and permanent basins and can improve basin performance by eliminating bottom orifices which have the potential of discharging solids. Some design considerations for this alternative outlet device includes the addition of a sand filter or perforated under drain at the low point in the basin and near the floating skimmer. These secondary drains allow the basin to fully drain. More detailed guidelines for sizing the skimmer can be downloaded from http://www.fairclothskimmer.com/.

- Hold and Release Valve: An ideal sediment/detention basin would hold all flows to the design storm level for sufficient time to settle solids, and then slowly release the storm water. Implementing a reliable valve system for releasing detention basins is critical to eliminate the potential for flooding in such a system. Some variations of hold and release valves include manual valves, bladder devices or electrically operated valves. When a precipitation event is forecast, the valve would be close for the duration of the storm and appropriate settling time. When the settling duration is met (approximately 24 or 48 hours), the valve would be opened and allow the stormwater to be discharged at a rate that does not resuspend settled solids and in a non-erosive manner. If this type of system is used the valve should be designed to empty the entire basin within 96 hours or as stipulated by local vector control regulations.

Step 3. Evaluate the Capacity of the Sediment Basin

- Typically, sediment basins do not perform as designed when they are not properly maintained or the sediment yield to the basin is larger than expected. As part of a good sediment basin design, designers should consider maintenance cycles, estimated soil loss and/or sediment yield, and basin sediment storage volume. The two equations below can be used to quantify the amount of soil entering the basin.

- The Revised Universal Soil Loss Equation (RUSLE, Eq.5) can be used to estimate annual soil loss and the Modified Universal Soil Equation (MUSLE, Eq.6) can be used to estimate sediment yield from a single storm event.

$$A = R \times K \times LS \times C \times P \qquad \text{(Eq.5)}$$

$$Y = 95\left(Q \times q_p\right)^{0.56} \times K \times LS \times C \times P \qquad \text{(Eq.6)}$$

Where:

A = annual soil loss, tons/acre-year

R = rainfall erosion index, in 100 ft.tons/acre.in/hr

K = soil erodibility factor, tons/acre per unit of R

LS = slope length and steepness factor (unitless)

C = vegetative cover factor (unitless)

P = erosion control practice factor (unitless)

Y = single storm sediment yield in tons

Q = runoff volume in acre-feet

q_p = peak flow in cfs

- Detailed descriptions and methodologies for estimating the soil loss can be obtained from standard hydrology text books (See References section).
- Determination of the appropriate equation should consider construction duration and local environmental factors (soils, hydrology, etc.). For example, if a basin is planned for a project duration of 1 year and the designer specifies one maintenance cycle, RUSLE could be used to estimate the soil loss and thereby the designer could indicate that the sediment storage volume would be half of the soil loss value estimated. As an example for use of MUSLE, a project may have a short construction duration thereby requiring fewer maintenance cycles and a reduced sediment storage volume. MUSLE would be used to estimate the anticipated soil loss based on a specific storm event to evaluate the sediment storage volume and appropriate maintenance frequency.
- The soil loss estimates are an essential step in the design and it is essential that the designer provide construction contractors with enough information to understand maintenance frequency and/or depths within the basin that would trigger maintenance. Providing maintenance methods, frequency and specification should be included in design bid documents such as the SWPPP Site Map.
- Once the designer has quantified the amount of soil entering the basin, the depth required for sediment storage can be determined by dividing the estimated sediment loss by the surface area of the basin.

Step 4. Other Design Considerations

- Consider designing the volume of the settling zone for the total storm volume associated with the 2-year event or other appropriate design storms specified by the local agency. This volume can be used as a guide for sizing the basin without iterative routing calculations. The depth of the settling zone can be estimated by dividing the estimated 2-yr storm volume by the surface area of the basin.
- The basin volume consists of two zones:
  - A sediment storage zone at least 1 ft deep.
  - A settling zone at least 2 ft deep.
  - The basin depth must be no less than 3 ft (not including freeboard).
- Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 96 hours (also referred

to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 96-hour limit is specified to mitigate vector control concerns.

- Confirmation of the basin performance can be evaluated by routing the design storm (10-yr 6-hr, or as directed by local regulations) through the basin based on the basin volume (stage-storage curve) and the outlet design (stage-discharge curve based on the orifice configuration or equivalent outlet design).

- Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.

  - Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap (or equivalent protection) on fill slopes.

  - The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.

- Rock, vegetation or appropriate erosion control should be used to protect the basin inlet, outlet, and slopes against erosion.

- The total depth of the sediment basin should include the depth required for sediment storage, depth required for settling zone and freeboard of at least 1 foot or as regulated by local flood control agency for a flood event specified by the local agency.

- The length to settling depth ratio (L/SD) should be less than 200.

- The basin alignment should be designed such that the length of the basin is more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet. If the site topography does not allow for this configuration baffles should be installed so that the ratio is satisfied. If a basin has more than one inflow point, any inflow point that conveys more than 30 percent of the total peak inflow rate has to meet the required length to width ratio.

- An alternative basin sizing method proposed by Fifield (2004) can be consulted to estimate an alternative length to width ratio and basin configuration. These methods can be considered as part of Option 3 which allows for alternative designs that are protective or more protective of water quality.

- Baffles (see Figure 4 at the end of this fact sheet) can be considered at project sites where the existing topography or site constraints limit the length to width ratio. Baffles should be constructed of earthen berms or other structural material within the basin to divert flow in the basin, thus increasing the effective flow length from the basin inlet to the outlet riser. Baffles also reduce the change of short circuiting and allows for settling throughout the basin.

- Baffles are typically constructed from the invert of the basin to the crest of the emergency spillway (i.e., design event flows are meant to flow around the baffles and flows greater than the design event would flow over the baffles to the emergency spillway).

- Use of other materials for construction of basin baffles (such as silt fence) may not be appropriate based on the material specifications and will require frequent maintenance (maintain after every storm event). Maintenance may not be feasible when required due to flooded conditions resulting from frequent (i.e., back to back) storm events. Use of alternative baffle materials should not deviate from the intended purpose of the material, as described by the manufacturer.
- Sediment basins are best used in conjunction with erosion controls.
- Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.
- A forebay, constructed upstream of the basin may be provided to remove debris and larger particles.
- The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.
- The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.
- A rock pile or rock-filled gabions can serve as alternatives to the debris screen, although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.
- The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.
- Cleanout level should be clearly marked on the riser pipe.

Installation

- Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).
- Areas under embankments must be cleared and stripped of vegetation.
- Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

Costs

The cost of a sediment basin is highly variable and is dependent of the site configuration. To decrease basin construction costs, designers should consider using existing site features such as berms or depressed area to site the sediment basin. Designers should also consider potential savings associated with designing the basin to minimize the number of maintenance cycles and siting the basin in a location where a permanent BMP (e.g., extended detention basin) is required for the project site.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level and as required by local requirements. It is recommended that at a minimum, basins be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Examine basin banks for seepage and structural soundness.
- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check inlet and outlet area for erosion and stabilize if required.
- Check fencing for damage and repair as needed.
- Sediment that accumulates in the basin must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage volume. Sediment removed during maintenance should be managed properly. The sediment should be appropriately evaluated and used or disposed of accordingly. Options include: incorporating sediment into earthwork on the site (only if there is no risk that sediment is contaminated); or off-site export/disposal at an appropriate location (e.g., sediment characterization and disposal to an appropriate landfill).
- Remove standing water from basin within 96 hours after accumulation.
- If the basin does not drain adequately (e.g., due to storms that are more frequent or larger than the design storm or other unforeseen site conditions), dewatering should be conducted in accordance with appropriate dewatering BMPs (see NS-2) and in accordance with local permits as applicable.
- To minimize vector production:
  - Remove accumulation of live and dead floating vegetation in basins during every inspection.
  - Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

References

A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zones, Metropolitan Washington Council of Governments, March 1992.

Draft-Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA. April 1990.

U.S. Environmental Protection Agency (USEPA). Erosion and Sediment Control, Surface Mining in the Eastern U.S., U.S. Environmental Protection Agency, Office of Water, Washington, DC,Washington, D.C., 1976.

Fifield, J.S. Designing for Effective Sediment and Erosion Control on Construction Sites. Forester Press, Santa Barbara, CA. 2004.

Goldman S.J., Jackson K. and Bursztynsky T.A. Erosion and Sediment Control Handbook. McGraw-Hill Book Company, 1986.

U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Guidelines for the Design and Construction of Small Embankment Dams, Division of Safety of Dams, California Department of Water Resources, March 1986.

Haan C.T., Barfield B.J. and Hayes J.C. Design Hydrology and Sedimentology for Small Catchments. Academic Press. 1994.

Inlet/Outlet Alternatives for Extended Detention Basins. State of California Department of Transportation (Caltrans), 2001.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

McLean, J., 2000. Mosquitoes in Constructed Wetlands: A Management Bugaboo? In T.R. Schueler and H.K. Holland [eds.], The Practice of Watershed Protection. pp. 29-33. Center for Watershed Protection, Ellicott City, MD, 2000.

Metzger, M.E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Water, Work Group-Working Paper, USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Quality Management Plan for the Lake Tahoe Region, Volume II Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Young, G.K. and Graziano, F., Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission, 1989.

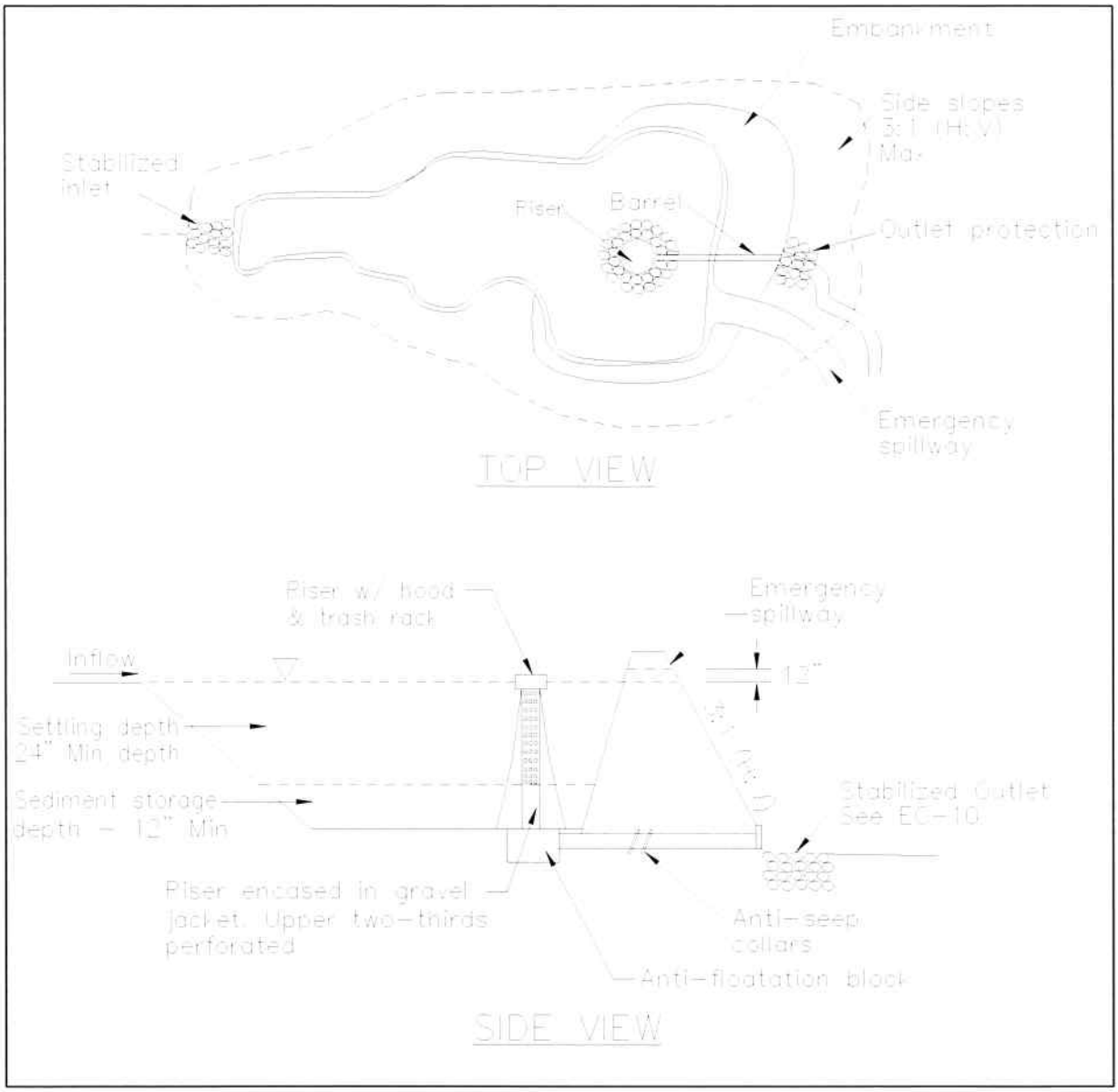


FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
MULTIPLE ORIFICE DESIGN
NOT TO SCALE

