STAFF REPORT

Final Staff Assessment (Part 2 - Soil & Water Resources)

DELTA ENERGY CENTER

Application for Certification (98-AFC-3)
Pittsburg, California

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CALIFORNIA ENERGY COMMISSION

Gray Davis, *Governor*

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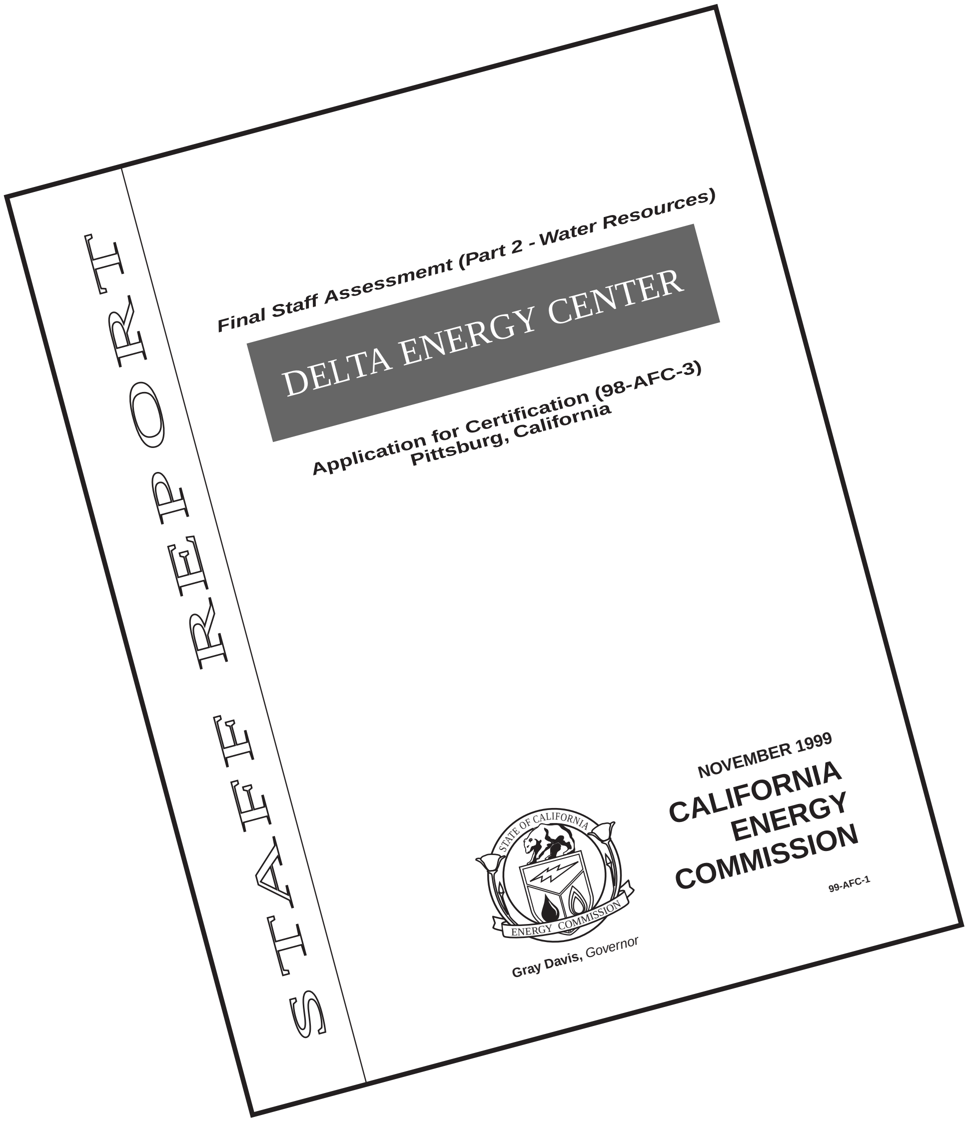

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SOIL & WATER RESOURCES

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INTRODUCTION

In this testimony, staff addresses the water and soil resource aspects of the proposed DEC, specifically focusing on the potential for the project to induce erosion and sedimentation, adversely affect water supplies, and degrade water quality. Where the potential for impacts is identified, staff proposes mitigation measures to reduce the significance of the impact and recommends conditions of certification to ensure mitigation implementation. Also addressed by staff in this testimony is the project’s ability to comply with all applicable federal, state and local laws, ordinances and standards.

Staff addresses potential drainage and flooding problem in the **Facility Design** section. Plant releases in the form of hazardous and non-hazardous wastes are described in the **Waste Management** section.

APPLICABLE LAWS, ORDINANCES, POLICIES AND STANDARDS

FEDERAL

CLEAN WATER ACT

The Clean Water Act (33 USC §1257 et seq.) requires states to set standards to protect water quality. Point source discharges to surface water are regulated by this act through requirements set forth in specific or general National Pollutant Discharge Elimination System (NPDES) Permits. Stormwater discharges during construction and operation of a facility and incidental non-stormwater discharges associated with transmission and pipeline construction also fall under this act and are addressed through a general NPDES permit. Section 307 of the Act and Code of Federal Regulations 403, requires that all non-domestic discharges to wastewater treatment plants must receive a pretreatment permit. This permit is to ensure that the discharge will not interfere with the treatment processes at the plant nor make the facility violate its own discharge permit limitations.

In California, the requirements of the Clean Water Act are administered by the nine Regional Water Quality Control Boards (RWQCBs). Section 404 of the act regulates the discharge of dredged or fill material into waters of the United States, including rivers, streams and wetlands. Site specific or general (nationwide) permits for such discharges are issued by the Army Corps of Engineers (ACOE).