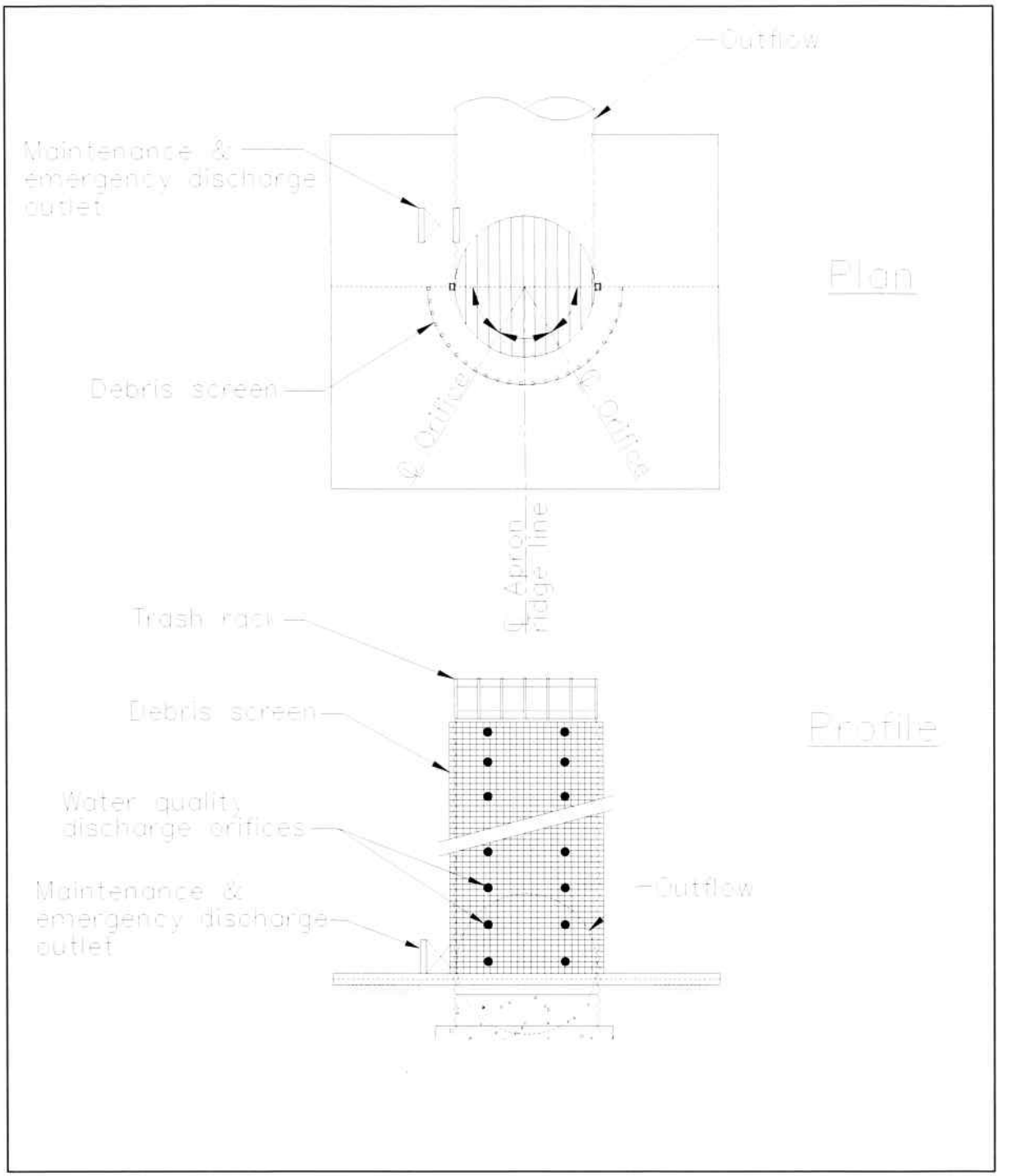


FIGURE 2: MULTIPLE ORIFICE OUTLET RISER

NOT TO SCALE

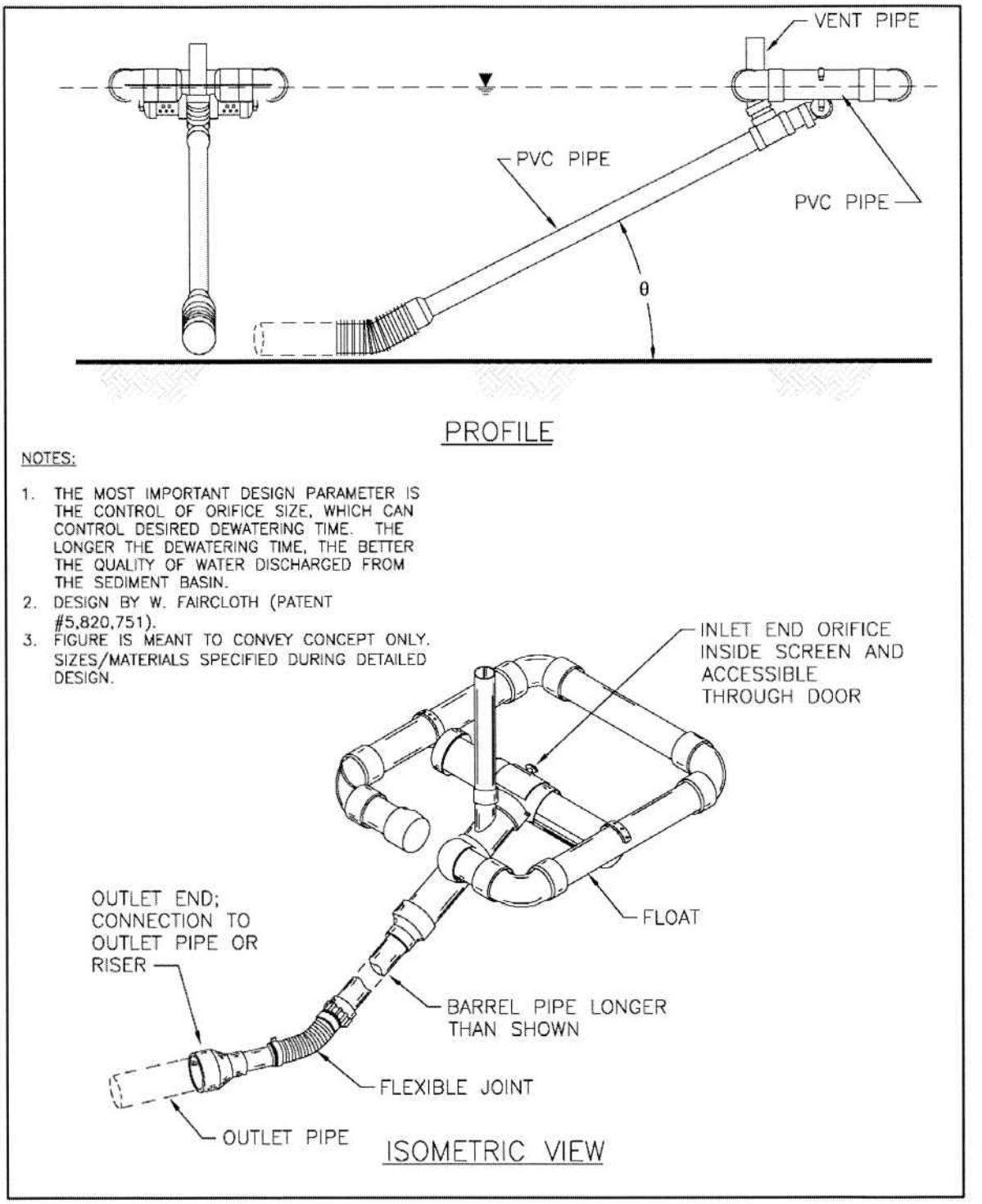


FIGURE 3: TYPICAL SKIMMER

NOT TO SCALE

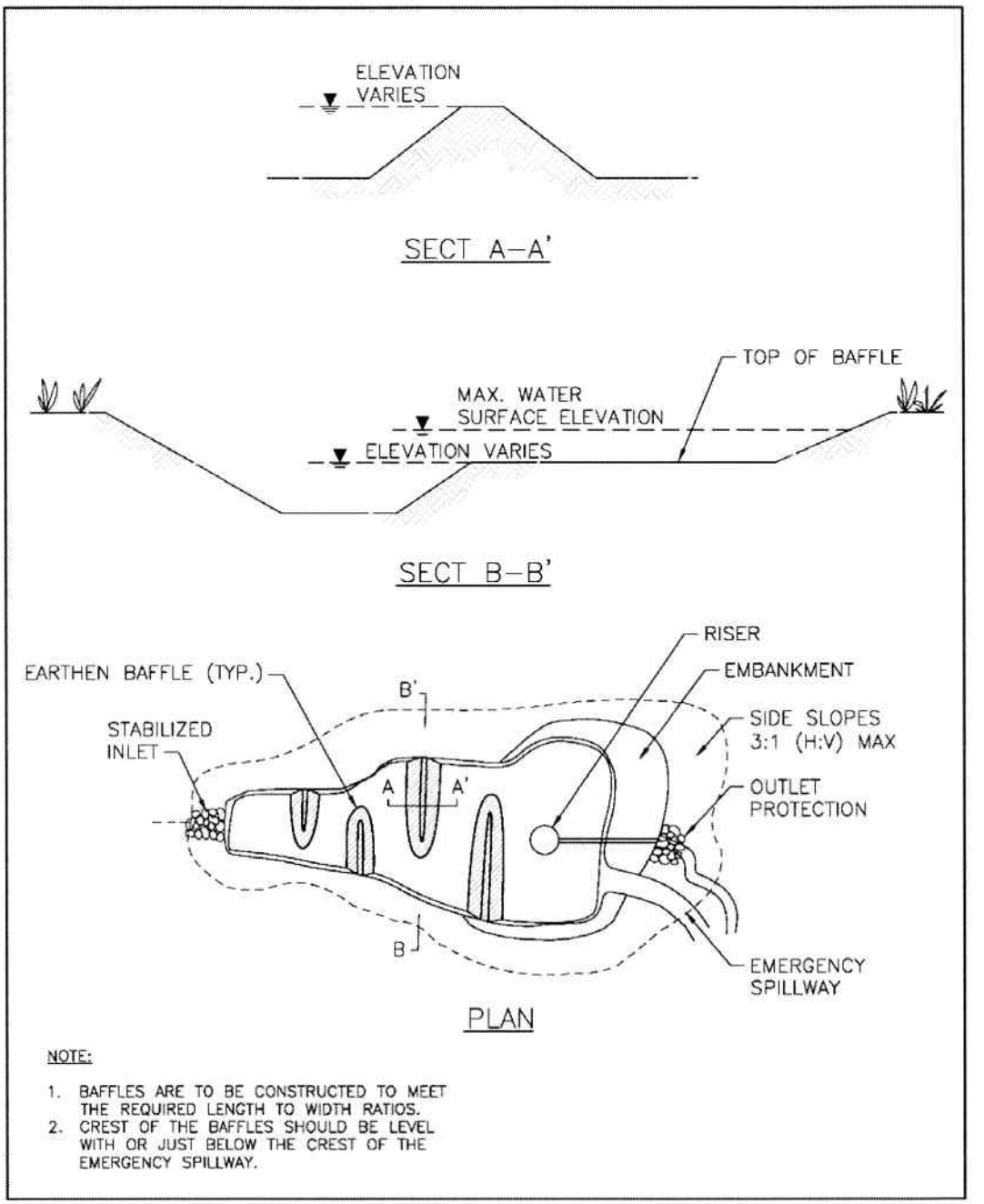
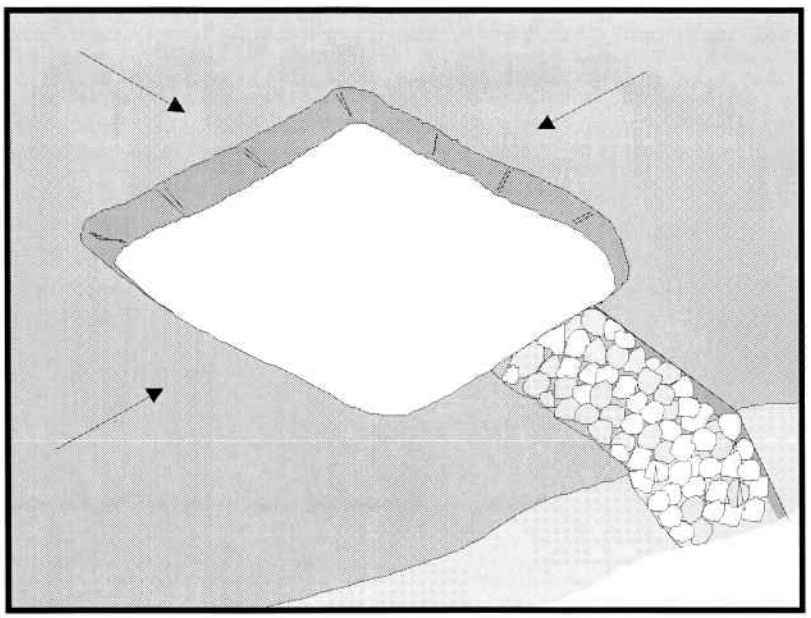


FIGURE 4: TYPICAL TEMPORARY SEDIMENT BASIN WITH BAFFLES

NOT TO SCALE

Sediment Trap SE-3



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-2 Sediment Basin (for larger areas)

Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.
- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

Implementation

Design

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed of, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 yd^3/acre and 33 yd^3/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

Installation

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.
- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.

- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

Costs

Average annual cost per installation and maintenance (18 month useful life) is $0.73 per ft^3 ($1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 72 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.

References

Brown, W., and T. Schueler. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD, 1997.

Draft – Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer, The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

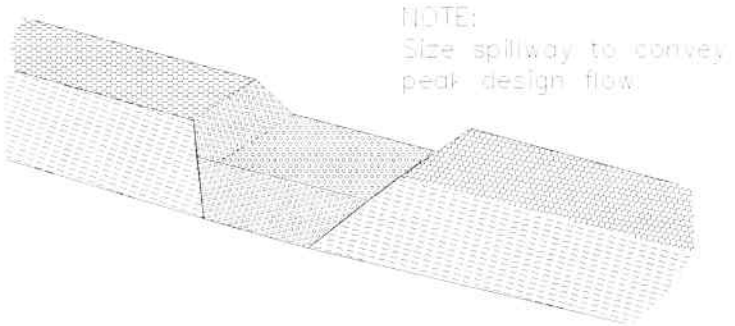
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

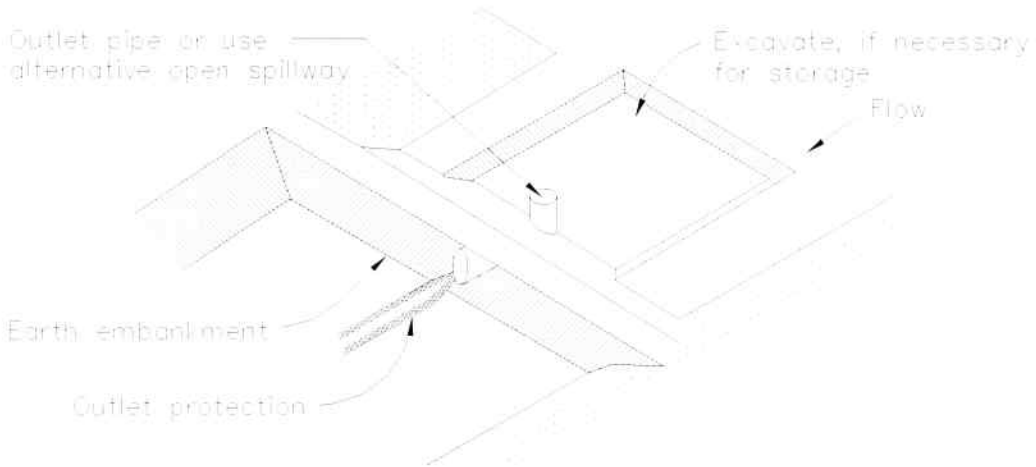
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

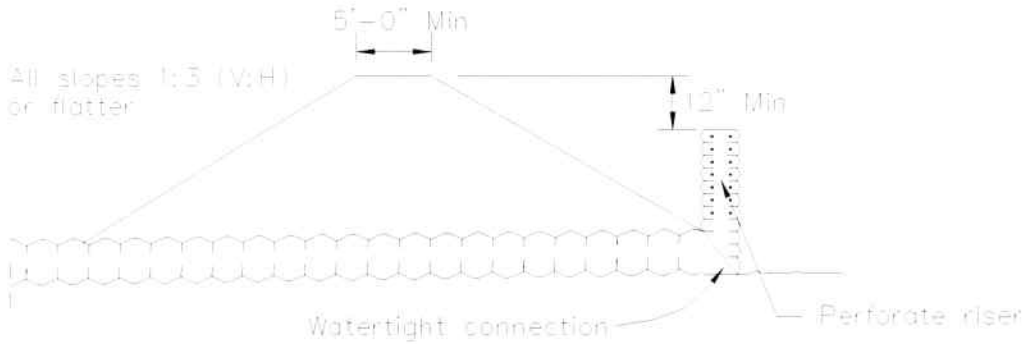
U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL OPEN SPILLWAY



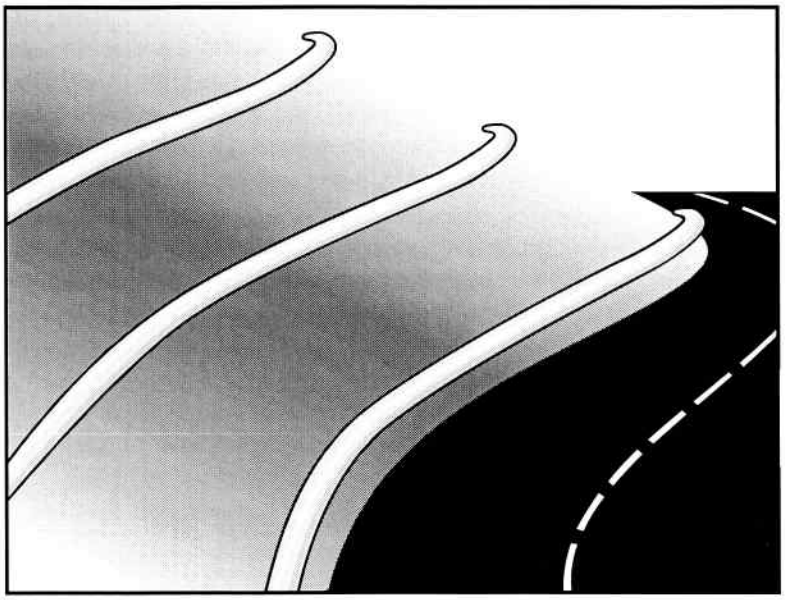


EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE

Fiber Rolls

SE-5



Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

Description and Purpose

A fiber roll consists of straw, coir, or other biodegradable materials bound into a tight tubular roll wrapped by netting, which can be photodegradable or natural. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight when staking the rolls are not feasible (such as use as inlet protection). When fiber rolls are placed at the toe and on the face of slopes along the contours, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.
- At operational storm drains as a form of inlet protection.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Around temporary stockpiles.

Limitations

- Fiber rolls are not effective unless trenched in and staked.
- Not intended for use in high flow situations.
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.
- Rolls typically function for 12-24 months depending upon local conditions.

Implementation

Fiber Roll Materials

- Fiber rolls should be prefabricated.
- Fiber rolls may come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll. Fiber rolls impregnated with PAM provide additional sediment removal capabilities and should be used in areas with fine, clayey or silty soils to provide additional sediment removal capabilities. Monitoring may be required for these installations.
- Fiber rolls are made from weed free rice straw, flax, or a similar agricultural material bound into a tight tubular roll by netting.
- Typical fiber rolls vary in diameter from 9 in. to 20 in. Larger diameter rolls are available as well.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth should be ¼ to 1/3 of the thickness of the roll, and the width should equal the roll diameter, in order to provide area to backfill the trench.

- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- It is recommended that pilot holes be driven through the fiber roll. Use a straight bar to drive holes through the roll and into the soil for the wooden stakes.
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into the trench.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.
- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or removed depending on the type of fiber roll and application (temporary vs. permanent installation). Typically, fiber rolls encased with plastic netting are used for a temporary application because the netting does not biodegrade. Fiber rolls used in a permanent application are typically encased with a biodegradeable material and are left in place. Removal of a fiber roll used in a permanent application can result in greater disturbance.
- Temporary installations should only be removed when up gradient areas are stabilized per General Permit requirements, and/or pollutant sources no longer present a hazard. But, they should also be removed before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.

Costs

Material costs for regular fiber rolls range from $20 - $30 per 25 ft roll.

Material costs for PAM impregnated fiber rolls range between 7.00-$9.00 per linear foot, based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP should be periodically removed

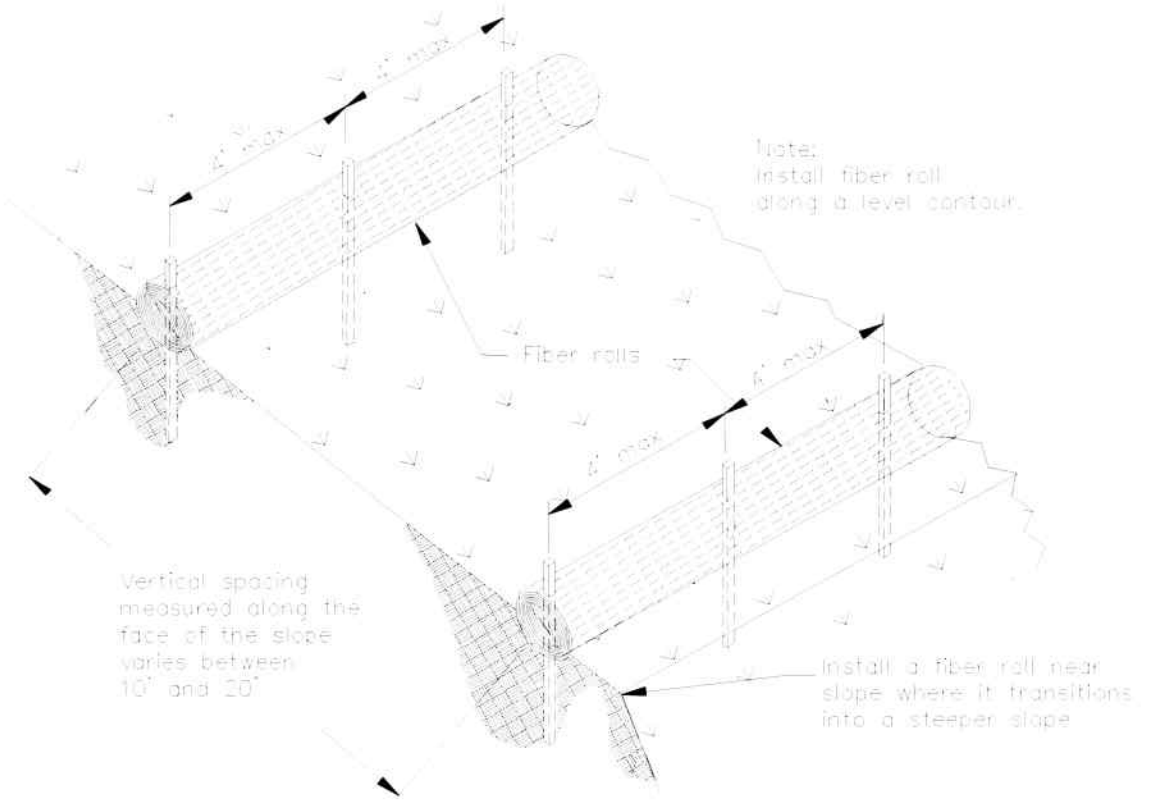
in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-third the designated sediment storage depth.

- If fiber rolls are used for erosion control, such as in a check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.
- Repair any rills or gullies promptly.

References

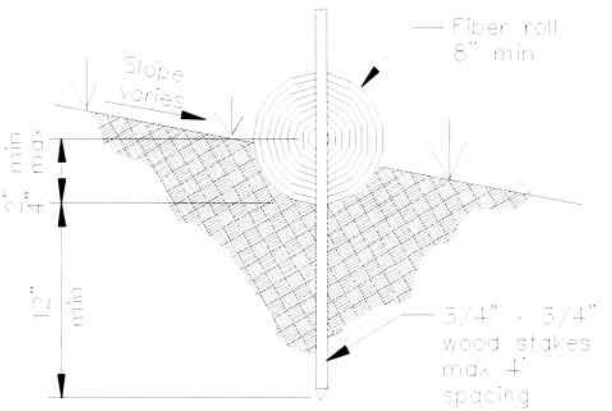
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



TYPICAL FIBER ROLL INSTALLATION

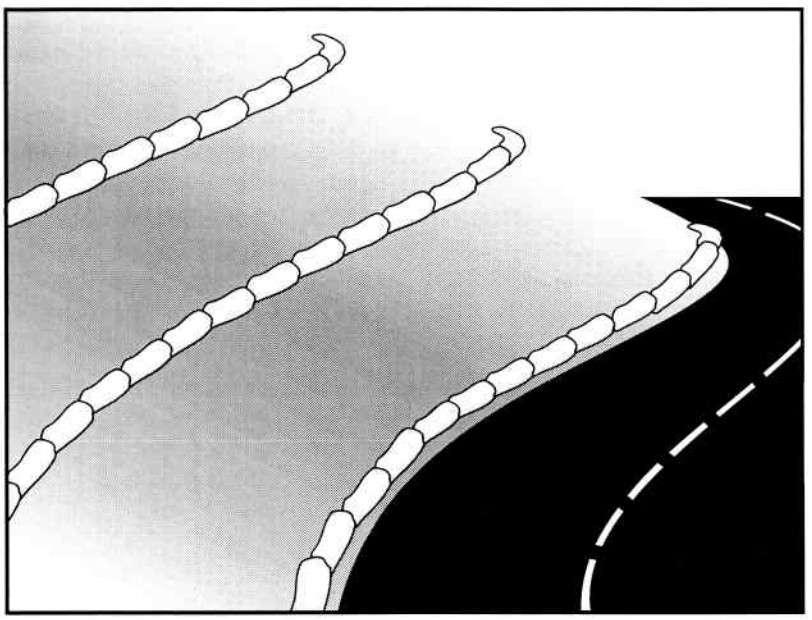
N.T.S.



ENTRENCHMENT DETAIL

N.T.S.

Gravel Bag Berm SE-6



Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flow, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As a linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- At the top of slopes to divert runoff away from disturbed slopes.
- As chevrons (small check dams) across mildly sloped construction roads. For use check dam use in channels, see SE-4, Check Dams.

Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the berm, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Durability of gravel bags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months.
- Easily damaged by construction equipment.
- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel-filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous. Generally, gravel bag berms should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate gravel bag berms on level contours.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Gravel bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

Slope inclination 2:1 (H:V) or greater: Gravel bags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, gravel bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the gravel bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 (H:V) or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- Butt ends of bags tightly.
- On multiple row, or multiple layer construction, overlap butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs

Material costs for gravel bags are average and are dependent upon material availability. $2.50-3.00 per filled gravel bag is standard based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.

- Reshape or replace gravel bags as needed.

- Repair washouts or other damage as needed.

- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- Remove gravel bag berms when no longer needed and recycle gravel fill whenever possible and properly dispose of bag material. Remove sediment accumulation and clean, re-grade, and stabilize the area.

References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Street Sweeping and Vacuuming SE-7

Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.
- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

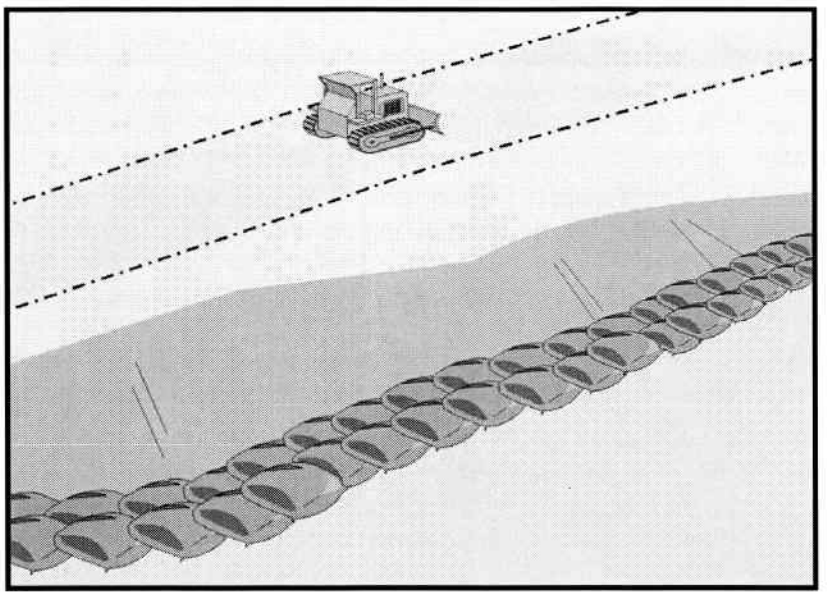
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Sandbag Barrier SE-8



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-14 Biofilter Bags

Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept or to divert sheet flows. Sandbag barriers placed on a level contour pond sheet flow runoff, allowing sediment to settle out.

Suitable Applications

Sandbag barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes.
  - As sediment traps at culvert/pipe outlets.
  - Below other small cleared areas.
  - Along the perimeter of a site.
  - Down slope of exposed soil areas.
  - Around temporary stockpiles and spoil areas.
  - Parallel to a roadway to keep sediment off paved areas.
  - Along streams and channels.
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- At the top of slopes to divert runoff away from disturbed slopes.
- As check dams across mildly sloped construction roads.

Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Sandbags are not intended to be used as filtration devices.
- Easily damaged by construction equipment.
- Degraded sandbags may rupture when removed, spilling sand.
- Sand is easily transported by runoff if bag is damaged or ruptured.
- Installation can be labor intensive.
- Durability of sandbags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months. When used to detain concentrated flows, maintenance requirements increase.
- Burlap should not be used for sandbags.

Implementation

General

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. Sand-filled bags have limited porosity, which is further limited as the fine sand tends to quickly plug with sediment, limiting or completely blocking the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms or SE-14, Biofilter Bags. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to gravel bag berms, but less porous. Generally, sandbag barriers should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate sandbag barriers on a level contour.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Sandbags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

    Slope inclination 2:1 (H:V) or greater: Sandbags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, sand bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the sand bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- Stack sandbags at least three bags high.
- Butt ends of bags tightly.
- Overlap butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 (H:V) or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- See typical sandbag barrier installation details at the end of this fact sheet.

Materials

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap is not an acceptable substitute, as sand can more easily mobilize out of burlap.
- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 3 (Caltrans Standard Specification, Section 25) permeable material free from clay and deleterious material, such as recycled concrete or asphalt..

Costs

Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd^3. Additional labor is required to fill the bags. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag. These costs are based upon vendor research.

Inspection and Maintenance

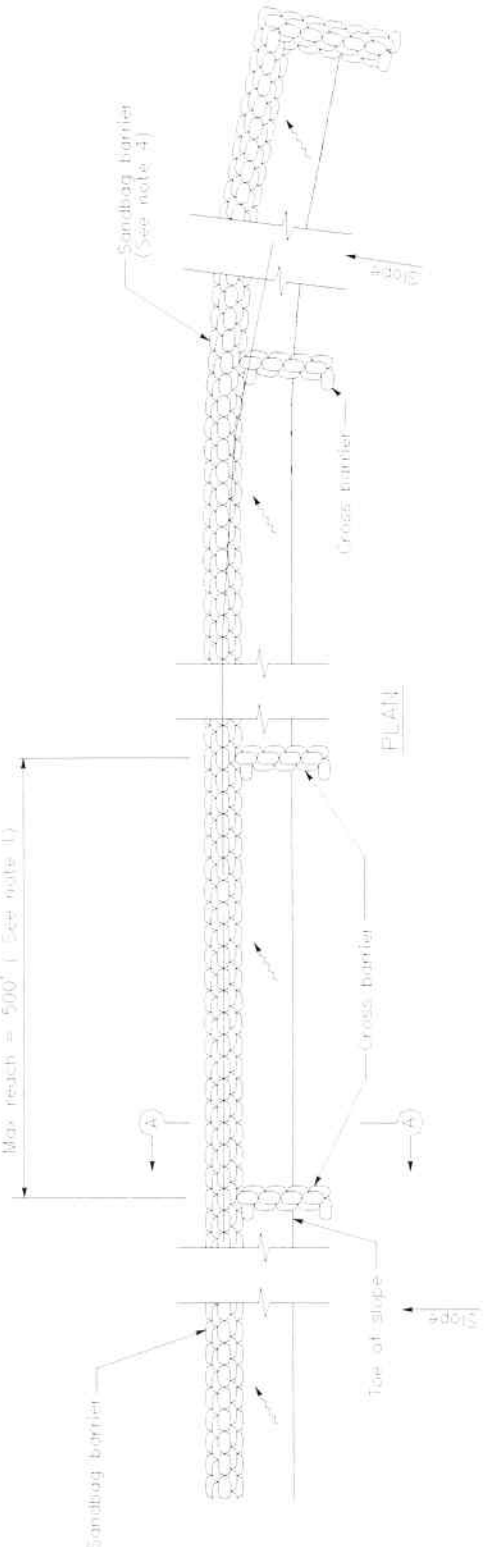
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.
- Reshape or replace sandbags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove sandbags when no longer needed and recycle sand fill whenever possible and properly dispose of bag material. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

References

Standard Specifications for Construction of Local Streets and Roads, California Department of Transportation (Caltrans), July 2002.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

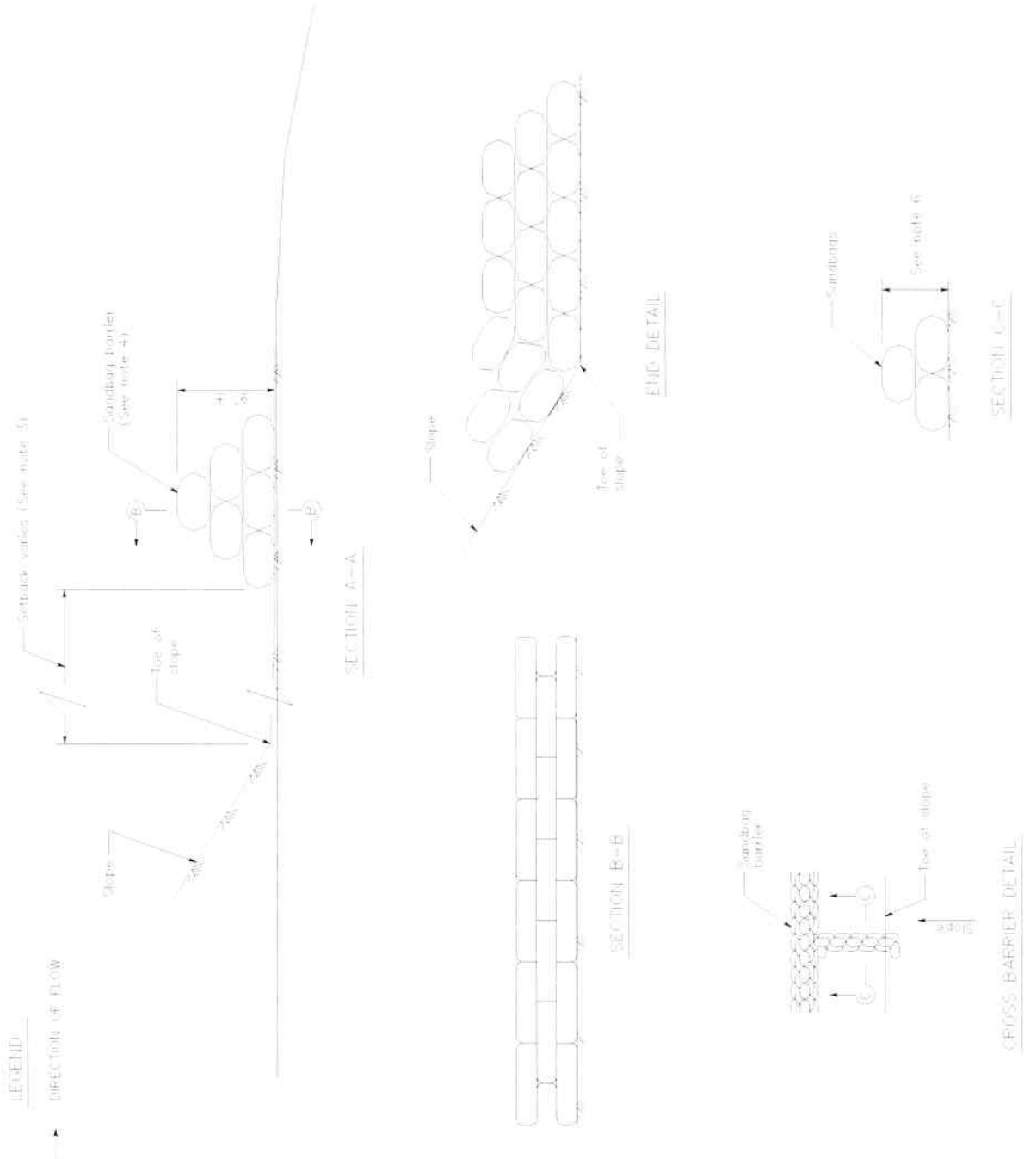
Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Setback varies (See note 3)
Sandbag barrier (See note 4)
Toe of slope
Slope
SECTION A–A
SECTION B–B
END DETAIL
Sandbags
See note 6
SECTION C–C
CROSS BARRIER DETAIL

- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

Limitations

Straw bale barriers:

- Are not to be used for extended periods of time because they tend to rot and fall apart
- Are suitable only for sheet flow on slopes of 10 % or flatter
- Are not appropriate for large drainage areas, limit to one acre or less
- May require constant maintenance due to rotting
- Are not recommended for concentrated flow, inlet protection, channel flow, and live streams
- Cannot be made of bale bindings of jute or cotton
- Require labor-intensive installation and maintenance
- Cannot be used on paved surfaces
- Should not to be used for drain inlet protection
- Should not be used on lined ditches
- May introduce undesirable non-native plants to the area

Implementation

General

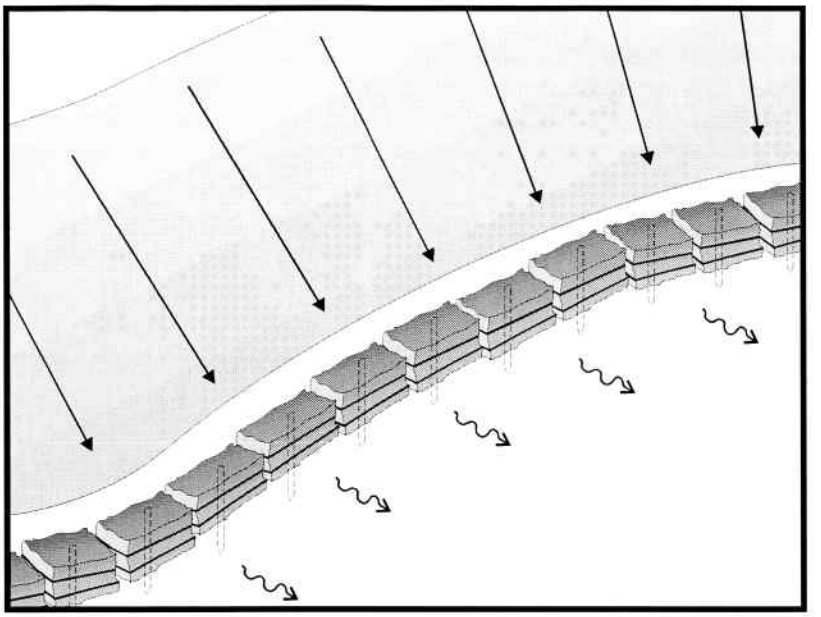
A straw bale barrier consists of a row of straw bales placed on a level contour. When appropriately placed, a straw bale barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. Straw bale barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils.

Straw bale barriers have not been as effective as expected due to improper use. These barriers have been placed in streams and drainage ways where runoff volumes and velocities have caused the barriers to wash out. In addition, failure to stake and entrench the straw bale has allowed undercutting and end flow. Use of straw bale barriers in accordance with this BMP should produce acceptable results.

Design and Layout

- Locate straw bale barriers on a level contour.
  - Slopes up to 10:1 (H:V): Straw bales should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the toe of slope.
  - Slopes greater than 10:1 (H:V): Not recommended.

Straw Bale Barrier SE-9



Description and Purpose

A straw bale barrier is a series of straw bales placed on a level contour to intercept sheet flows. Straw bale barriers pond sheet- flow runoff, allowing sediment to settle out.

Suitable Applications

Straw bale barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Turn the ends of the straw bale barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sand bags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 1 acre, or 0.25 acre per 100 ft of barrier.
- Maximum flow path to the barrier should be limited to 100 ft.
- Straw bale barriers should consist of two parallel rows.
  - Butt ends of bales tightly
  - Stagger butt joints between front and back row
  - Each row of bales must be trenched in and firmly staked
- Straw bale barriers are limited in height to one bale laid on its side.
- Anchor bales with either two wood stakes or four bars driven through the bale and into the soil. Drive the first stake towards the butt joint with the adjacent bale to force the bales together.
- See attached figure for installation details.

Materials

- ***Straw Bale Size:*** Each straw bale should be a minimum of 14 in. wide, 18 in. in height, 36 in. in length and should have a minimum mass of 50 lbs. The straw bale should be composed entirely of vegetative matter, except for the binding material.
- ***Bale Bindings:*** Bales should be bound by steel wire, nylon or polypropylene string placed horizontally. Jute and cotton binding should not be used. Baling wire should be a minimum diameter of 14 gauge. Nylon or polypropylene string should be approximately 12 gauge in diameter with a breaking strength of 80 lbs force.
- ***Stakes:*** Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake, or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable. Steel bar reinforcement should be equal to a #4 designation or greater. End protection should be provided for any exposed bar reinforcement.

Costs

Straw bales cost $5 - $7 each. Adequate labor should be budgeted for installation and maintenance.

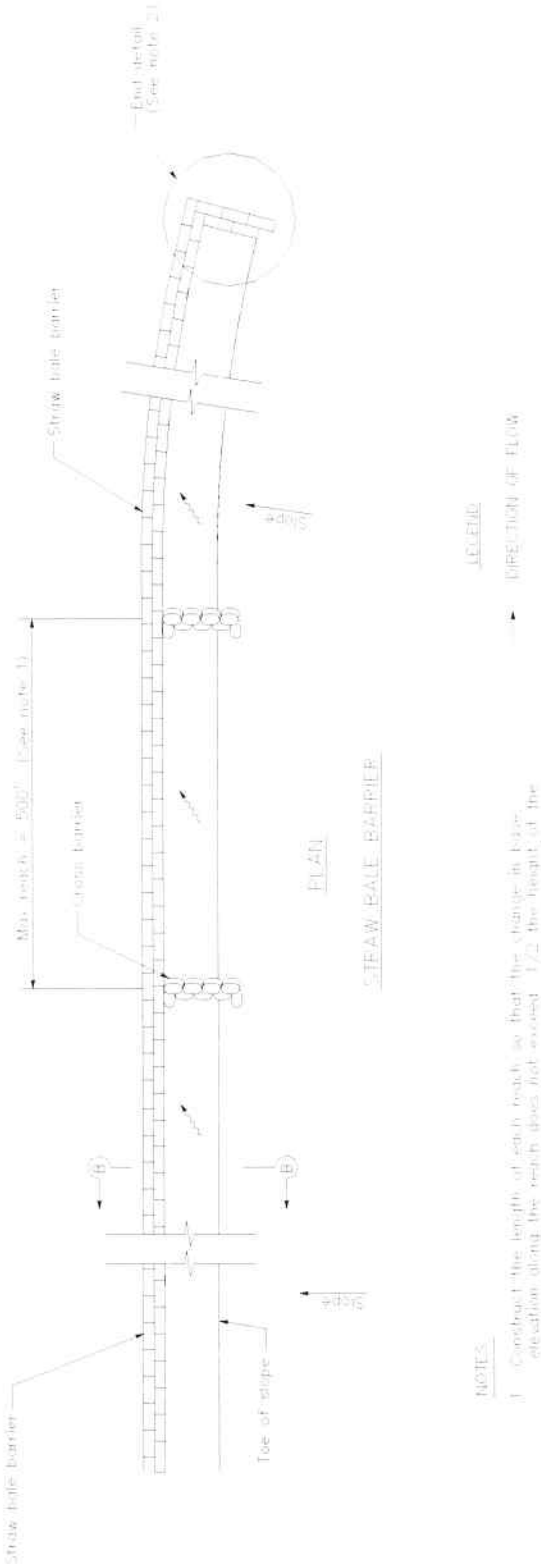
Inspection and Maintenance

Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Straw bales degrade, especially when exposed to moisture. Rotting bales will need to be replaced on a regular basis.
- Replace or repair damaged bales as needed.
- Repair washouts or other damages as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove straw bales when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

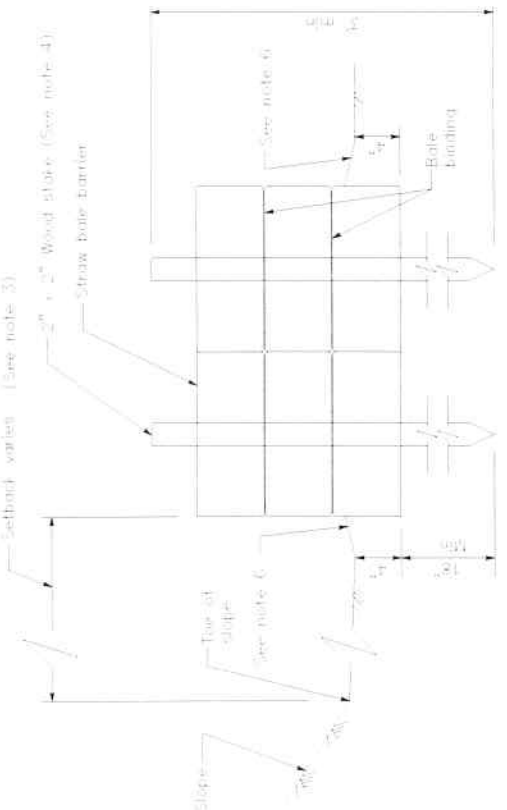
References

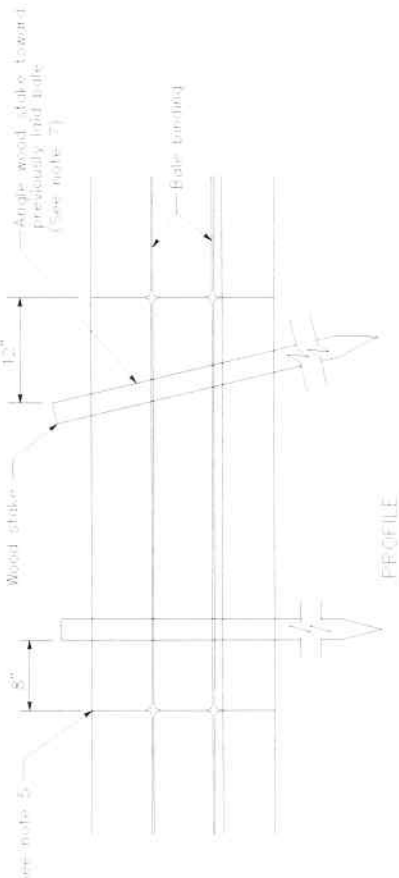
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

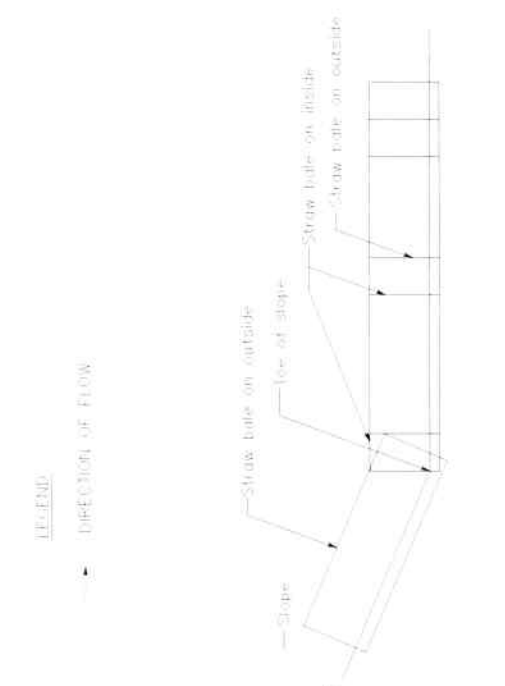


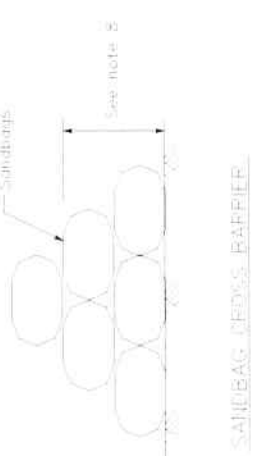
NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The end of barrier shall be turned up slope.
3. Dimension may vary to fit field condition.
4. Stake dimensions are nominal.
5. Place straw bales tightly together.
6. Tamp embankment spoils against sides of installed bales.
7. Drive angled wood stake before vertical stake to ensure tight abutment to adjacent bale.
8. Sandbag cross barriers should be a min. of 1/2" and a max. of 2/3 the height of the linear barrier.
9. Sandbag rows and layers should be offset to eliminate gaps.


Setback varies (See note 3)
2" x 2" Wood stake (See note 4)
Straw Bale Barrier
See note 6
Bale binding
Toe of slope
See note 6
Slope
SECTION B–B


Angle wood stake toward previously laid bale (See note 7)
Bale binding
12"
Wood stake
6"
See note 5
PROFILE


LEGEND
DIRECTION OF FLOW
Straw bale on outside
Toe of slope
Straw bale on inside
Straw bale on outside
Slope
END DETAIL


Sandbags
See note 8
SANDBAG CROSS BARRIER

Biofilter Bags

SE-14

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-4 Check Dams

SE-5 Fiber Roll

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-10 Storm Drain Inlet Protection

Description and Purpose

Biofilter bags, or bio-bags, are a multi-purpose sediment control BMP consisting of a plastic mesh bag filled with 100% recycled wood product waste. Biofilter bags come in a variety of sizes (30" X 18" and 30" X 9" being common) and generally have between 1-2 cubic yards of recycled wood waste (or wood chips). Biofilter bags work by detaining flow and allowing a slow rate of discharge through the wood media. This action removes suspended sediment through gravity settling of the detained water and filtration within the bag.

Suitable Applications

Biofilter bags are a short-term BMP that can be rapidly deployed, maintained, and replaced. Biofilter bags can be an effective short-term solution to place in developed rills to prevent further erosion until permanent measures can be established. Suitable short-term applications include:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - Below other small cleared areas
  - Along the perimeter of a site (with low-expected flow)
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Along streams and channels

- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
  - At the top of slopes to divert runoff away from disturbed slopes
  - As check dams across mildly sloped construction roads
- Inlet Protection (See SE-10)
- Supplement to silt fences or other sediment control devices

Limitations

- Short life-span (2-3 months); regular maintenance and replacement required to ensure effectiveness. Bags will rapidly fill with sediment and reduce permeability.
- Easily damaged by construction vehicles.
- If not properly staked, will fail on slope applications.
- If improperly installed can allow undercutting or side-cutting flow.
- Not effective where water velocities or volumes are high.
- Potentially buoyant and easily displaced if not properly installed.

Implementation

General

Biofilter bags are a relatively low cost temporary BMP that are easily deployed and have a simple installation that can be performed by hand. Without proper installation, however, biofilter bags can fail due to their light weight, potential displacement, and multiple joint locations. One of the benefits of utilizing biofilter bags is that the media (wood-product) can be recycled or used onsite when no longer needed (where acceptable).

Design and Layout – Linear control

- Locate biofilter bags on level contours.
  - Slopes between 20:1 and 4:1 (H:V): Biofilter bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slopes between 4:1 and 2:1 (H:V): Biofilter bags should be placed at a maximum interval of 15 ft, with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Biofilter bags should be placed at a maximum interval of 10 ft., with the first row placed the slope toe.

- Turn the ends of the biofilter bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the biofilter bag berm to allow ponding, and to provide room for sediment storage.
- Stake biofilter bags into a 1 to 2 in. deep trench with a width equal to the bag.
  - Drive one stake at each end of the bag.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- Biofilter bags should be overlapped (6 in.), not abutted.

Costs

Pre-filled biofilter bags cost approximately $2.50-$3.50 per bag, dependent upon size.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Biofilter bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace biofilter bags as needed.
- Repair washouts or other damage as needed.
- Sediment that is retained by the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove biofilter bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Biofilter media may be used on-site, if allowed.

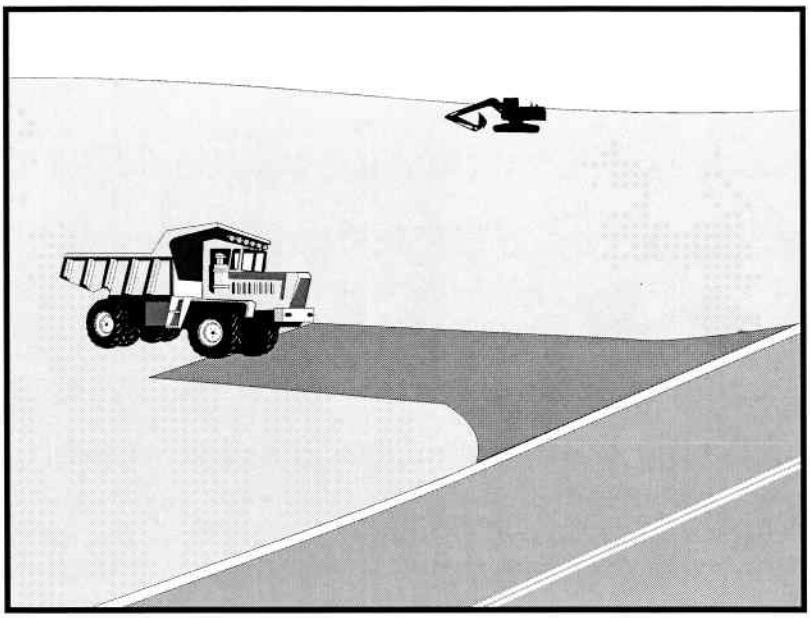
References

Catalog of Stormwater Best Management Practices for Idaho Cities and Counties. Volume 2, Section 7, BMP 34 – Biofilter Bags, Idaho Department of Environmental Quality, 2005.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stabilized Construction Entrance/Exit TC-1



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water

runoff.

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft minimum, and 30 ft minimum width.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

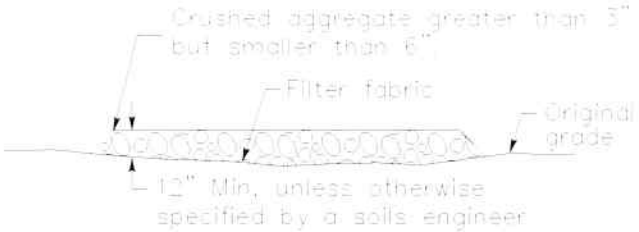
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

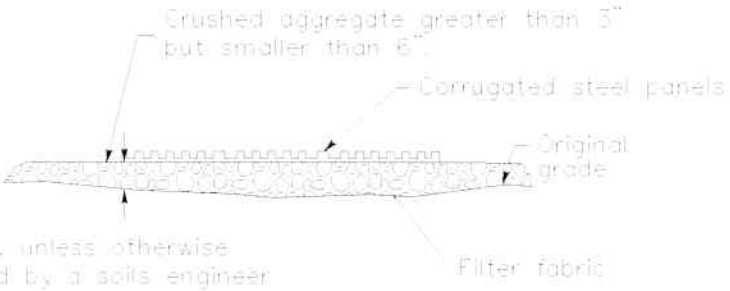
Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

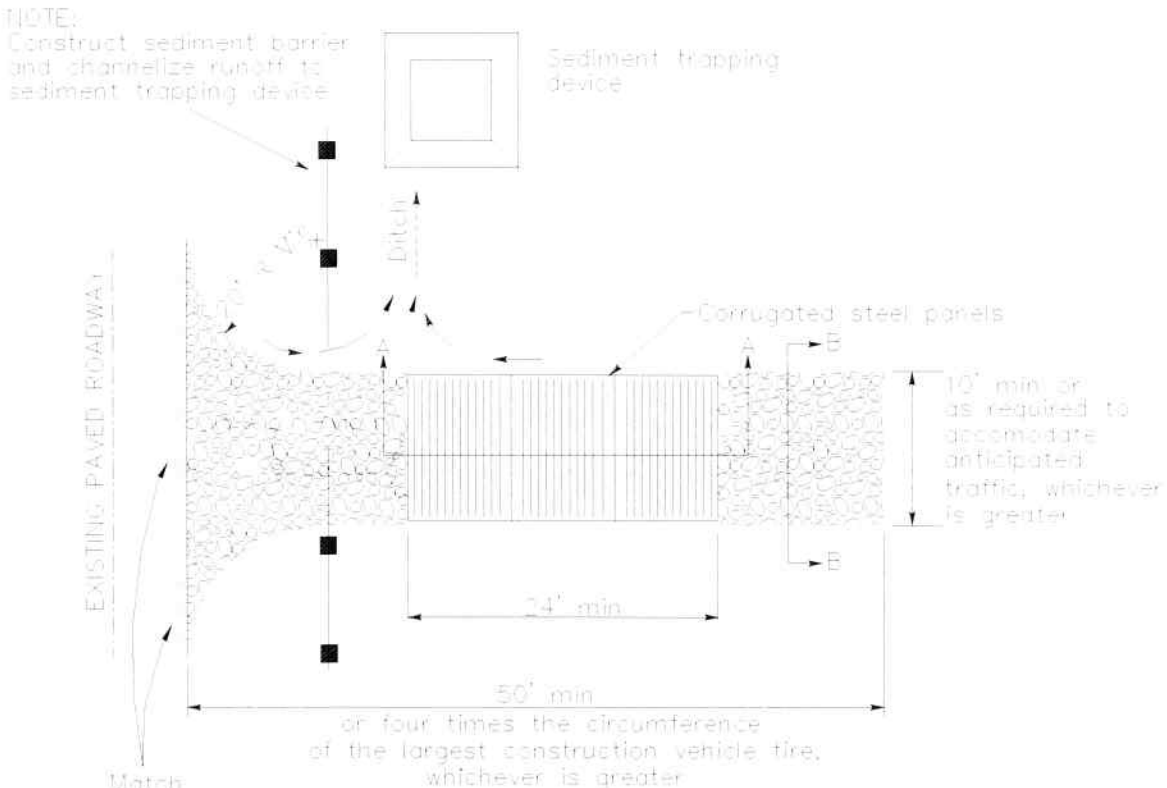
Stabilized Construction Entrance/Exit TC-1



SECTION B–B
NTS

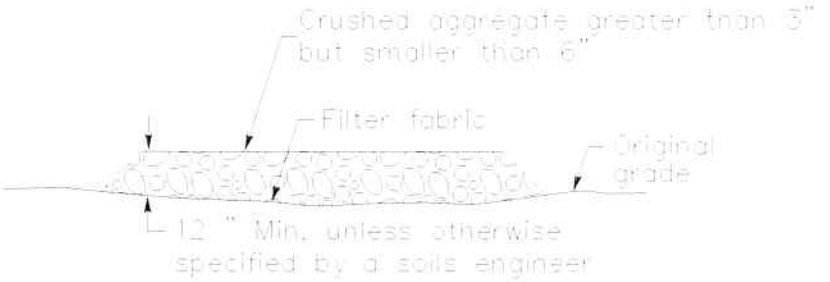


SECTION A–A
NOT TO SCALE

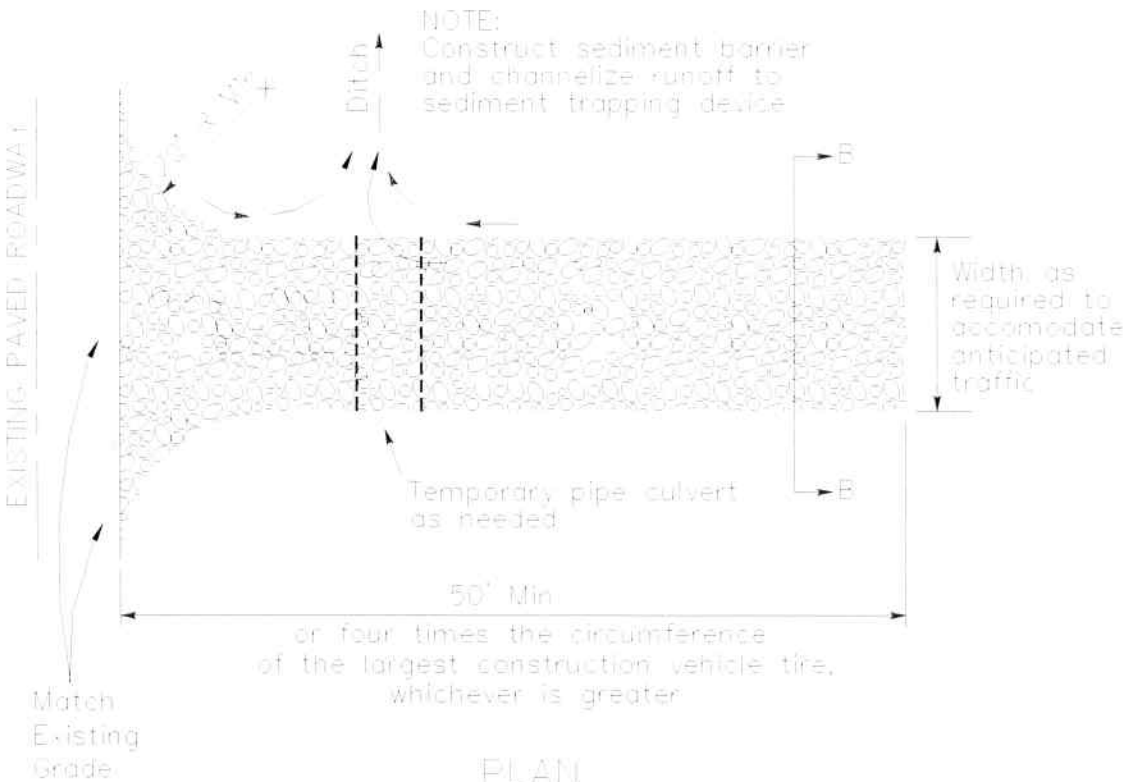


PLAN
NTS

Stabilized Construction Entrance/Exit TC-1

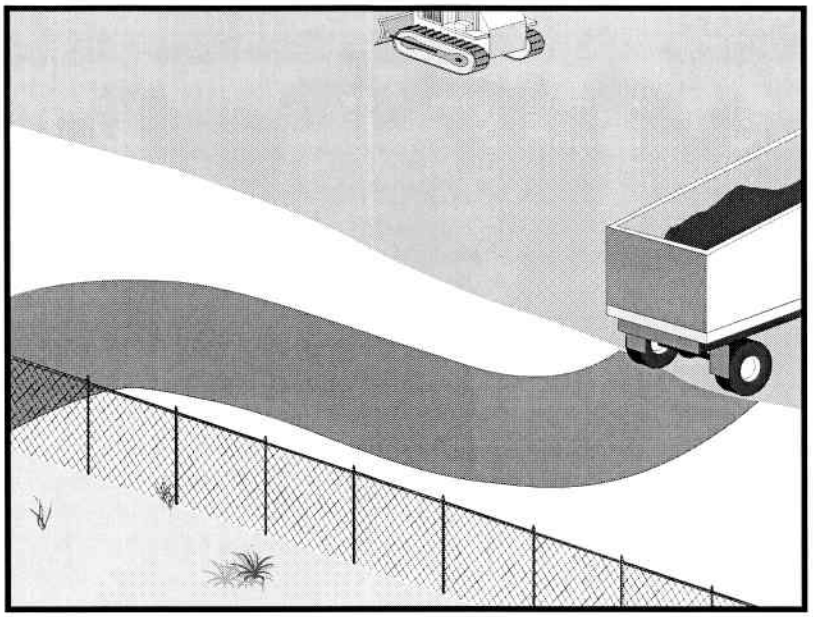


SECTION B–B
NTS



PLAN
NTS

Stabilized Construction Roadway TC-2



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.
- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.