STATE

PORTER-COLOGNE WATER QUALITY CONTROL ACT

The Porter-Cologne Water Quality Control Act of 1967, Water Code section 13000 et seq., requires the State Water Resources Control Board (SWRCB) and the nine RWQCBs to adopt water quality criteria to protect state waters. These criteria include the identification of beneficial uses, narrative and numerical water quality standards and implementation procedures. The criteria for the project area are contained in the San Francisco Bay Regional Water Quality Control Board's (SFBRWQCB) San Francisco Bay Basin Water Quality Control Plan (Basin Plan) ([SFBRWQCB] 1995). In addition to the requirements of the Basin Plan, the SWRCB (1971) adopted the Plan for the Control of Temperature in Coastal and Interstate Waters and Enclosed Bays and Estuaries. This plan sets numerical and narrative water quality standards controlling the discharge of wastes with elevated temperature to the state's waters.

Under provisions of the Clean Water Act, the SWRCB adopted two general National Pollutant Discharge Elimination System (NPDES) Permits for control of stormwater runoff during construction and operation of industrial facilities, such as a power plant and associated facilities.

Ground disturbance activities affecting greater than five acres are required, under the General Construction Activity Storm Water Permit, to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP). This plan identifies best management practices to reduce sediment, oil and other contaminants in stormwater discharges from the site. The general NPDES permit for Industrial Activities also requires industrial facilities, such as power plants, to prepare and implement a SWPPP that identifies best management practices to reduce the discharge of contaminants from facility operation in stormwater discharge.

The SWRCB has also adopted a number of policies that provide guidelines for water quality protection. The principle policy of the SWRCB which addresses the specific siting of energy facilities is the Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling (adopted by SWRCB on June 19, 1976 by Resolution 75-58). This policy states that use of fresh inland waters should only be used for powerplant cooling if other sources or other methods of cooling would be environmentally undesirable or economically unsound. This SWRCB policy requires that power plant cooling water should, in order of priority come from wastewater being discharged to the ocean, ocean water, brackish water from natural sources or irrigation return flow, inland waste waters of low total dissolved solids, and other inland waters. This policy goes on to address cooling water discharge prohibitions.

Section 13551 of the Water Code prohibits the use of "…water from any source of quality suitable for potable domestic use for nonpotable uses, including …industrial… uses, if suitable recycled water is available…" given conditions set forth in section 13550. These conditions take into account the quality and cost of the water, the potential for public health impacts and the effects on downstream water rights, beneficial uses and biological resources.

Section 13552.6 of the Water Code states that the use of potable domestic water for cooling towers, if suitable recycled water is available, is an unreasonable use of water. The availability of recycled water is based upon a number of criteria, which must be taken into account by the SWRCB. These criteria are that: the quality and quantity of the reclaimed water are suitable for the use; the cost is reasonable; the use is not detrimental to public health, will not impact downstream users or biological resources and will not degrade water quality.

Section 13552.8 of the Water Code states that any public agency may require the use of recycled water in cooling towers if certain criteria are met. These criteria include that recycled water is available and meets the requirements set forth in section 13550; the use does not adversely affect any existing water right; and if there is public exposure to cooling tower mist using recycled water, appropriate mitigation or control is necessary.

LOCAL

DELTA-DIABLO SANITATION DISTRICT

Chapter 2.28 of the Subregional Sewer System Use Rules and Regulations sets forth the pretreatment requirements for non-domestic discharges to the sewer and wastewater treatment system.

CITY OF PITTSBURG GRADING ORDINANCE (1984)

The City of Pittsburg relies upon the Uniform Building Code, Chapter 33 for grading and erosion control, pursuant to Pittsburg Municipal Code Chapter 15.88 Grading, Erosion, and Sediment Control.

CITY OF ANTIOCH STORMWATER MANAGEMENT AND DISCHARGE CONTROL ORDINANCE (1995)

The Antioch Municipal Code Title 6, Chapter 9, § 6-9.01 et seq. controls non-stormwater discharges to the city’s storm water system.

ENVIRONMENTAL SETTING

TOPOGRAPHY AND SOILS

The proposed DEC power plant and associated facilities are located on low-lying alluvial fan and terrace deposits on the southern side of New York Slough, a branch of the San Joaquin River. The proposed site is topographically flat and slightly above sea level in elevation. The topography and native soils present at the site have not been extensively altered. The project area has been mowed, burned, and/or disked on an annual basis by the local fire department. The Dow Wetlands

Preserve consisting of 150 acres is located approximately 0.25 miles northeast of the proposed project's site.

The 20-acre site is reported to have a slight erosion hazard potential which requires erosion control. While considered prime agricultural land, the site is not currently under cultivation.

HYDROLOGY

Surface water bodies in the project vicinity are shown in Figure 1. New York Slough, located north of the power plant site, is a three-mile long natural channel connected to the San Joaquin River on the east and Suisun Bay on the west. The Slough is maintained for navigation and periodically dredged by the Army Corps of Engineers. The Slough is estimated to carry from one third to half the flow of the San Joaquin River.