Appendix H
CASQA BMP Handbook Fact Sheets

- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, impact weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

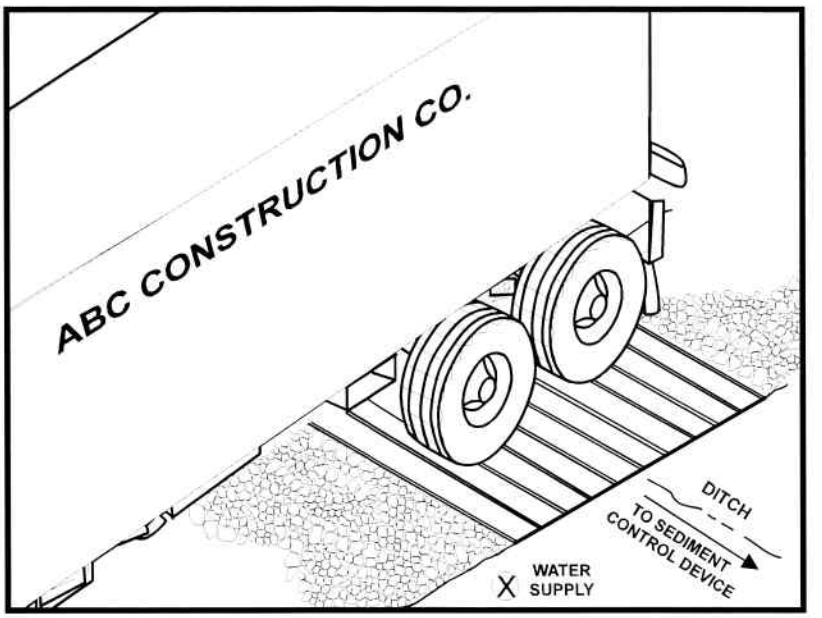
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

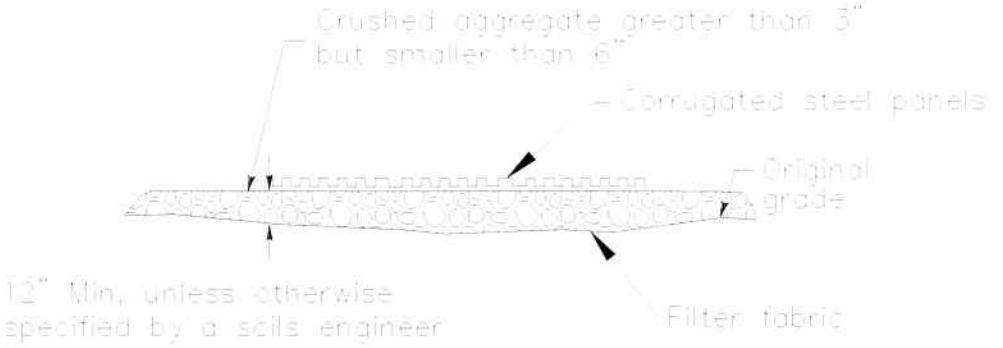
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

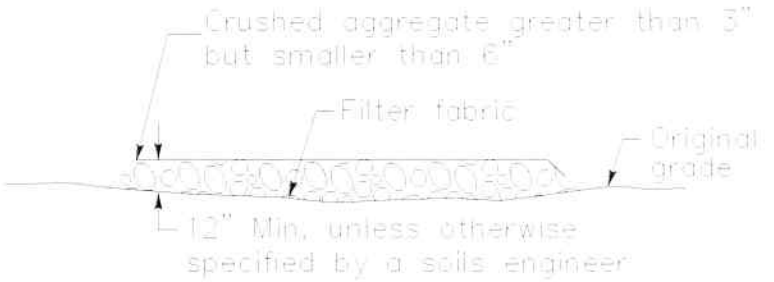
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

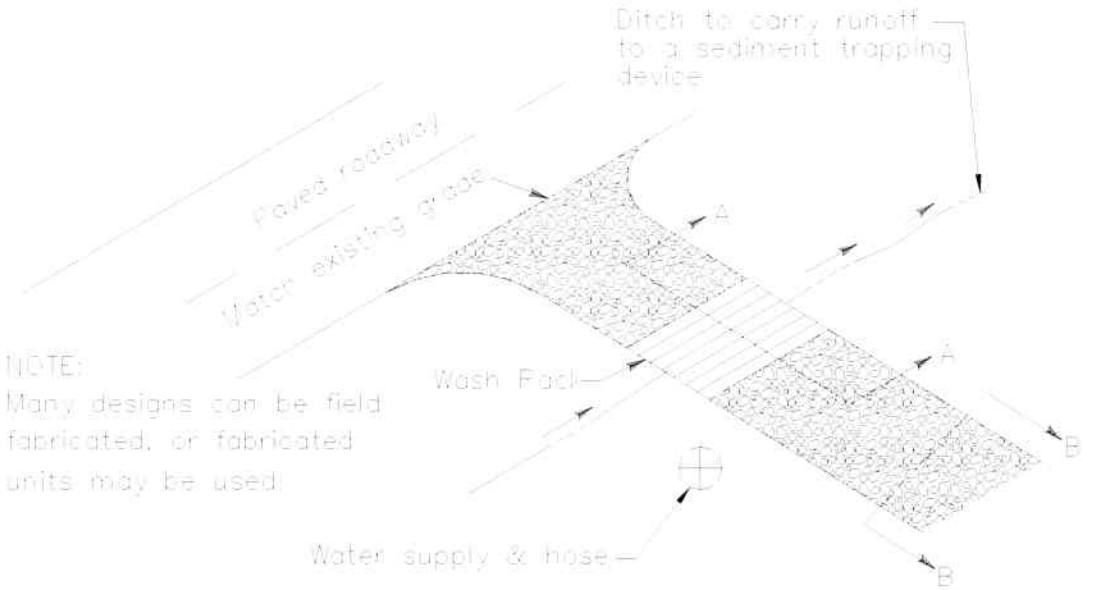
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



SECTION A–A
NOT TO SCALE

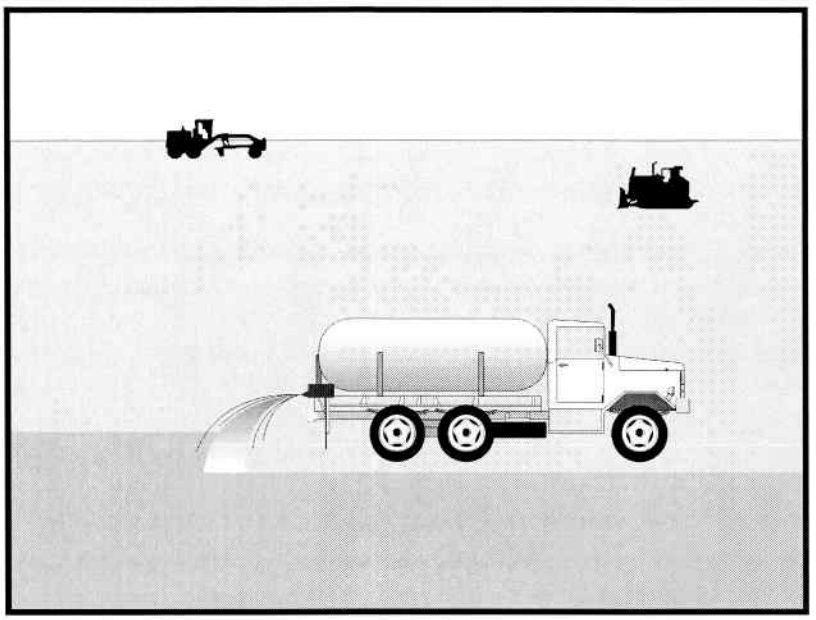


SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Wind Erosion Control WE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	☑
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-5 Soil Binders

Description and Purpose

Wind erosion or dust control consists of applying water or other chemical dust suppressants as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

California's Mediterranean climate, with a short "wet" season and a typically long, hot "dry" season, allows the soils to thoroughly dry out. During the dry season, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment. Site conditions and climate can make dust control more of an erosion problem than water based erosion. Additionally, many local agencies, including Air Quality Management Districts, require dust control and/or dust control permits in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. Wind erosion control is required to be implemented at all construction sites greater than 1 acre by the General Permit.

Suitable Applications

Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion and dust control requirements required by other agencies will generally meet wind erosion control requirements for water quality protection. Wind erosion control BMPs are suitable during the following construction activities:

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period (generally less than a few hours) and should be applied daily (or more often) to be effective.
- Over watering may cause erosion and track-out.
- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Chemical dust suppression agents may have potential environmental impacts. Selected chemical dust control agents should be environmentally benign.
- Effectiveness of controls depends on soil, temperature, humidity, wind velocity and traffic.
- Chemical dust suppression agents should not be used within 100 feet of wetlands or water bodies.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.
- If the soil surface has minimal natural moisture, the affected area may need to be pre-wetted so that chemical dust control agents can uniformly penetrate the soil surface.

Implementation

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table presents dust control practices that can be applied to varying site conditions that could potentially cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph or less, and controlling the number and activity of vehicles on a site at any given time.

Chemical dust suppressants include: mulch and fiber based dust palliatives (e.g. paper mulch with gypsum binder), salts and brines (e.g. calcium chloride, magnesium chloride), non-petroleum based organics (e.g. vegetable oil, lignosulfonate), petroleum based organics (e.g. asphalt emulsion, dust oils, petroleum resins), synthetic polymers (e.g. polyvinyl acetate, vinyls, acrylic), clay additives (e.g. bentonite, montimorillonite) and electrochemical products (e.g. enzymes, ionic products).

Site Condition	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Temporary Gravel Construction Entrances/Equipment Wash Down	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	X	X	X	X	X			X
Disturbed Areas Subject to Traffic			X	X	X	X		X
Material Stockpiles		X	X	X			X	X
Demolition			X			X	X	
Clearing/ Excavation			X	X				X
Truck Traffic on Unpaved Roads			X	X	X	X	X	
Tracking					X	X		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (see EC-1, Scheduling).
- Quickly treat exposed soils using water, mulching, chemical dust suppressants, or stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Restrict construction traffic to stabilized roadways within the project site, as practicable.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.
- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality

Control Board (RWQCB) requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and wheel wash areas.
- Stabilize inactive areas of construction sites using temporary vegetation or chemical stabilization methods.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.

Costs

Installation costs for water and chemical dust suppression vary based on the method used and the length of effectiveness. Annual costs may be high since some of these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check areas protected to ensure coverage.
- Most water-based dust control measures require frequent application, often daily or even multiple times per day. Obtain vendor or independent information on longevity of chemical dust suppressants.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

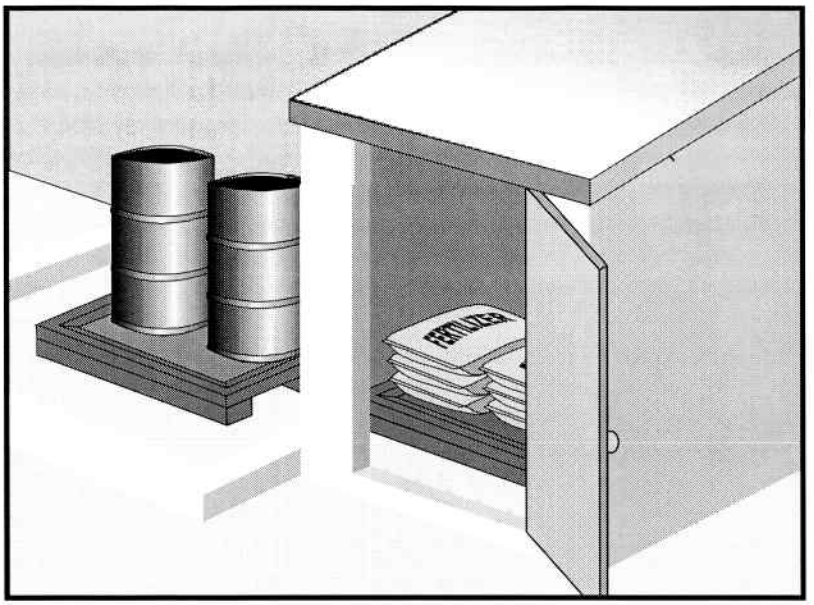
California Air Pollution Control Laws, California Air Resources Board, updated annually.

Construction Manual, Chapter 4, Section 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative", California Department of Transportation (Caltrans), July 2001.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Material Delivery and Storage WM-1



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Asphalt and concrete components
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Chemicals must be stored in water tight containers with appropriate secondary containment or in a storage shed.
- When a material storage area is located on bare soil, the area should be lined and bermed.
- Use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages, to meet material storage requirements.
- Stack erodible landscape material on pallets and cover when not in use.
- Contain all fertilizers and other landscape materials when not in use.
- Temporary storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be available on-site for all materials stored that have the potential to effect water quality.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located away from waterways, if possible.
    - Avoid transport near drainage paths or waterways.
    - Surround with earth berms or other appropriate containment BMP. See EC-9, Earth Dikes and Drainage Swales.
    - Place in an area that will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.

- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- Keep ample spill cleanup supplies appropriate for the materials being stored. Ensure that cleanup supplies are in a conspicuous, labeled area.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove and dispose of materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Materials should be covered prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or completely enclosed storage sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous wastes.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.
- If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep storage areas clean and well organized, including a current list of all materials onsite.
- Inspect labels on containers for legibility and accuracy.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

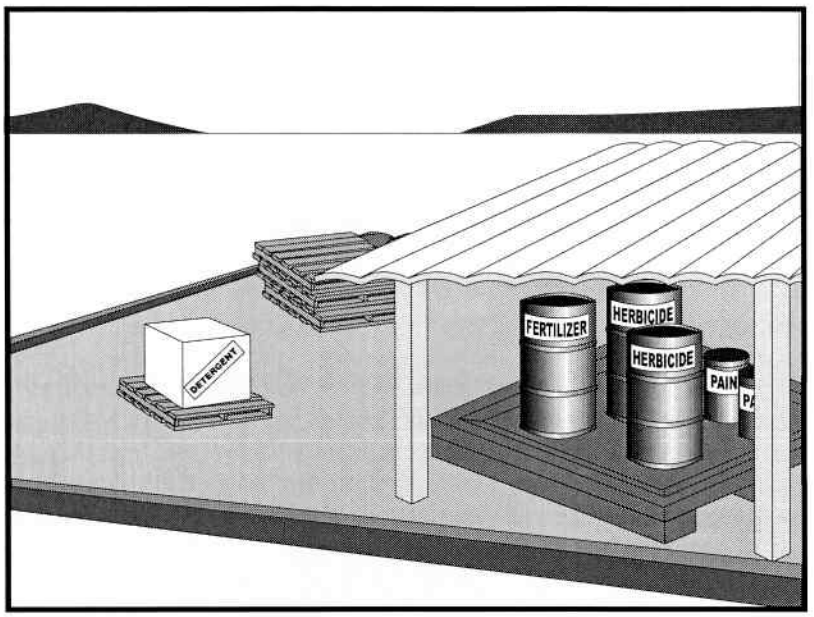
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Material Use

WM-2



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- The preferred method of termiticide application is soil injection near the existing or proposed structure foundation/slab; however, if not feasible, soil drench application of termiticides should follow EPA label guidelines and the following recommendations (most of which are applicable to most pesticide applications):
  - Do not treat soil that is water-saturated or frozen.
  - Application shall not commence within 24-hours of a predicted precipitation event with a 40% or greater probability. Weather tracking must be performed on a daily basis prior to termiticide application and during the period of termiticide application.
  - Do not allow treatment chemicals to runoff from the target area. Apply proper quantity to prevent excess runoff. Provide containment for and divert stormwater from application areas using berms or diversion ditches during application.
  - Dry season: Do not apply within 10 feet of storm drains. Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds).
  - Wet season: Do not apply within 50 feet of storm drains or aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds) unless a vegetative buffer is present (if so, refer to dry season requirements).
  - Do not make on-grade applications when sustained wind speeds are above 10 mph (at application site) at nozzle end height.
  - Cover treatment site prior to a rain event in order to prevent run-off of the pesticide into non-target areas. The treated area should be limited to a size that can be backfilled and/or covered by the end of the work shift. Backfilling or covering of the treated area shall be done by the end of the same work shift in which the application is made.
  - The applicator must either cover the soil him/herself or provide written notification of the above requirement to the contractor on site and to the person commissioning the

application (if different than the contractor). If notice is provided to the contractor or the person commissioning the application, then they are responsible under the Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) to ensure that: 1) if the concrete slab cannot be poured over the treated soil within 24 hours of application, the treated soil is covered with a waterproof covering (such as polyethylene sheeting), and 2) the treated soil is covered if precipitation is predicted to occur before the concrete slab is scheduled to be poured.

- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or contain for proper disposal off site. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.
- Document the location, time, chemicals applied, and applicator's name and qualifications.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.
- Discontinue use of erodible landscape material within 2 days prior to a forecasted rain event and materials should be covered and/or bermed.

- Provide containment for material use areas such as masons' areas or paint mixing/preparation areas to prevent materials/pollutants from entering stormwater.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Ensure employees and subcontractors throughout the job are using appropriate practices.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

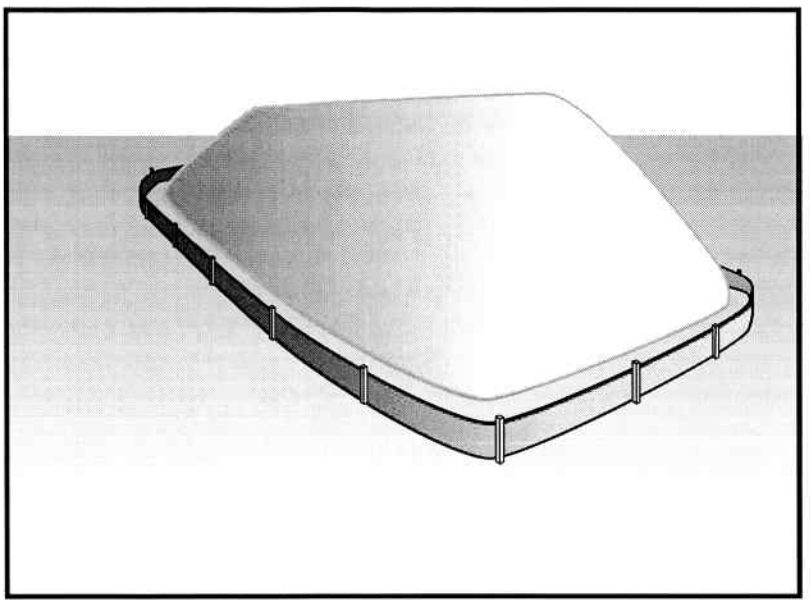
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Comments on Risk Assessments Risk Reduction Options for Cypermethrin: Docket No. OPP–2005–0293; California Stormwater Quality Association (CASQA) letter to USEPA, 2006.Environmental Hazard and General Labeling for Pyrethroid Non-Agricultural Outdoor Products, EPA-HQ-OPP-2008-0331-0021; USEPA, 2008.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Stockpile Management WM-3



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, soil amendments, sand, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

Suitable Applications

Implement in all projects that stockpile soil and other loose materials.

Limitations

- Plastic sheeting as a stockpile protection is temporary and hard to manage in windy conditions. Where plastic is used, consider use of plastic tarps with nylon reinforcement which may be more durable than standard sheeting.
- Plastic sheeting can increase runoff volume due to lack of infiltration and potentially cause perimeter control failure.
- Plastic sheeting breaks down faster in sunlight.
- The use of Plastic materials and photodegradable plastics should be avoided.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

- On larger sites, a minimum of 50 ft separation from concentrated flows of stormwater, drainage courses, and inlets is recommended.
- All stockpiles are required to be protected immediately if they are not scheduled to be used within 14 days.
- Protect all stockpiles from stormwater runon using temporary perimeter sediment barriers such as compost berms (SE-13), temporary silt dikes (SE-12), fiber rolls (SE-5), silt fences (SE-1), sandbags (SE-8), gravel bags (SE-6), or biofilter bags (SE-14). Refer to the individual fact sheet for each of these controls for installation information.
- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.
- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Some plastic covers withstand weather and sunlight better than others. Select cover materials or methods based on anticipated duration of use.

Protection of Non-Active Stockpiles

Non-active stockpiles of the identified materials should be protected further as follows:

Soil stockpiles

- Soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- Temporary vegetation should be considered for topsoil piles that will be stockpiled for extended periods.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- Stockpiles should be covered and protected with a temporary perimeter sediment barrier at all times.

Stockpiles of "cold mix"

- Cold mix stockpiles should be placed on and covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Stockpiles of fly ash, stucco, hydrated lime

- Stockpiles of materials that may raise the pH of runoff (i.e., basic materials) should be covered with plastic and surrounded by a berm.

Stockpiles/Storage of wood (Pressure treated with chromated copper arsenate or ammoniacal copper zinc arsenate

- Treated wood should be covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Protection of Active Stockpiles

Active stockpiles of the identified materials should be protected as follows:

- All stockpiles should be covered and protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" and treated wood, and basic materials should be placed on and covered with plastic sheeting or comparable material and surrounded by a berm prior to the onset of precipitation.
- The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm and runoff should be diverted around or away from the stockpile on the upstream perimeter.

Costs

For cost information associated with stockpile protection refer to the individual erosion or sediment control BMP fact sheet considered for implementation (For example, refer to SE-1 Silt Fence for installation of silt fence around the perimeter of a stockpile.)