Other surface water bodies in the project vicinity include Kirker Creek and Dowest Slough (Kirker Creek Remnant Channel). Kirker Creek is a channelized, ephemeral stream located south of the power plant site and runs parallel to the Pittsburg-Antioch Highway. Kirker Creek now discharges into the Los Medanos Wasteway (an overflow spillway for the Contra Costa Canal operated by the Bureau of Reclamation) that flows finally into the eastern end of New York Slough (PDEF 1998). There are constraints to the volume of Kirker Creek discharge that is allowed by the Bureau of Reclamation. As part of development conditions that allowed rerouting of Kirker Creek, Dow Chemical constructed and operates a detention basin which accommodates storm flows in excess of that allowed for discharge into the Los Medanos Wasteway. A portion of waters detained in the Dow Chemicals basin drains into Dowest Slough. The City of Pittsburg has begun engineering and design projects to increase the capacity of Kirker Creek and detention facilities. Kirker Creek regularly floods the Antioch Pittsburg Highway (Reinders 1999). Dowest Slough is the remnant of the former Kirker Creek channel before Kirker Creek was realigned for flood control. Dowest Slough contains open water areas supporting wetland vegetation and is tidally influenced. Dowest Slough runs north-south on the Dow Chemical property. Former Kirker Creek areas are currently under investigation by the SFBRWQCB for inorganic and organic contaminants (Christian 1999).

In the project vicinity, groundwater is found in both shallow and deeper aquifers within the Pittsburg Plain groundwater basin. Groundwater typically flows from south to north discharging to New York Slough in the area of DEC. The deeper, confined aquifer is found from approximately 90 feet to 140 feet below ground surface (DEC 1998a).

Groundwater contamination has occurred as a result of industrial uses which began in the 1920's. Contamination associated with the intrusion of brackish water resulted when the groundwater was intensively used by industrial operations located in the area of DEC. However, the normal groundwater flow was reestablished when groundwater pumping was reduced in the 1950's. Contamination of the shallow aquifer with industrially used chemicals such as carbon tetrachloride has also been reported. Currently, the only local user of groundwater is the City of Pittsburg which derives approximately one-fifth of its drinking water supply from the lower aquifer. Based upon information from two City of Pittsburg production wells, the groundwater quality of the deeper aquifer meets most drinking water standards (DEC 1998a).

ENVIRONMENTAL IMPACTS

PROJECT SPECIFIC

WATER SUPPLY

Water for the proposed DEC project will be supplied by the Delta-Diablo Sanitation District (DDSD) from the DDWTF, the Contra Costa Water District (CCWD) from the Contra Costa Canal and the City of Pittsburg from the city's potable water system. Reclaimed water from the wastewater treatment facility will be used for cooling water. Fresh water from the canal will be used for heat recovery steam generator and evaporative cooler makeup as well as for general plant service water needs. City of Pittsburg water will be used for domestic purposes (Buchanan 1999).

RECYCLED WATER

Cooling water makeup demands for the proposed project will be met with effluent from the DDWTF. The dry weather capacity of the wastewater treatment facility is 16.5 million gallons per day (mgd). During 1998, the average flow at DDWTF was approximately 13.2 mgd (Baatrup 1999). Prior to discharge, effluent at the wastewater treatment plant prior to discharge is treated to a secondary level, where most settable solids and organic compounds are removed. Currently, all of the treated effluent is then discharged to New York Slough.

In general, cooling water demand for the proposed project varies with the number of cycles water can be circulated through the cooling process and ambient temperatures. DEC (1998a) proposes to circulate the effluent up to five cycles of concentration, but because of wastewater quality limitations, may have to circulate the water through only three cycles. For three cycles of concentration, under average operating conditions, the proposed project will require approximately 5.07 mgd of secondary treated effluent from the DDWTF. Under maximum operating conditions, the demand for effluent will rise to 8.02 mgd (DEC 1999g, data response number 76). In the industrial pretreatment application (DEC 1999o), 8.5 mgd is indicated. For five cycles of concentration, under average operating conditions, the proposed project will require approximately 4.22 mgd of effluent while peak conditions will require approximately 6.68 mgd. Maximum conditions are anticipated to occur when ambient temperature equals or exceeds 90^{o} F.

The California Department of Health Services (DHS) is currently promulgating regulations under Title 22 of the California Code of Regulations that require recycled water used in systems with cooling towers to be disinfected tertiary recycled water. Tertiary treatment consists of the removal of additional organic compounds and settable solids. This treatment will occur at the DDWTF where the district has permitted a tertiary treatment facility. This facility will process secondary treated effluent through additional coagulation, sedimentation, filtration and disinfection processes to meet Department of Health Services standards for tertiary treated effluent. This treatment process is discussed further in the **Public Health** section. DDSD (1999b) will install two tertiary treatment modules with a capacity of 6.1 mgd each for a total capacity of 12.2 mgd.

To provide recycled water to the proposed project, DDSD must receive a General Water Reuse Permit from the SFBRWQCB. This permit is in lieu of a Master Recycling Permit required by section 13523 et seq. of the California Water Code. This permit allows the sanitation district to establish and enforce requirements for recycled water users such as the proposed project. DDSD has not yet filed a notice of intent (application) to the SFBRWQCB (Condit 1999; Barsamian 1999). The SFRWQCB has indicated, however, that once requirements have been met, the district can provide recycled water to DEC under their existing NPDES permit (Barsamian 1999). This issue is discussed further below.

In addition to the General Water Reuse Permit from the SFRWQCB, Section 13550 of the California Water Code requires the Department of Health Services to approve the design of the water recycling facility and program to ensure the protection of public health. DDSD (1999b,c) has submitted an Engineering Report with amendments to the Department of Health Services. Approval by the Department is expected shortly.

The backup cooling water makeup supply is water from the Contra Costa Canal. Since the quality of this water is superior to that of the recycled water from the wastewater treatment facility, it could be cycled more often through the cooling process and, thus a smaller amount compared to recycled water would be required.

As noted above, during 1998, the average flow at the DDWTF was approximately 13.2 mgd (Baatrup 1999). Allowing for the 3.4 mgd of effluent that will be provided the proposed Pittsburg District Energy Facility (PDEF), sufficient effluent is available to supply the proposed project.

CONTRA COSTA CANAL WATER

Water for heat recovery steam generator (HRSG), auxiliary boiler and evaporative cooler makeup and other plant service water demands will be supplied from the Contra Costa Water District through an existing Dow Chemical connection with the Contra Costa Canal. Untreated water in the 48-mile long canal is diverted by the Contra Costa Water District from the San Joaquin River Delta. This is done under a contract with the U.S. Bureau of Reclamation for up to 195,000-acre feet per year. Other water contracts allow the water district to divert approximately an additional 50,000-acre feet of water per year. The water agency diverts on average 100,000 to 120,000-acre feet of water per year (Nolan 1999). Canal water represents approximately 80 percent of the City of Pittsburg's water supply and approximately 40 percent of the City of Antioch's supply.

Under average operating conditions, this demand represents approximately 0.22 mgd, under peak operating conditions, the demand raises to 0.80 mgd (DEC 1999g, data response number 76). Peak conditions are anticipated to occur when ambient temperature equals or exceeds 90^{o} F. Over a year, given that peak operating conditions only occur during the summer months, the project will likely require approximately 400 acre feet of canal water.

DEC (1998a) has identified Contra Costa Canal water as the backup cooling water for the power plant if effluent from the wastewater treatment plant is not available. In a worse case situation, DEC estimates that, lacking effluent from the DDWTF, 5,000 acre feet of water from the Contra Costa Water District would be required over the course of a year (Buchanan 1999). As noted above, the Water District's current diversions are well below contractual limits. Furthermore, even under likely drought conditions, diversions would likely be sufficient to provide the project with water (East County Water Management Association 1996). An interruption in effluent from the wastewater treatment plant being available is, however, likely to be of very short duration.

POTABLE WATER

Potable water for the proposed project will be supplied by the City of Pittsburg. The city supply is mainly Contra Costa Canal water augmented with groundwater. Supply is more than adequate to meet the approximately 2 gpm of the project (DEC 1999o).

WATER QUALITY

The proposed project could adversely affect surface and groundwater through inadvertent spills and discharges during construction and operation. Wastewater discharges to the DDWTF may adversely affect treatment processes or cause the facility to exceed its own discharge limitations.

WASTEWATER

Wastewater from the proposed project will include cooling tower, evaporative cooler, heat recovery steam generator (HRSG) blowdown, filtration and reverse osmosis backwash and water from the oil/water separator (DEC 1998a). Cooling tower blowdown represents the majority of the wastewater generated by the project, approximately 72 percent. Therefore, the volume of wastewater will vary with the number of cycles cooling water is circulated through the cooling towers. With three cycles of concentration, average and peak operating conditions will generate 1.79 mgd and 2.97 mgd, respectively. With five cycles of concentration, average and peak operating conditions will generate 0.94 mgd and 1.62 mgd, respectively. These values are based upon revised water balance diagrams in data response 80 (DEC 1999g). Elsewhere, DEC (1999o, pages 5 and 8) suggests an average annual daily wastewater flow of 2.09 mgd and 3.39 mgd.

Estimated water quality based upon five cycles of concentration is shown in Soil and Water Table 1. Constituents of concern in the wastewater are those conservative, inorganic constituents already present in the source water supply-the wastewater effluent. Although a significant portion of the wastewater is lost through evaporation as it cycles through the cooling tower, it is assumed that none of the inorganic constituents are lost. Instead they are concentrated in the cooling water blowdown.

DEC is proposing that wastewater from the project be discharged to the DDWTF facility. This is instead of discharging directly to either the existing Dow Chemical or to the DDWTF outfalls as had also previously been proposed. At the DDWTF, wastewater from DEC (and PDEF) will be returned to the chlorine mixers where secondary effluent is chlorinated prior to discharge to New York Slough. It should be noted that wastewater from the two power plants will be returned to a point in the secondary treatment process that is after secondary effluent is diverted to the tertiary treatment modules. Therefore, the effluent supply for the project (and PDEF) will not be affected by the wastewater returning from the power plant.

As shown in Soil & Water Resources Figure 1, New York Slough, located north of the power plant site, is a three-mile long natural channel connected to the San Joaquin River on the east and Suisun Bay on the west. The slough is estimated to carry from one third to half the flow of the San Joaquin River. The SFBRWQCB considers New York Slough as part of Suisun Bay. A number of beneficial uses for the slough has been identified by the SFBRWQCB, including municipal and agricultural supply. Other discharges to New York Slough in the project vicinity include Dow Chemical and USS Posco.

The location of the water intake for the City of Antioch, approximately two miles upstream of the DDWTF outfall, is also shown in Soil & Water Resources Figure 1. The City takes up to 16 mgd of water from this uptake, representing approximately 60 percent of the city’s water supply.

Suisun Bay has been identified by the United States Environmental Protection Agency ([EPA] 1999) and the SWRCB as an impaired water body for selenium, nickel, copper and mercury. This designation reflects that ambient levels of these constituents are too high to protect beneficial uses.

The DDSD outfall is shown in Soil and Water Resources Figure 1. The DDWTF outfall extends approximately 710 feet into the channel and terminates at a depth of about 22 feet below mean sea level (DEC 1999).

DDSD is currently renewing the existing NPDES permit for the DDWTF, a process that may take several years (Baatrup 1999). This renewal process is required once every five years for NPDES permits. Based upon information submitted by DDSD (1999b,c) to the SFRWQCB, the board staff concluded that the district can provide effluent to and receive wastewater from the proposed project under the existing NPDES permit. DDSD will still be required to receive approval from the Department of Health Services and receive a general water reuse permit from the Regional Board.

RESERVED FOR FIGURE 1

DEC estimates that constituents in the source water, with five cycles of concentration will increase by a factor of 3.5 (1998a; 1999c, data response number 81). Values shown in Soil and Water ResourcesTable 1, therefore, reflect a 3.5 increase over source water levels.