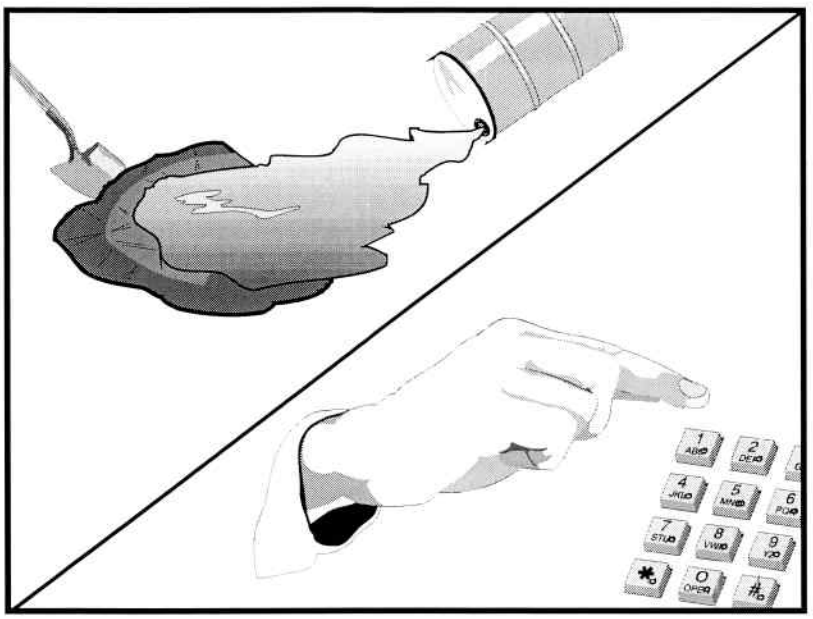
Inspection and Maintenance

- Stockpiles must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during certain conditions (for example, high winds or extreme heat).
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.
- Sediment shall be removed when it reaches one-third of the barrier height.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Spill Prevention and Control WM-4



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

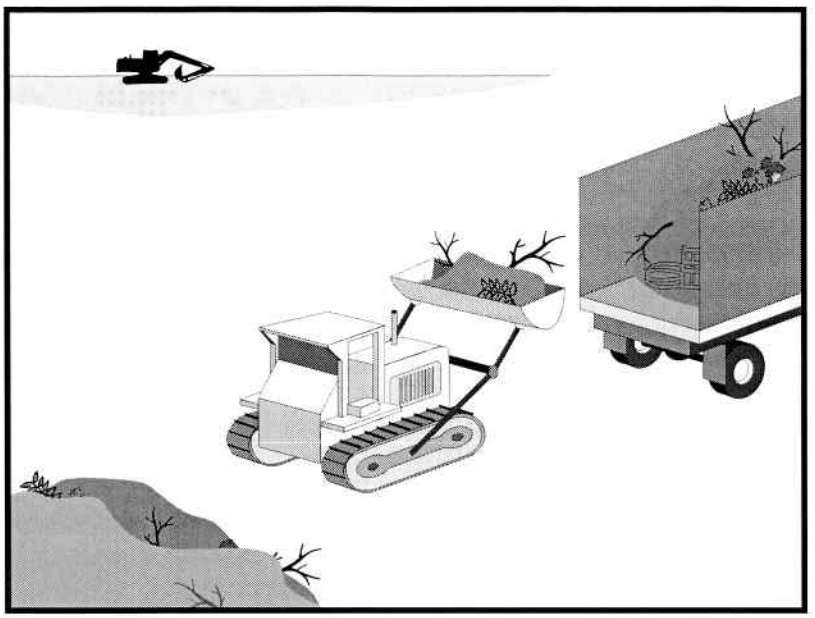
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials
- Highway planting wastes, including vegetative material,

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Inspect construction waste area regularly.
- Arrange for regular waste collection.

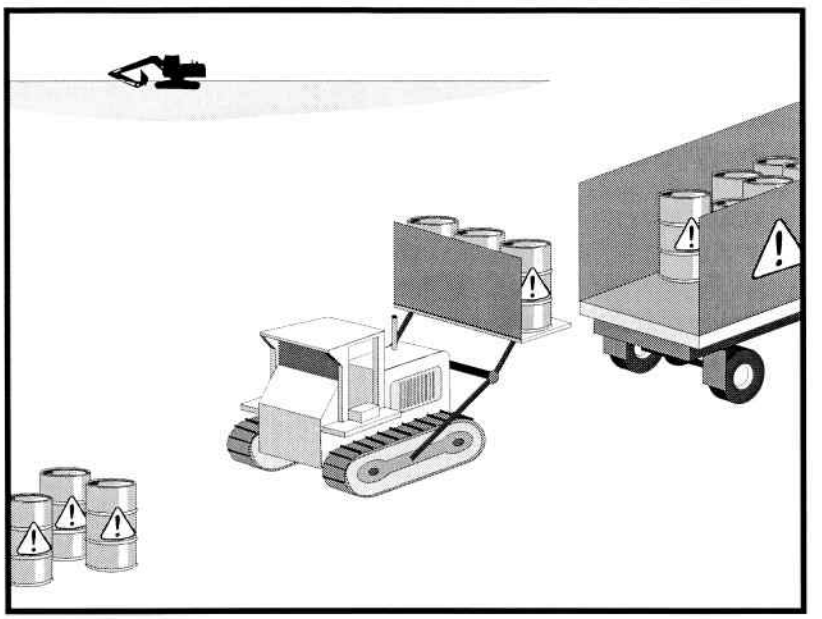
References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Hazardous Waste Management WM-6



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Concrete Curing Compounds
- Palliatives
- Septic Wastes
- Stains
- Wood Preservatives
- Asphalt Products
- Pesticides
- Acids
- Paints
- Solvents
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

Material Use

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.
- Unless watertight, containers of dry waste should be stored on pallets.
- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.
- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.
- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.
- The following actions should be taken with respect to temporary contaminant:
  - Ensure that adequate hazardous waste storage volume is available.
  - Ensure that hazardous waste collection containers are conveniently located.
  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
  - Minimize production or generation of hazardous materials and hazardous waste on the job site.
  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.
  - Segregate potentially hazardous waste from non-hazardous construction site debris.
  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

Waste Recycling Disposal

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

Disposal Procedures

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.
- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.

- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

References

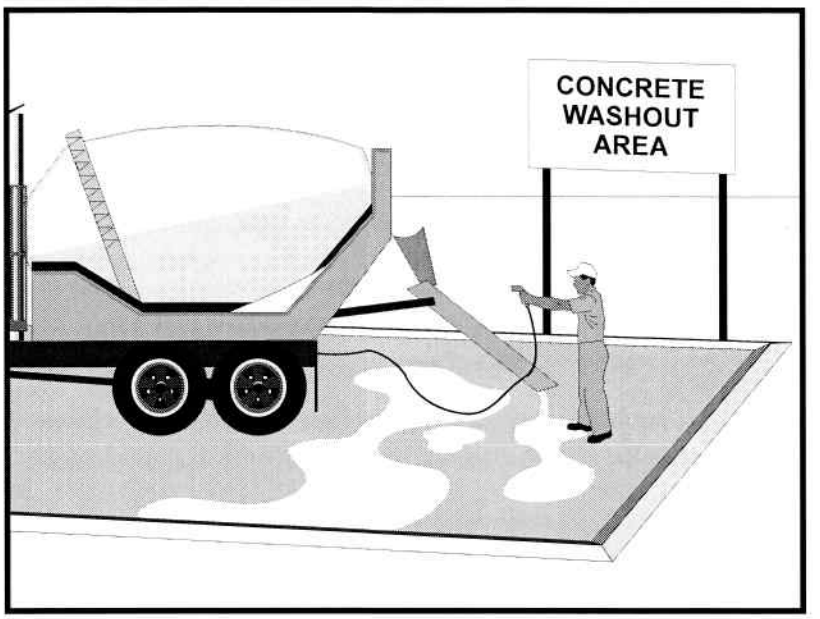
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Concrete Waste Management WM-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area, and by employee and subcontractor training.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials, including mortar, concrete, stucco, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows and raising pH to levels outside the accepted range.

Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing portland cement concrete (PCC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Concrete trucks and other concrete-coated equipment are washed onsite.
- Mortar-mixing stations exist.
- Stucco mixing and spraying .
- See also NS-8, Vehicle and Equipment Cleaning.

Limitations

- Offsite washout of concrete wastes may not always be possible.
- Multiple washouts may be needed to assure adequate capacity and to allow for evaporation.

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas. Refer to WM-1, Material Delivery and Storage for more information.
- Avoid mixing excess amounts of concrete.
- Perform washout of concrete trucks in designated areas only, where washout will not reach stormwater.
- Do not wash out concrete trucks into storm drains, open ditches, streets, streams or onto the ground. Trucks should always be washed out into designated facilities.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - On larger sites, it is recommended to locate washout areas at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Washout wastes into the temporary washout where the concrete can set, be broken up, and then disposed properly.
  - Washout should be lined so there is no discharge into the underlying soil.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- See typical concrete washout installation details at the end of this fact sheet.

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.

- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.
- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.

Concrete Demolition Wastes

- Stockpile concrete demolition waste in accordance with BMP WM-3, Stockpile Management.
- Dispose of or recycle hardened concrete waste in accordance with applicable federal, state or local regulations.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below).
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut concrete slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine or by sweeping. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Concrete slurry residue should be disposed in a temporary washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Temporary washout facilities should be lined to prevent discharge to the underlying ground or surrounding area.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of or recycled offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of or recycle hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft; however, smaller sites or jobs may only need a smaller washout facility. With any washout, always maintain a sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
  - Materials used to construct the washout area should conform to the provisions detailed in their respective BMPs (e.g., SE-8 Sandbag Barrier).
  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
  - Alternatively, portable removable containers can be used as above grade concrete washouts. Also called a "roll-off"; this concrete washout facility should be properly sealed to prevent leakage, and should be removed from the site and replaced when the container reaches 75% capacity.
- Temporary Concrete Washout Facility (Type Below Grade)
  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.
  - Lath and flagging should be commercial type.
  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- The base of a washout facility should be free of rock or debris that may damage a plastic liner.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and properly disposed or recycled in accordance with federal, state or local regulations. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and properly disposed or recycled in accordance with federal, state or local regulations..

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

Costs

All of the above are low cost measures. Roll-off concrete washout facilities can be more costly than other measures due to removal and replacement; however, provide a cleaner alternative to traditional washouts. The type of washout facility, size, and availability of materials will determine the cost of the washout.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and properly disposed or recycled in accordance with federal, state or local regulations.

- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

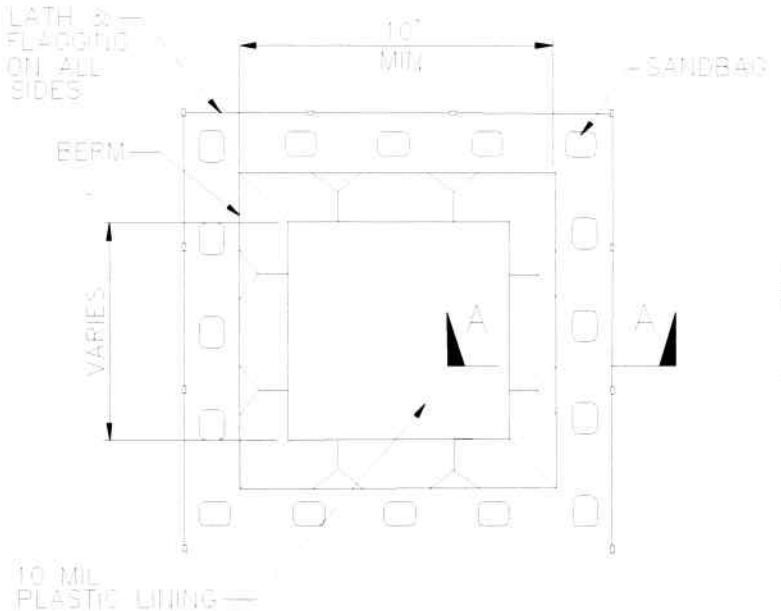
- Inspect washout facilities for damage (e.g. torn liner, evidence of leaks, signage, etc.). Repair all identified damage.

References

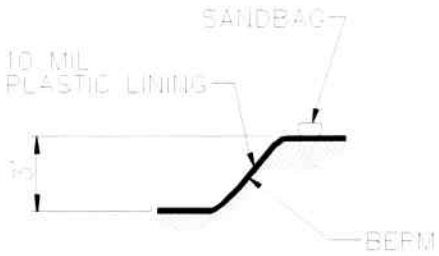
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000, Updated March 2003.

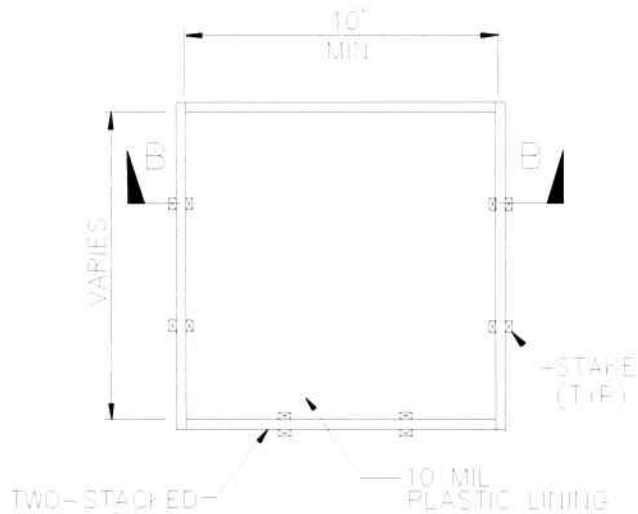
Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



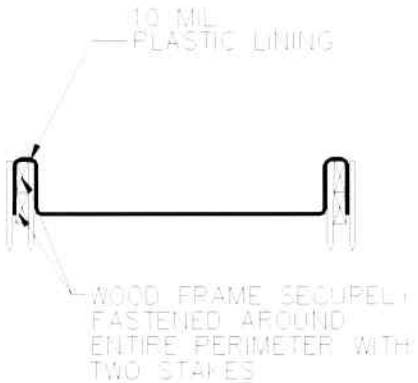
PLAN
NOT TO SCALE
TYPE "BELOW GRADE"



SECTION A–A
NOT TO SCALE



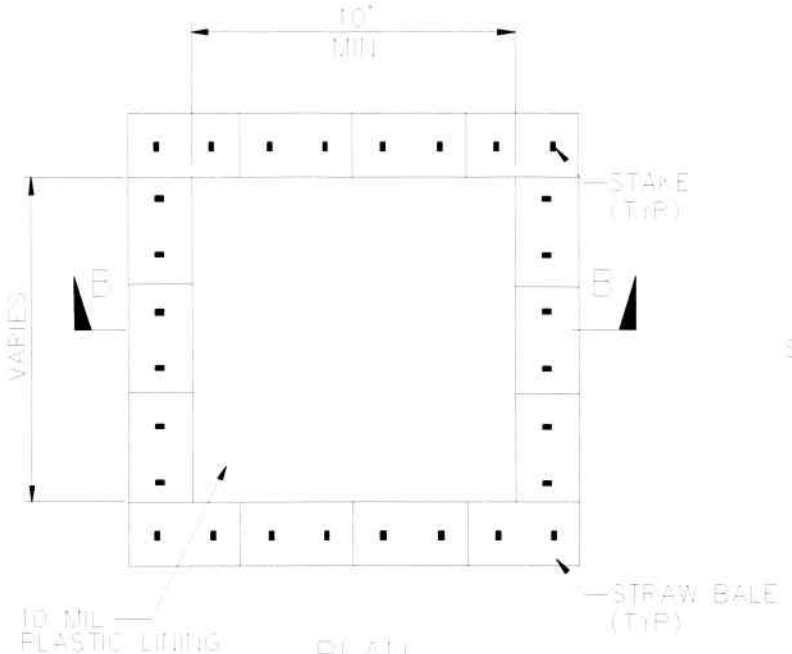
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



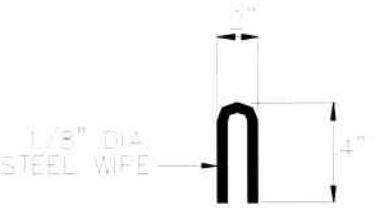
SECTION B–B
NOT TO SCALE

NOTES

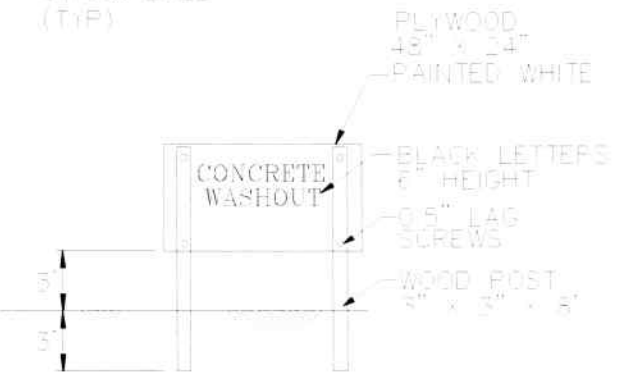
1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



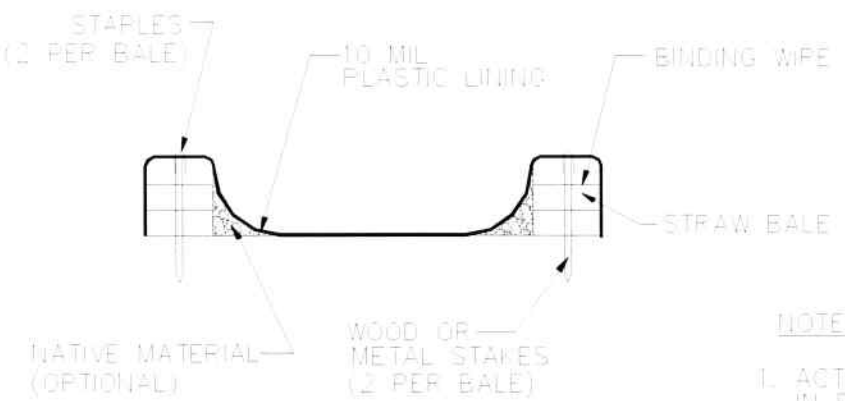
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES



STAPLE DETAIL



CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

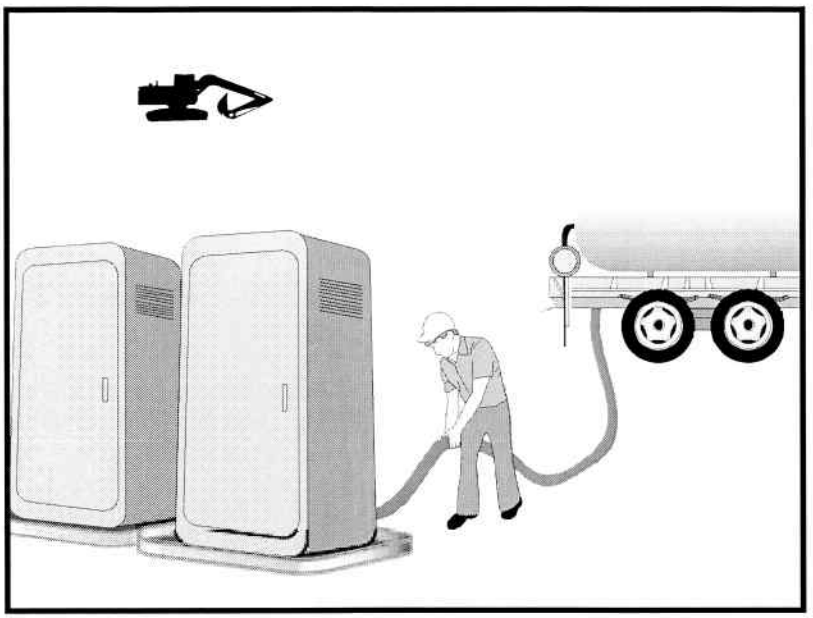


SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Sanitary/Septic Waste Management WM-9



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents	
Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	☑
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

Limitations

None identified.

Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. If site conditions allow, place portable facilities a minimum of 50 feet from drainage conveyances and traffic areas. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Temporary sanitary facilities must be equipped with containment to prevent discharge of pollutants to the stormwater drainage system of the receiving water.
- Consider safety as well as environmental implications before placing temporary sanitary facilities.
- Wastewater should not be discharged or buried within the project site.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.
- If a spill does occur from a temporary sanitary facility, follow federal, state and local regulations for containment and clean-up.

Education

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce the use of sanitary facilities (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

Costs

All of the above are low cost measures.

Inspection and Maintenance

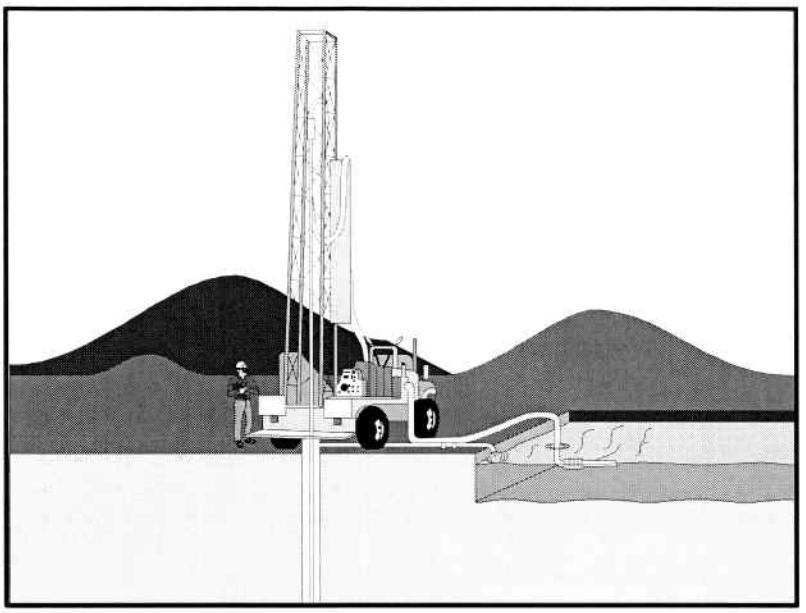
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.
- If spills or leaks from sanitary or septic facilities occur that are not contained and discharge from the site, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Liquid Waste Management WM-10



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous wastes (WM-6, Hazardous Waste Management), or concrete slurry residue (WM-8, Concrete Waste

Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

Implementation

General Practices

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.
- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.
- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

Containing Liquid Wastes

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.
- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.
- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.
- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.
- Containment devices must be structurally sound and leak free.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

Capturing Liquid Wastes

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

Disposing of Liquid Wastes

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.
- Inspect containment areas and capturing devices and repair as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Appendix I
Authorized Inspection Individuals

Authorized Inspection Individuals

The QSD (or designee) will maintain a list of authorized inspection individuals for the SWPPP (Appendix I), including the QSD and the QSP. Include a copy of all training certificates or other verification of training.

Date	Name	Phone Number	Date of Training	Name and Date of Training Certificate	Description of Role on Project

Name	Phone	Phone Number	Address	Emergency Contact Information (name and ph.)	Description of Work

Appendix J
Construction Site Inspection Report Forms

Risk Level 1, 2, 3
Visual Inspection Field Log Sheet

Date and Time of Inspection:	Report Date:

Inspection Type:	☐ Weekly	☐ Before predicted rain	☐ During rain event	☐ Following qualifying rain event	☐ Contained stormwater release	☐ Quarterly non-stormwater

Site Information

Construction Site Name:	
Construction stage and completed activities:	Approximate area of exposed site:

Weather and Observations

Date Rain Predicted to Occur:	Predicted % chance of rain:

Estimate storm beginning: _____ (date and time)	Estimate storm duration:_____ (hours)	Estimate time since last storm: _____ (days or hours)	Rain gauge reading: _____ (inches)

Observations: If yes identify location		
Odors	Yes ☐	No ☐
Floating material	Yes ☐	No ☐
Suspended Material	Yes ☐	No ☐
Sheen	Yes ☐	No ☐
Discolorations	Yes ☐	No ☐
Turbidity	Yes ☐	No ☐

Site Inspections

Outfalls or BMPs Evaluated	Deficiencies Noted
(add additional sheets or attached detailed BMP Inspection Checklists)	

Photos Taken:	Yes ☐	No ☐	Photo Reference IDs:

Corrective Actions Identified (note if SWPPP/REAP change is needed)

Inspector Information

Inspector Name:	Inspector Title:
Signature:	Date:

Appendix K
Training Reporting Form

Training Reporting Form

Storm Water Management Training Log

Project Name: _____

Project Number/Location: _____

Storm Water Management Topic: (check as appropriate)

- ❑ Erosion Control
- ❑ Sediment Control
- ❑ Wind Erosion Control
- ❑ Tracking Control
- ❑ Non-storm water management
- ❑ Waste Management and Materials Pollution Control
- ❑ Storm Water Sampling

Specific Training Objective: _____

Location: _____ Date: _____

Instructor: _____ Telephone: _____

Course Length (hours): _____

Attendee Roster (attach additional forms if necessary)

Name	Company	Phone

Name	Company	Phone

COMMENTS:

Appendix L
Responsible Parties

Responsible Parties

Include in this Section:

Name of Approved Signatory or LRP (Legally Responsible Person)

Copy of the written agreement or other mechanism that provides this authority from the LRP.

Appendix M
Contractors and Subcontractors

Contractors and Subcontractors

The General Permit requires (Section VII.B.5) that the SWPPP include a list of names of all contractors, subcontractors, and individuals who will be directed by the QSP.

Contents of the list include telephone numbers, work addresses, and the specific areas of responsibility for each contractor, and emergency contact numbers. Section 6.2.

Name	Phone	Address	Emergency Contact Information (name and ph.)	Description of Work

Name	Phone	Address	Emergency Contact Information (name and ph.)	Description of Work

Appendix N
Construction Site Monitoring Program

Draft

Oakley Generation Station Project (09-AFC-4)

Construction Site Monitoring Program

Prepared for

February 2010

CH2MHILL
2485 Natomas Park Drive
Sacramento, California 95833

Contents

Section **Page**

Construction Site Monitoring Program Oakley Generating Station.....1
1.0 Purpose.....1
2.0 Applicability of Permit Requirements.....1
2.1 Qualifying Storm Event.....1
3.0 Monitoring Locations.....1
4.0 Safety.....2
5.0 Visual Monitoring (Inspection).....2
5.1 BMP Inspections.....2
5.2 Qualifying Rain Event Inspections.....2
5.3 Pre-Rain Event Inspection.....2
5.4 Post-Rain Event Inspection.....3
5.5 Non-Stormwater Discharges Inspections.....3
6.0 Water Quality Sampling and Analysis.....4
6.1 Non-Visible Pollutants.....4
6.2 Sample Collection and Handling.....4
6.3 Analytical Methods.....6
7.0 Watershed Monitoring Option.....8
8.0 Quality Assurance/Quality Control.....8
8.1 Field Logs.....8
9.0 Reporting and Records Retention.....10
9.1 Annual Report.....10
9.2 Records Retention.....11

Table

1 Potential Non-visible Pollutants Based on Common Construction Activities

Figure

1 CSMP Sampling and Observation Locations

Attachment

Field Log

Construction Site Monitoring Program
Oakley Generating Station

1.0 Purpose

The General Permit requires that all construction projects develop and implement a site-specific Construction Site Monitoring Plan prior to the commencement of construction activities, and be revised as necessary to reflect project revisions. The CSMP must be a part of the SWPPP. The CSMP must include the monitoring procedures and instructions, location maps, form, and checklists necessary to implement the visual and water quality monitoring for the site.

2.0 Applicability of Permit Requirements

The OGS CSMP is designed to meet the specific requirements and objectives identified in the General Permit for Risk Level 1 sites. These requirements are described in the following sections.

Each construction site must have a Qualified SWPPP Practitioner (QSP) to oversee the implementation of the CSMP including the BMP inspections, rain-event triggered inspections, and the collection of water quality samples. The QSP may delegate any or all of these activities to an employee trained to do the task(s) but the QSP must supervise the delegated tasks. Monitoring at the OGS site includes visual monitoring (inspections) and sampling and analysis.

2.1 Qualifying Storm Event

Any event that produces 0.5 inches or more precipitation with a 48 hour or greater period between rain events is considered a qualifying storm event.

3.0 Monitoring Locations

Figure 1 shows the locations of potential sampling and observation points within the Project Site. These locations are typically located in low-lying areas, upslope of the wetlands, yet down slope of potential areas that may discharge non-visible pollutants and sediment. Sampling of wetlands shall occur throughout the entire construction period. A sampling point located near the temporary bioswale in the laydown area is also delineated and will be monitored and sampled as required during construction activities. These locations will be verified in the field prior to sampling events and may change due to field conditions. Any changes will be documented in the Amendment Section of the SWPPP (Appendix C) and this CSMP. Sampling points along the linear utility line will be specified as site plans are developed.

4.0 Safety

If the construction site is safely accessible during inclement weather, the monitor shall list the observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-stormwater controls. If inclement weather presents a safety hazard, at a minimum, the inspector will list the results of visual inspections at all relevant outfalls, discharge points, downstream locations, and identify any projected post-rain event maintenance activities.

5.0 Visual Monitoring (Inspection)

All sites (Risk Levels 1, 2, and 3) are required to conduct visual monitoring (inspections). Visual monitoring includes inspections of BMPs, inspections before and after qualifying rain events, and inspection for non-stormwater discharges. Visual inspections are required for the duration of the project with the goal of confirming that appropriately selected BMPs have been implemented, are being maintained, and are effective in preventing potential pollutants from coming in contact with stormwater.

5.1 BMP Inspections

The General Permit requires that BMPs be inspected weekly and once each 24-hour period during extended storm events. The purpose of these inspections is to identify BMPs that need maintenance to operate effectively, have failed, or could fail to operate as intended. If deficiencies are identified during BMP inspections, repairs or design changes to BMPs must be initiated within 72 hours of identification and need to be completed as soon as possible.

All BMP inspections will be documented on the inspection checklist located in the Attachment. This form will be supplemented with the Construction Site Inspection Report Forms located in Appendix J of the SWPPP.

5.2 Qualifying Rain Event Inspections

The construction site will be inspected within two days prior to a predicted qualifying rain event is and within two days after a qualifying rain event. These inspections are only required during normal business hours of the construction site. The General Permit requires that dischargers only use weather forecasts from the National Oceanographic and Atmospheric Administration (NOAA). Pre-project inspections should be initiated after consulting NOAA for a qualifying rain event with 50 percent or greater probability of precipitation (PoP). These forecasts can be obtained at http://www.srh.noaa.gov/. Rain event records will be recorded in the Visual Inspection Field Log (see Attachment).

5.3 Pre-Rain Event Inspection

The purpose of the pre-rain event inspection is to make sure the site and the BMPs are ready for the predicted rain. The pre-rain event inspection includes the following information:

- All stormwater drainage areas to identify any spills, leaks, or uncontrolled pollutant sources
- All BMPs to identify whether they have been properly implemented per the SWPPP

- Stormwater storage and containment areas to detect leaks and ensure maintenance of adequate freeboard
- The presence or absence of floating and suspended materials, a sheen on the surface
- Discolorations, turbidity, odors, and source(s) of any observed pollutants within stored stormwater

5.4 Post-Rain Event Inspection

The purpose of the post-rain event inspection is to observe the discharge locations and the discharge of any stored or contained rainwater; determine if BMPs functioned as designed; and identify if any additional BMPs are required. The post-rain event inspection includes the following information:

- All stormwater discharge locations.
- The discharge of stored or contained stormwater that is derived from and discharged subsequent to a qualifying rain event.
- All BMPs to determine if they were adequately designed, implemented, and effective. After assessing BMPs it should be noted on the inspection form whether the BMPs need maintenance.

5.5 Non-Stormwater Discharges Inspections

The General Permit requires that construction sites, regardless of risk level, be inspected quarterly for the presence of non-stormwater discharges. Records must be kept of all inspections and must be maintained on site. Non-stormwater discharge inspections are only required during normal business hours of the construction site. The purpose of these inspections is to detect unauthorized non-stormwater discharges and observe authorized non-stormwater discharges. Quarterly inspections need to include each drainage area of the project and document the following information:

- Presence or indications of unauthorized and authorized non-stormwater discharges and their sources
- Pollutant characteristics of the non-stormwater discharge (floating and suspended)
- Material, sheen, discoloration, turbidity, odor, etc
- Personnel performing the observations
- Dates and approximate time each drainage area and non-stormwater discharge was observed
- Response taken to observations

Quarterly inspections will be recorded on the Visual Inspection Field Log Sheet located in the Attachment.

6.0 Water Quality Sampling and Analysis

Risk Level 1 projects are only required to collect water quality samples if there is a BMP breach, malfunction, leakage, or spill. Water quality samples will be taken for nonvisible pollutants that may have been discharged from the site.

6.1 Non-Visible Pollutants

Monitoring for pollutants not visually detectable is only required if those pollutants are determined to be potentially present in stormwater leaving the construction site; and is typically the result of a BMP failure or spill on the construction site. This determination is documented in the pollutant source assessment in the SWPPP.

Projects should attempt to eliminate the exposure of construction materials to prevent stormwater pollution and limit sampling and analysis requirements. It is important to note that covered construction materials or those that are in their final constructed form, do not need to be monitored. Materials that are stored exposed to precipitation and may generate runoff need to be considered for non-visible pollutant monitoring.

Non-visible pollutants may also exist on the project site as a result of the land use prior to the start of the construction activity and will be monitored for non-visible polluting. A significant soil characteristic concerning the proposed 20-acre laydown area is the presence of waste titanium dioxide. A portion of this area was historically used for disposal of titanium dioxide waste during manufacturing operations at the DuPont facilities. Titanium dioxide (TiO_2) is an inert mineral pigment primarily used in paints, paper, and plastics, and is produced by reacting the mineral rutile, removing impurities, and oxidizing to TiO_2, a very fine pure white powder (DuPont, 2003). During active manufacturing at the DuPont facility, the proposed laydown area was a TiO_2 landfill that was used for disposal of spent ore from the TiO_2 process after being acid-leached and settling in retention basins (DuPont, 2003). This material is estimated to be approximately 3 feet thick (DuPont, 2006); thus, soil material that is present in this area likely does not reflect characteristics of mapped soils. The fill material is not expected to present a human health or wildlife risk (DuPont, 2006).

6.2 Sample Collection and Handling

It is important to use the correct methods to collect and handle samples to ensure the samples are valid. While the handling requirements apply primarily to grab samples collected for laboratory analysis, field measurements can be affected by sample collection procedures.

The General Permit requires dischargers to designate and train personnel to collect, maintain, and ship water quality samples in accordance with the *Surface Water Ambient Monitoring Program (SWAMP) 2008 Quality Assurance Program Plan (QAPrP)*, which is available at http://www.swrcb.ca.gov/water_issues/programs/swamp/tools.shtml#qa.

Sampling methods, handling procedures, and locations should be identified in advance of the sampling event in order to provide sufficient time to gather the supplies and equipment necessary to sample and plan for safe access by the sampling crew(s).

Adherence to SWAMP sampling guidance and proper development of a sampling plan provides for consistent, reproducible, and accurate results. Design of the field sampling procedures should carefully consider contamination potential from sample location (e.g., sediment disturbances, equipment exhaust), sampling techniques, and sample handling.

The following "clean technique" approach and protocol will be used when sampling at the OGS site:

- Samples (for laboratory analysis) are collected only in analytical laboratory-provided sample containers
- Clean, powder-free nitrile gloves should be worn for collection of samples
- Gloves are changed whenever something not known to be clean has been touched
- Decontaminate all equipment (e.g. bucket, tubing) except laboratory provided sample containers, prior to sample collection using a trisodium phosphate (TSP)-soapy water wash, distilled water rinse, and final rinse with distilled water. (Dispose of wash and rinse water appropriately, i.e., do not discharge to storm drain or receiving water)
- To reduce potential contamination, sample collection personnel must adhere to the following rules while collecting samples:
  - No smoking
  - Never sample near a running vehicle
  - Do not park vehicles in the immediate sample collection area (even non-running vehicles)
  - Do not eat or drink during sample collection
  - Do not breathe, sneeze, or cough in the direction of an open sample container

Water quality samples should be collected in appropriate sample containers and be of adequate volume to conduct the required measurements or laboratory analyses. The most important aspect of grab sampling is to make sure that the sample best represents the entire runoff stream. Typically, samples are collected by dipping the collection container in the runoff flow paths and streams as noted below.

i. For small streams and flow paths, simply dip the bottle facing upstream until full.

ii. For larger stream that can be safely accessed, collect a sample in the middle of the flow stream by directly dipping the mouth of the bottle. Once again making sure that the opening of the bottle is facing upstream as to avoid any contamination by the sampler.

iii. Avoid collecting samples from ponded, sluggish or stagnant water.

All samples must be maintained between 0-6 degrees Celsius during delivery to the laboratory. Samples must be kept on ice, or refrigerated, from sample collection through delivery to the laboratory. Shipped samples should be placed inside coolers with ice. Make sure the sample bottles are well packaged to prevent breakage and secure cooler lids with packaging tape. Ship samples that will be laboratory analyzed to the analytical laboratory right away. Many analytical methods have short hold-times before which the analysis must be started. Hold times are measured from the time the sample is collected to the time the

sample is analyzed. The General Permit requires that samples be received by the analytical laboratory within 48 hours of the physical sampling (unless otherwise required by the analytical laboratory).

Collect proper information regarding time and sampling conditions, appropriately label the bottles, and fill out the required chain of custody forms and field logs.

6.3 Analytical Methods

All laboratory analyses must be conducted according to analytical procedures specified in 40 Code of Federal Regulations (CFR) Part 136, unless other analytical procedures have been specified in the General Permit or by the RWQCB. With the exception of field analyses conducted by the discharger for turbidity and pH, all analyses must be sent to and conducted by a state-certified analytical laboratory. Currently, the SSC method is not state certified and a limited number of laboratories have the capability of doing this analysis.

Analytical laboratories should be contacted and a contract should be worked out before the wet season to minimize potential disruptions during the critical sampling period. A laboratory should be chosen foremost by their accreditation, ability to perform the required samples in the desired turn-around-time, and then by their proximity for ease of sample delivery. Although with overnight mail delivery, proximity is less important, it may still be an important factor to avoid bottle breakage during shipment.

State-certified analytical laboratories can be found by using the Environmental Laboratory Accreditation Program's (ELAP) website at:
http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx.

Non-visible pollutants may include a wide range of analytical methods. A list of potential nonvisible pollutants based on common construction activities is shown in Table 1. This list is not meant to be inclusive but to provide general guidance for projects. Consult with the analytical laboratory or 40 CFR Part 136 to identify specific analytical methods, sample volume, and containers needed for the expected non-visible pollutants.

Dischargers can perform pH analysis on site with a calibrated pH meter, or pH test kit. Dischargers can perform turbidity analysis using a calibrated turbidity meter (turbidimeter), either on site or at an accredited analytical laboratory. Many manufacturers offer single parameter meters or multiple parameter meters with various optional probes. Dischargers will need to determine the best type of meter for their individual situation. Any meter selected for field monitoring should have the ability to be calibrated, be accompanied by detailed operation instructions, and should be ruggedly designed for field use and long term storage (you are unlikely to need it during the dry season).