DEC is proposing to discharge wastewater from the proposed project to the wastewater treatment plant itself. Although an NPDES permit from the SFBRWQCB is not be required for the project to discharge to the DDWTF, a pretreatment permit, referred to as an industrial discharge permit, will be required from the DDSD. DEC (1999o) filed an application for an industrial discharge permit on June 25, 1999.

To discharge to the DDWTF, the project must meet the pretreatment limits identified in Soil and Water Resources Table 1. In addition, the project has to meet average chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), oil and grease, and temperature limitations as well.

SOIL & WATER RESOURCES Table 1
Industrial Discharge Limitations (mg/L)

Constituents	Estimated Discharge	Pretreatment Limits
Arsenic	0.088	0.53
Cadmium	0.099	0.10
Chromium	0.015	0.50
Copper	0.029	0.50
Lead	0.083	0.50
Mercury	0.003	0.01
Selenium	ND	2.0
Silver	0.018	0.20
Zinc	0.189	1.0

Sources: DEC 1999o

Discharge of wastewater from DEC to the DDWTF will not cause capacity problems. As noted above, the dry weather capacity of the wastewater treatment facility is 16.5 mgd. In 1998, average flow was 13.2 mgd (Baatrup 1999). Flows to the wastewater treatment plant increase approximately 0.2 mgd per year.

Routing anywhere from 0.94 mgd to 2.97 mgd of wastewater from DEC to the DDWTF could substantially reduce the remaining capacity of the facility. Since the proposed PDEF will also be discharging approximately 0.9 mgd of wastewater to the wastewater treatment plant, the additive effect of the two projects could account for most of the remaining capacity. DDSD (1999b,c) is proposing to return wastewater from both power plants to the chlorine mixers which disinfect secondary treated effluent prior to the discharge of the wastewater to New York Slough. Since tertiary treated effluent is diverted from this flow prior to this point, the return of this wastewater to DDWTF does not reduce facility capacity.

Accelerated wind and water induced erosion may result from earth moving activities associated with construction of the proposed project. Removal of the vegetative cover and alteration of the soil structure leaves soil particles vulnerable to detachment and removal by wind or water. Although many of the native soils that will be affected by the project have low or moderate wind and water erosion potential, once disturbed, all of these soils are vulnerable to erosion. Rainfall may be intense, which greatly enhances the potential for water erosion. Grading activities may redirect runoff into areas more vulnerable to erosion. Areas where linear facilities cross drainages are especially vulnerable to erosion. During project operation, wind and water action can continue to erode unprotected surfaces. An increase in the amount of impervious surfaces can increase runoff, leading to the erosion of unprotected surfaces.

Discharge of stormwater contaminated with sediment or other pollutants resulting from construction and operation may lead to the degradation of surface and groundwater and soils. Diversion of stormwater runoff to unprotected areas may also cause erosion.

The proposed power plant site is approximately 20 acres in size. In addition, a 10-acre temporary laydown area will be used. Soils at the power plant site belong to the Capay clay and Rincon clay loam soil series with slow to moderate runoff potential and slight erosion hazard. The precipitation in the Pittsburg area averages from 17.5 inches to 12.5 inches annually depending on elevation. Precipitation occurs primarily during the months of November through April. The site's drains to Dowest Slough within the Kirker Creek watershed. Construction of the proposed DEC facility will pave over 70% of the site's surface, adding approximately 520,000 square feet of impervious ground to the area increasing runoff rates and volumes (DEC 1999g, data response number 85). The total area drained, as estimated in the NPDES Permit Application (DEC 1999c), comprises approximately 800,000 square feet. Stormwater using a system of underground drains and discharge this water via a 36 inch diameter pipe to Dowest Slough.

Linear facilities associated with the project include a stormwater, natural gas, reclaimed water and wastewater pipelines and a transmission line. The transmission line, the natural gas pipeline and the stormwater discharge pipeline could potentially affect natural water-ways and sensitive biological habitats. Slant drilling for the natural gas pipeline, for example, will allow the project to avoid disturbing coastal marsh areas. For further discussion of these habitats, see the **Biological Resources** section. To address the potential for accelerated erosion and contamination from earth moving activities and stormwater runoff, DEC has prepared a draft Erosion Control, Revegetation and Stormwater Management Plan (DEC 1999g, data response number 85).

This plan identifies potential best management practices to ensure sediment and other pollutants are not carried off-site by stormwater runoff. Stormwater will be discharged to Dowest Slough. Contaminated sediment has been identified in this tidally influenced water body. Discharge of stormwater by DEC will not contribute to resuspending this contaminated sediment due to existing site conditions and the design of the stormwater discharge outlet.

Since greater than five acres are to be disturbed during construction of the proposed project, the applicant will have to file a notice of intent with the SWRCB to comply with the provisions of the General Construction Activity Stormwater Permit. During operation, DEC will be required to operate under the General Industrial Activity Stormwater Permit. These general permits require the identification and implementation of best management practices to control runoff.

CUMULATIVE IMPACTS

WATER QUALITY

As discussed above, DEC will utilize anywhere from 5.07 to 8.5 mgd of effluent from the DDWTF. In addition, the wastewater treatment plant will supply from 3.4 mgd to 3.7 mgd of tertiary treated effluent to the 500 MW combined cycle PDEF ([PDEF] 98-AFC-1). Combined, the two power plants represent a substantial diversion of the wastewater treatment plant’s discharge, potentially over 90 percent of the facility’s 1998 average flows.

The volume of wastewater that DEC could potentially discharge to the wastewater treatment plant, range from 0.94 mgd to 2.97 mgd. Wastewater discharges from PDEF will range from 0.97 mgd to 1.09 mgd (CEC 1999). PDEF will use tertiary treated effluent for both the cooling and steam cycles. The effluent will be circulated through the cooling process approximately three times and the resulting inorganic concentrations in the wastewater quality is estimated to be three times that of the source water.

To determine the effect of this diversion and the return of the concentrated wastewater from the two power plants to the DDWTF a mass balance analysis was performed. The purpose of the mass balance analysis is to evaluate the two power plants’ potential effect on DDSD’s ability to complying with its existing NPDES permit limitations. DDSD’s permit expired in November of 1998 and has been administratively extended by the Regional Board until a new permit can be issued. DDSD anticipates that a revised permit renewal application that reflects providing effluent to the two power plants will be submitted shortly (Baatrup 1999). As noted above, the SFRWQCB staff has determined that determined that DDSD can provide effluent to and receive wastewater from the two power plants under the existing (administratively extended) permit. Assumptions used in this mass balance analysis are discussed below.

Given the likely increase in wastewater discharges to the wastewater treatment facility before the two proposed projects are operating, staff used a total effluent flow of 13.5 mgd. Given the range of potential levels of effluent demand and wastewater discharge for DEC, staff assumes a 5.0 mgd effluent demand. For PDEF, a 3.7 mgd effluent demand is assumed. Based upon these project designs, therefore, approximately 8.7 mgd of a total effluent flow of 13.5 mgd at the wastewater treatment plant will be diverted to the two power plants. For DEC, wastewater flows are assumed to be 2.1 mgd and, for PDEF, 1.1 mgd. As a worst case cumulative impact analysis, the mass balance assumed both projects would discharge directly to the DDWTF's outfall. Therefore, approximately 7.45 mgd of wastewater will be discharged to New York Slough.

SOIL & WATER RESOURCES FIGURE 2 provides a schematic of the assumed flows. It should be noted that the flows shown in this schematic are slightly different than those used by staff in the mass balance. Since New York Slough, as part of Suisun Bay is considered impaired for copper, mercury, nickel and selenium, these four metals are addressed in the mass balance. In addition, because chromium is a constituent of concern for the Suisun Bay area, it is also included in the mass balance analysis.

To properly characterize effluent from the wastewater treatment plant, staff evaluated monitoring data for 1996, 1997 and 1998. Since significant variation in concentration levels for the five metals exists, effluent concentrations were characterized by the 95 percentile. This is the value of the constituent that will only be exceeded five percent of the time. In addition, the effluent limitations contained within the wastewater treatment plant's NPDES permit are based upon a 10:1 dilution credit. The Basin Plan ([SFBRWQCB] 1995) allows a 10:1 dilution credit for deep water outfalls, such as the sanitation district's, even if actual dilution is significantly greater.

As shown in **SOIL & WATER RESOURCES Table 2,** the results of this analysis show that the combined discharges will not exceed the wastewater treatment plant's existing NPDES permit limitation. This is consistent with the SFRWQCB staff's (Barsamian 1999) conclusion that no modification of the existing permit is necessary because wastewater from the two power plant projects "…would not significantly change mass loading or cause a violation of permit conditions".

As noted above, DDSD is in the process of renewing its permit. Although the proposed projects will not cause DDSD to exceed the existing limitations, the new permit limitations could be more severe. The SFBRWQCB has indicated in the 1995 Basin Plan that some of the criteria contained in the plan may not protect ambient water quality. Furthermore, the U.S. Environmental Protection Agency is proposing the California Toxics Rule which could cause permit limitations to also be revised downward. Staff does not want to speculate what the new discharge limitations will be for DDSD. Generally, processing NPDES permits takes about six months; it is likely that the DDSD permit will take substantially longer (Baatrup 1999). A further consideration is that DDSD, in dealing with revised permit limitations, has a large number of options in meeting the new standards. For example, if necessary, DDSD can revise pretreatment standards for PDEF and other industrial dischargers to the wastewater treatment plant or treat effluent prior to discharge to New York Slough.

RESERVED FOR FIGURE 2

SOIL & WATER RESOURCES Table 2
Delta Diablo Sanitation District Mass Balance Analysis

	Current Daily Average Effluent Limitations [1.] (ug/L)	1996-1998 Effluent Concentration 95th Percentile [2.] (ug/L)	Total Daily Discharge to New York Slough (ug/L)
Copper	78	22.35	40.51
Mercury	24	1.08	1.96
Nickel	71	9.25	16.77
Selenium	50	5.4	9.79

Sources:

1. DDSD NPDES Permit (1993)
2. DDSD (1999a) December Monthly Self-Monitoring Reports summarizing annual data (1996-1998)

As part of the NPDES permit application for DEC, dilution and dispersion modeling was conducted to estimate the behavior of the wastewater discharge plume. The dilution and dispersion modeling for the DEC application is subdivided into three separate modeling efforts. Staff has conducted an evaluation of this modeling. Attached to this testimony is the complete staff analysis of the modeling effort. Also discussed are dispersion experiments and field studies conducted prior to the construction of the wastewater treatment plant's outfall (Brown and Caldwell, 1980). This analysis is based upon DEC either discharging directly to the existing Dow Chemical outfall or the DDWTF outfall. DEC has decided not to pursue either the use of the Dow Chemical outfall nor go directly to the DDWTF outfall. For dispersion modeling purposes, however, direct discharge of wastewater from DEC directly to the DDWTF outfall is the same as routing the wastewater to the DDWTF.