TABLE 1
Potential Non-visible Pollutants Based on Common Construction Activities

Activity	Potential Pollutant Source	Laboratory Analysis
Water line flushing	Chlorinated water	Residual chlorine
Portable toilets	Bacteria, disinfectants	Total/fecal coliform
Concrete & Masonry	Acid wash	pH
Curing compounds		
pH, alkalinity,		
Volatile organic compounds (VOCs)		
Concrete rinse water		pH
Painting	Resins	Semi-volatile organic compounds (SVOCs)
Thinners	Phenols, VOCs	
Paint Strippers	VOCs	
Solvents	Phenols, VOCs	
Adhesives	Phenols, SVOCs	
Sealants	SVOCs	
Methylene Blue Activated Substances (MBAS),		
phosphates		
Cleaning	Detergents	
Bleaches	Residual chlorine	
Solvents	VOCs	
Landscaping	Pesticides/Herbicides	Check with analytical laboratory
Fertilizers	$NO_3/NH_3/P$	
Lime and gypsum	Acidity/alkalinity	
Aluminum sulfate, sulfur	Total dissolved solids (TDS), alkalinity	
Treated wood	Copper, arsenic, selenium	Metals
Soil amendments &		
dust control		
Lime, gypsum		pH
Plant gums	Biochemical oxygen demand (BOD)	
Magnesium chloride	Alkalinity, TDS	
Calcium chloride	Alkalinity, TDS	
Natural brines	Alkalinity, TDS	
Lignosulfonates	Alkalinity, TDS	

Hach, Hydrolab, Global Water, Fisher Scientific, and LaMott are some known manufacturers and/or vendors of turbidity and pH meters. Whichever turbidimeter is selected, it is important to use the same meter; different meters may have different results even if properly calibrated. If you need to use several turbidimeters, then assign to each meter to a specific location.

Dischargers utilizing a sediment basin are required to conduct a soil particle analysis.

Dischargers may also want to conduct this analysis to establish site-specific particle size information, which can be used to justify the project risk level using RUSLE. (The particle size analysis provides the K factor.) The soil particle analysis is conducted using the American Society for Testing and Materials (ASTM) test method ASTM D-422 (Standard Test Method for Particle-Size Analysis of Soils), as revised, to determine the percentages of sand, very fine sand, silt, and clay on the site. The percentages of particles less than 0.02 mm in diameter must also be determined. This analysis is conducted before construction starts and is reported with the Permit Registration Documents (PRDs).

Dischargers are not required to physically collect samples or conduct visual observations during dangerous weather conditions (flooding, electrical storms, etc.) or outside of scheduled construction site business hours. An explanation must be provided in the Annual Report if a project was unable to collect required samples or visual observations because of dangerous weather conditions.

7.0 Watershed Monitoring Option

This option does not apply to the OGS site.

8.0 Quality Assurance/Quality Control

An effective QA/QC plan will be implemented as part of the CSMP to ensure that analytical data can be used with confidence. QA/QC procedures to be initiated include the following:

- Field logs
- Clean sampling techniques
- Sample Chains of Custody (COCs)
- Data verification

Each of these procedures is discussed in more detail in the following sections.

8.1 Field Logs

The purpose of field logs is to record sampling information and field observations during monitoring that may explain any uncharacteristic analytical results. Sampling information to be included in the field log include the date and time of water quality sample collection, sampling personnel, sample container identification numbers, and types of samples that were collected. Field observations should be noted in the field log for any abnormalities at the sampling location (color, odor, BMPs, etc.). Field measurements for pH and turbidity should also be recorded in the field log. The field log is located in the Attachment.

Clean Sampling Techniques

Clean sampling techniques involve the use of certified clean containers for sample collection and clean powder-free nitrile gloves during sample collection and handling. As discussed previously, adoption of a clean sampling approach will minimize the chance of field contamination and questionable data results.

Sample Chain-of-Custody

The sample COC is an important documentation step that tracks samples from collection through analysis to ensure the validity of the sample. Sample COC procedures include the following:

- Proper labeling of samples;
- Use of COC forms for all samples; and
- Prompt sample delivery to the analytical laboratory.

Analytical laboratories usually provide COC forms to be filled out for sample containers.

Data Verification- sampling

After analytical results are received from the analytical laboratory, the data should be verified to ensure that it is complete, accurate, and the appropriate QA/QC requirements were met. Data should be verified as soon as the data reports are received.

The COC and laboratory reports need to be checked to make sure all requested analysis were performed and all samples are accounted for in the reports. Laboratory reports will be checked to make sure hold times were met and that the reporting levels meet or are lower than the reporting levels agreed to in the contract. Date will be checked for outlier values and will be followed up with the laboratory. Occasionally typographical errors, unit reporting errors, or incomplete results are reported and should be easily detected. These errors need to be identified, clarified, and corrected quickly by the laboratory. Attention should be paid to data that is an order of magnitude or more different than similar locations, or is inconsistent with previous data from the same location.

For laboratory analyses, EPA establishes QA/QC checks and acceptable criteria. These data are typically reported along with the sample results. Data reviewers should evaluate the reported QA/QC data to check for contamination (look at method, field, and equipment blanks), precision (laboratory matrix spike duplicates), and accuracy (matrix spikes and laboratory control samples). When QA/QC checks are outside acceptable ranges, the laboratory must flag the data, and usually provides an explanation of the potential impact to the sample results.

The data set will be checked for outlier values and, accordingly, results will be confirmed, and samples re-analyzed where appropriate. Sample re-analysis will only be undertaken when it appears that some part of the QA/QC resulted in a value out of the expected range. Initial data, even if outside the expected range may not be discounted unless the analytical laboratory identifies the required QA/QC criteria were not met. If this occurs, the project should obtain a written statement from the analytical laboratory regarding the validity of the sample result.

Similarly, field data needs to be checked as soon as possible to identify potential errors. Reported data and observations should be verified to ensure that it is complete and accurate and as soon as the field logs are received. Field logs should be checked to make sure all required measurements were completed and appropriately documented. Crews may occasionally miss-record a value. Reported values that appear out of the typical range or inconsistent, should be followed up on immediately to identify potential reporting or equipment problems. Equipment calibration notations should be verified for outlier data, and if appropriate equipment calibrations should be checked after sampling. Observations noted on the field logs can also help to identify potential interferences. Notations should be made of any errors and actions taken to correct the equipment or recording errors.

When using a field meter it is important to record the value and then make note of any possible meter failures or interferences that could have led to an exceedance. Some possible instrument problems may include the need to recalibrate; the need to replace the battery; problems with the sample container (such as scratches on glass or plastic optical sample cells or particles on the outside of the optical sample cells); or fouled probes.

9.0 Reporting and Records Retention

9.1 Annual Report

All dischargers are required to prepare and electronically submit an Annual Report no later than September 1 each year. The Annual Reports must be certified in accordance with the Special Provisions in the General Permit. The Annual Report must include the following stormwater monitoring information:

- A summary and evaluation of all sampling and analysis results, including original laboratory reports
- The analytical method(s), method reporting unit(s), and MDL(s) of each analytical parameter (analytical results that are less than the MDL must be reported as “less than the MDL” or “<MDL”)
- A summary of all corrective actions taken during the compliance year
- Identification of any compliance activities or corrective actions that were not implemented
- A summary of all violations of the General Permit
- The individual(s) who performed facility inspections, sampling, visual observation (inspections), and/or measurements
- The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation (rain gauge)
- The visual observations and sample collection exception records and reports

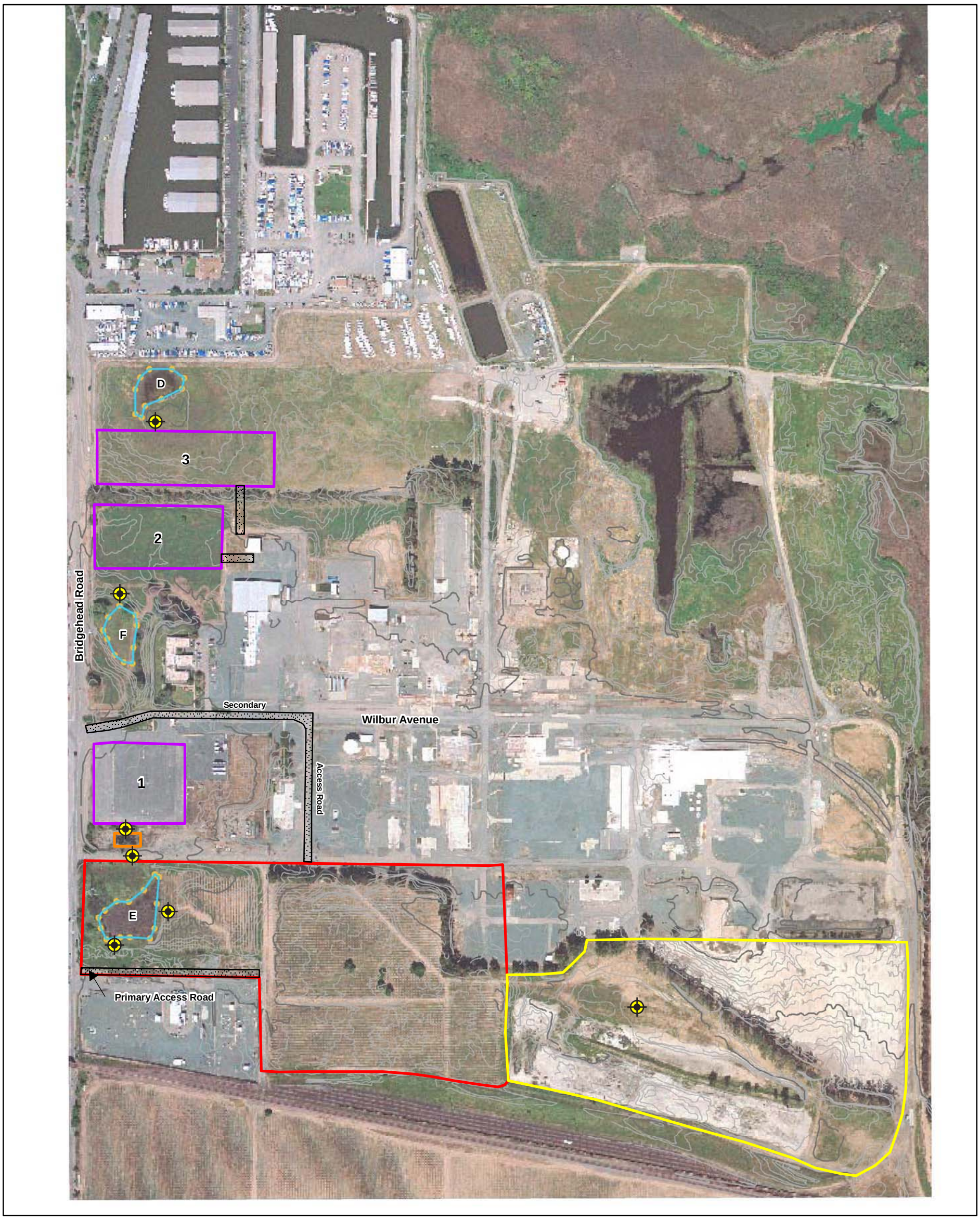
9.2 Records Retention

Dischargers must retain records of all stormwater monitoring information and copies of all reports (including Annual Reports) for a period of at least three years from date of submittal or longer if required by the RWQCB. ATS dischargers must retain all records for three years after the completion of the construction project. Records are to be kept on site while construction is ongoing. These records include:

- The date, place, and time of facility inspections, sampling, visual observations (inspections), and/or measurements, including precipitation
- The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and/or measurements
- The date and approximate time of analyses
- The individual(s) who performed the analyses
- A summary of all analytical results from the last three years, the method detection limits and reporting limits, and the analytical techniques or methods used
- Rain gauge readings from site inspections
- QA/QC records and results
- Non-stormwater discharge inspections and visual observations (inspections) and stormwater discharge visual observation records
- Visual observation and sample collection exemption records
- NAL Exceedance Reports and NEL Violation Reports
- The records of any corrective actions and follow-up activities that resulted from analytical results, visual observations (inspections), or inspections.

Results of field measurements and laboratory analyses must be kept in the SWPPP. It is also recommended that training logs, COCs, and other documentation related to sampling and analysis be kept with the project's SWPPP.

Figure 1
CSMP Sampling and Observation Locations



LEGEND

- Wetland
- Facility Site
- Laydown Area
- Stockpiles
- Access Road
- Existing Retention Basin
- Sampling and Observation Locations

N

0 175 350
Feet

VICINITY MAP

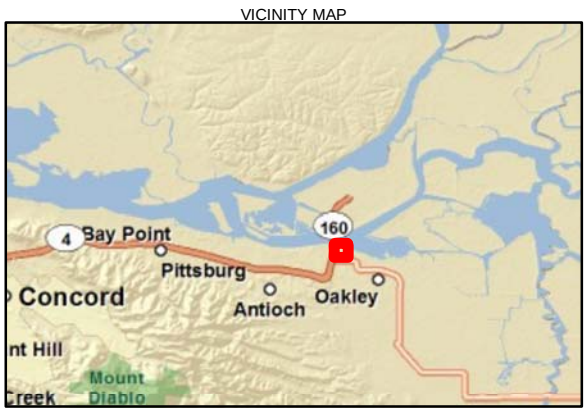


FIGURE 1
CSMP Sampling and Observation Locations
Oakley Generating Station DESCP/SWPPP
Oakley, California

CH2MHILL

\\ZION\SACGIS\PROJ\400956\15_OAKLEY\MAPFILES\FIG_PROJECTAREA.MXD JBONE 1/25/2010 10:54:12
IS012010223151SAC Figure_1.ai 02.24.2010 tdaus

Attachment
Field Log

Risk Level 1, 2, 3
Visual Inspection Field Log Sheet

Date and Time of Inspection:	Report Date:

Inspection Type:	☐ Weekly	☐ Before predicted rain	☐ During rain event	☐ Following qualifying rain event	☐ Contained stormwater release	☐ Quarterly non-stormwater

Site Information

Construction Site Name:	
Construction stage and completed activities:	Approximate area of exposed site:

Weather and Observations

Date Rain Predicted to Occur:	Predicted % chance of rain:

Estimate storm beginning: _____ (date and time)	Estimate storm duration:_____ (hours)	Estimate time since last storm: _____ (days or hours)	Rain gauge reading: _____ (inches)

Observations: If yes identify location		
Odors	Yes ☐	No ☐
Floating material	Yes ☐	No ☐
Suspended Material	Yes ☐	No ☐
Sheen	Yes ☐	No ☐
Discolorations	Yes ☐	No ☐
Turbidity	Yes ☐	No ☐

Site Inspections

Outfalls or BMPs Evaluated	**Deficiencies Noted**
(add additional sheets or attached detailed BMP Inspection Checklists)	

Photos Taken:	Yes ☐	No ☐	Photo Reference IDs:

Corrective Actions Identified (note if SWPPP/REAP change is needed)

Inspector Information

Inspector Name:	Inspector Title:
Signature:	Date:

Risk Level 2 ***Effluent Sampling Field Log Sheets***			
Construction Site Name:		Date:	Time Start:
Sampler:			
Sampling Event Type:	☐ Stormwater	☐ Non-stormwater	☐ Non-visible pollutant

Field Meter Calibration	
pH Meter ID No./Desc.: Calibration Date/Time:	Turbidity Meter ID No./Desc.: Calibration Date/Time:

Field pH and Turbidity Measurements			
Discharge Location Description	pH	Turbidity	Time

Grab Samples Collected		
Discharge Location Description	Sample Type	Time

Additional Sampling Notes:
Time End:

Risk Level 3 ***Effluent Sampling Field Log Sheets***				
Construction Site Name:		Date:		Time Start:
Sampler:				
Sampling Event Type:	☐ Stormwater	☐ Non-stormwater	☐ Non-visible pollutant	☐ Post NEL Exceedance

Field Meter Calibration	
pH Meter ID No./Desc.: Calibration Date/Time:	Turbidity Meter ID No./Desc.: Calibration Date/Time:

Field pH and Turbidity Measurements			
Discharge Location Description	pH	Turbidity	Time

Grab Samples Collected			
Discharge Location Description	SSC	Other (specify)	Time

Additional Sampling Notes:
Time End:

Risk Level 3
Receiving Water Sampling Field Log Sheets

Construction Site Name:	Date:	Time Start:
Sampler:		

Receiving Water Description and Observations

Receiving Water Name/ID:		
Observations:		
Odors	Yes ☐	No ☐
Floating material	Yes ☐	No ☐
Suspended Material	Yes ☐	No ☐
Sheen	Yes ☐	No ☐
Discolorations	Yes ☐	No ☐
Turbidity	Yes ☐	No ☐

Field Meter Calibration

pH Meter ID No./Desc.:	Turbidity Meter ID No./Desc.:
Calibration Date/Time:	Calibration Date/Time:

Field pH and Turbidity Measurements and SSC Grab Sample

Upstream Location

Type	Result	Time	Notes
pH			
Turbidity			
SSC	Collected Yes ☐ No ☐		

Downstream Location

Type	Result	Time	Notes
pH			
Turbidity			
SSC	Collected Yes ☐ No ☐		

Additional Sampling Notes:

Time End:

Appendix O
Notice of Discharge

Notice of Discharge, Written Notice, or Order

Instructions

- This form will used to report instances of discharges. The completed form will be submitted to the Project Manager within 7 days of the assessment of discharge, written notice, or orders from a regulatory agency. A report of all discharges will also be submitted to the SMARTS system.
- It is recommended that photographs (before and after the discharge) are also submitted with this report.

Notice of Discharge, Written Notice, or Order

(copy this form as needed)

To: _____ Date: _____
Project Manager

FROM: _____
QSD

Subject: Notice of Discharge

Project Name: _____

Contract Number: _____

In accordance with the NPDES Statewide Permit for Storm Water Discharges Associated with Construction Activity, the following instance of discharge is noted:

Date, time, and location of discharge.

Nature of the operation that caused the discharge.

Initial assessment of any impact cause by the discharge.

Existing BMP(s) in place prior to discharge event.

Date of deployment and type of BMPs deployed after the discharge.

Steps taken or planned to reduce, eliminate and/or prevent recurrence of the discharge.

Implementation and maintenance schedule for any affected BMPs.

SWPPP Amendments:

If further information or a modification to the above schedule is required, notify the contact person below.

Name of Contact Person	Title QSD
Company CH2M HILL	Telephone Number
Signature	Date

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION
FOR THE *OAKLEY GENERATING STATION*

Docket No. 09-AFC-4
PROOF OF SERVICE
(Revised 11/17/2010)

APPLICANT

Greg Lamberg, Sr. Vice President
RADBACK ENERGY
145 Town & Country Drive, #107
Danville, CA 94526
Greg.Lamberg@Radback.com

APPLICANT'S CONSULTANTS

Douglas Davy
CH2M HILL
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833
ddavy@ch2m.com

COUNSEL FOR APPLICANT

Scott Galati
Marie Mills
Galati & Blek, LLP
455 Capitol Mall, Suite 350
Sacramento, CA 95814
sgalati@gb-llp.com
mmills@gb-llp.com

INTERESTED AGENCIES

California ISO
E-mail Preferred e-recipient@caiso.com

INTERVENORS

Robert Sarvey
501 W. Grantline Road
Tracy, CA 95376
Sarveybob@aol.com

ENERGY COMMISSION

JAMES D. BOYD
Vice Chair and Presiding Member
jboyd@energy.state.ca.us

ROBERT B. WEISENMILLER
Commissioner and Associate Member
rweisenm@energy.state.ca.us

Kourtney Vaccaro
Hearing Officer
kvaccaro@energy.state.ca.us

Pierre Martinez
Siting Project Manager
pmartine@energy.state.ca.us

Kevin Bell
Staff Counsel
kwbell@energy.state.ca.us

Jennifer Jennings
Public Adviser
E-mail preferred
publicadviser@energy.state.ca.us

*indicates change

DECLARATION OF SERVICE

I, Mary Finn, declare that on November 19, 2010, I served and filed copies of the attached Oakley Generating Station Project (09-AFC-4) Construction Drainage, Erosion, and Sediment Control/ Stormwater Pollution Prevention Plan. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: **[http://www.energy.ca.gov/sitingcases/contracosta/index.html].** The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

For service to all other parties:

_____ sent electronically to all email addresses on the Proof of Service list;
_____ by personal delivery;
___x__ by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses NOT marked "email preferred."

AND

For filing with the Energy Commission:

x **sending an original paper copy and one electronic copy, mailed to the address below (preferred method);**

OR

_____depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-4
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Mary Finn