To address initial, transition and far field dispersion of the wastewater plume, the NPDES application involves three separate modeling efforts to address the different regions of influence. Both outfalls are essentially submerged pipes with a number of ports to discharge the wastewater. The Initial dilution of the discharge depicts the movement of the wastewater as it exits the outfall and begins to mix with ambient water. The initial dilution rate of the wastewater discharge is due to the velocity of the discharge (jet velocity) and buoyancy. As the wastewater flow (jet) exits the diffuser and enters the receiving water, a shear layer is formed between the jet and the water. Waves within the shear zone entrain ambient water into the jet and mix the two fluids, diluting the concentration of the discharge.

The initial dilution modeling was conducted using the United States Environmental Protection Agency (EPA) model UDKHDEN. Factors taken into account include effluent flow variation and density, ambient water density and currents and diffuser orientation and port configuration. A number of model runs were conducted for a range of discharge flows, current speeds and ambient densities (DEC 1999). Important factors in identifying a worse case for initial dilution include shallow water conditions due to low tide conditions, stratification within the water column due to high water densities and low current velocities. Stratification was found in the modeling runs to be the most critical condition.

The initial dilution modeling efforts using UDKHDEN explored a wide range of critical scenarios. A reasonable range of factors for currents, densities, and stratification were evaluated. Modeling results indicated that initial dilution ranged from 48:1 to 281:1 for the DEC outfall. For the DDSD outfall, dilution factors ranged from 34.4:1 to 656:1. For comparison, the range for the current DDSD configuration for these scenarios was 39:1 to 181:1.

The subsequent transition-mixing region used the modified Brooks Method. Within the transition-mixing region, the discharge plume is still somewhat coherent and mixing is not as rapid as that of the initial phase. This modeling indicated that the plume from the DDSD discharge hit the southern shoreline of New York Slough approximately 2,500 to 5,000 feet downstream of the discharge under average conditions. The Delta Simulation Model 2 (DSM2) gave acceptable results for background dilutions to apply to the transition zone modeling. The analysis done with the Modified Brooks approach appeared only to have accounted for the ebb scenario, that is, when flows are to the bay. A similar study for the flood scenario, that is when water is moving upstream due to tidal action was not done. From the 1980 study, it appears that the plume would likely stay on the south bank near Antioch during flood.

Because the estuary system that the DEC facility would be releasing to is very complex, the DSM2 which is used by the California Department of Water Resources was used to define the hydrodynamics of the region. In addition, the subprogram, QUAL was used to estimate the background dilution in the immediate area of the discharge. Because the DSM2 model is a one-dimensional representation of flow, the model consists of a series of channels and nodes representing junctions. At each junction all the water entering from the main channel and any tributary water during a timestep is mixed completely. The DEC facility is located very close to (3,700 feet downstream) the confluence of New York Slough and Broad Slough. During flood tide, water flows from New York Slough into Broad Slough. With the model representation, any concentration in New York Slough (~940 feet wide) is mixed with the Broad Slough (~3,000 feet wide) when the node is reached. This effectively mixes the concentration across the entire span of Broad Slough and increases the dilution. In reality, the flow in this region is very two dimensional in nature. It would not be expected that the concentration would be immediately mixed across the channel. Modeling results indicate that approximately 25,000 feet downstream, dilution reaches 96:1, assuming an initial effective dilution of 48:1. Factoring in vertical mixing, this number reaches 263:1. Therefore, results of this model may not be adequate to predict exact concentration levels at the City of Antioch intake. However, based on the dye study done in 1980, the dilution at Antioch is about 400:1 to 3,000:1 which is a much higher dilution than the predicted background concentration of 323:1.

Based upon information provided in the modeling results and the 1980 studies, it is clear that sufficient dilution would occur to ensure that a wastewater plume from the DDSD outfall would not adversely affect the City of Antioch's water intake. The City of Antioch, as part of the PDEF proceedings also evaluated these modeling efforts and came to the same conclusion (CEC 1999b).

FACILITY CLOSURE

A planned, unexpected temporary or permanent closure of the proposed DEC should not be a significant concern if site drainage and erosion are properly dealt with for any potential closure. Proper closure of the cooling tower basin is also required. Unexpected permanent closure may raise the potential for drainage and erosion problems due to a lack of maintenance of the facilities. Staff will require DEC to address this concern in their closure plan.

MITIGATION

DEC PROPOSED MITIGATION

The following mitigation measures are those actions that have been identified to reduce the level of significance of specific impacts. Compliance with applicable laws, ordinances and standards are discussed in this section.

WATER SUPPLY

No mitigation measures identified.

WATER QUALITY

No mitigation measures are identified beyond those to comply with discharge permits.

EROSION CONTROL AND STORMWATER MANAGEMENT

DEC submitted a detailed erosion control and stormwater management plan that identifies best management practices to control erosion, sedimentation and the discharge of stormwater runoff (DEC 1999g, data response number 85).

CEC STAFF PROPOSED MITIGATION

Staff proposed conditions of certification are to ensure that the proposed project complies with the applicable laws, ordinances and standards. In particular, these proposed conditions address compliance with stormwater runoff and erosion control and DDSD pretreatment permit requirements. Staff has also proposed a condition requires the project owner to notify staff if Contra Costa Canal water is used for cooling water make-up for greater than 14 days.

COMPLIANCE WITH APPLICABLE LAWS, ORDINANCES, POLICIES AND STANDARDS

Project use of recycled water is consistent with SWRCB's Resolution 75-58 regarding the use of inland water for cooling. The project also complies with California Water Code section 13550 which addresses the use of recycled water. This section of the water code indicates that use of potable water for non-potable purposes including industrial uses is a waste or an unreasonable use of water.

Although the water in the Contra Costa Canal requires treatment prior to being used for domestic consumption, State Water Resources Control Board staff (Vassey 1999) assume that this water is considered potable. Section 13550 (2) requires that the recycled water must be provided at a reasonable cost to the user. It goes on to state that "…the cost of supplying the treated recycled water is comparable to, or less than, the cost of supplying potable domestic water." State Water Resources Control Board staff interpret this as to require that the cost of using recycled water (including delivery and treatment costs) cannot be greater than that using potable water.

In response to a staff data request (April 26, 1999 Water Resources Response WR-11) the applicant provided a discussion of two alternative treatment processes and costs that could be used to treat the recycled water to a quality suitable for use in the proposed project's steam cycle. This cycle requires significantly higher quality water than required for the cooling cycle. The lowest estimate would require an additional capital cost of $384,000 and an annual operating costs of $144,645. These numbers are consistent with treatment costs staff has developed from other sources. Although staff does not consider these costs prohibitive, they are significantly greater than treatment costs required for use of the Contra Costa Canal water. Therefore, staff concludes that the project is consistent with California Water Code section 13350.

CONCLUSIONS AND RECOMMENDATIONS

Staff concludes that the proposed DEC will not contribute to any significant project specific impacts to soil resources. Use of recycled wastewater from the DDWTF for project cooling water demand is a beneficial use of this water source. Use of potable quality water for steam cycle make-up will not adversely affect water supplies. Staff also concludes that the proposed project will not adversely affect water quality. Staff also concludes that the proposed project will comply with all applicable laws, ordinances and standards.

CONDITIONS OF CERTIFICATION

SOIL & WATER 1: Prior to beginning any clearing, grading or excavation activities associated with project construction, the project owner will develop and implement a Storm Water Pollution Prevention Plan.

Verification: Thirty days prior to the start of construction, the project owner will submit to the Energy Commission Compliance Project Manager (CPM) a copy of the Storm Water Pollution Prevention Plan.

SOIL & WATER 2: Prior to the initiation of any earth moving activities, the project owner shall submit an erosion control and stormwater management plan for City of Pittsburg Community Development Department review and Energy Commission staff approval. The final plan shall contain all the elements of the draft plan with changes made to address the final design of the project.

Verification: The final erosion control plan shall address all comments of the City of Pittsburg Community Development Department and be submitted to the Energy Commission CPM for approval 30 days prior to the initiation of any earth moving activities.

SOIL & WATER 3: Sixty days prior to commercial operation, the project owner must submit a notice of intent to the State Water Resources Control Board to indicate that the project will operate under provisions of the General Industrial Activity Storm Water Permit. As required by the general permit, the project owner will develop and implement a Storm Water Pollution Prevention Plan.

Verification: Thirty days prior to the start of commercial operation, the project owner will submit to the Energy Commission CPM a copy of the Storm Water Pollution Prevention Plan.

SOIL & WATER-4: The project owner shall use tertiary treated effluent from the Delta Diablo Wastewater Treatment Facility for cooling water make-up whenever possible. If water from the Contra Costa Canal is used for cooling water make-up for more than 14 days, the project owner shall notify staff in writing of this fact and explain why the backup source is being used.

Verification: The project owner shall notify the Energy Commission CPM in writing if the backup water supply is used for cooling water make-up for more than 14 consecutive days. The notification should explain the cause of the interruption and the anticipated time when treated effluent will again be available.

SOIL & WATER-5: The project owner shall obtain an Industrial Discharge Permit from the Delta Diablo Sanitation District prior to the discharge of the project's wastewater to the Delta Diablo Wastewater Treatment Facility.

Verification: No fewer than 45 days prior to commercial operation, the project owner shall provide the Energy Commission CPM a copy of a valid Industrial Discharge Permit including any pretreatment requirements and/or limitations. The project owner shall notify the Energy Commission CPM in writing of any changes to and/or renewal of the permit.

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APPENDIX A

HYDRODYNAMIC MODELING ANALYSIS BY NANCY MONSEN

INTRODUCTION

In order to evaluate the hydrodynamic modeling done for the proposed Delta Energy Center (DEC), both the NPDES application submitted by CH2M Hill and the Predischarge Receiving Water Monitoring (Brown and Caldwell, 1980) were reviewed.

The NPDES application involves three separate modeling efforts to address different regions of influence. The initial dilution of the outfall, where mixing caused by the diffuser is important, is modeled with UDKHDEN. The transition zone, where the flow has developed into a plume but has not fully mixed across the channel, is modeled by the Modified Brooks approach. Finally, the far field mixing which determines background dilutions, is modeled with the Delta Simulation Model 2 (DSM2). Each of these modeling efforts will be evaluated separately.

The 1980 Predischarge Receiving Water Monitoring documentation contains the results of several field experiments and an experiment done in the Corps of Engineers Physical Model of the Delta. The field experiments include measurements of temperature, salinity, and velocity profiles near the discharge site. In addition, current drogue experiments and a field dye dispersion study were conducted.

BACKGROUND TERMS

DILUTION

Throughout this discussion, we will be referring to a term called dilution. Dilution is defined as the ratio if initial concentration to the final concentration.
For instance, if we had an initial concentration of 100 g/l and the mixing process

$$Dilution = \frac{Initial\_concentration}{final\_concentration}$$

reduced the concentration to 25 g/l, then the dilution would be 4:1. For every 4 parts we had, 1 part remains after mixing.
Effective Dilution

The initial dilution modeling, which takes into account the mixing from the diffuser, assumes that the ambient (or receiving) water has no contaminates in it. However, over time, the receiving water will actually have a background concentration associated with it. Therefore, the initial dilution results will need to be adjusted for the background value using the following equation:

$$S_e = \frac{(S_n \times S_f + 1)}{(S_f + S_n)}$$

where S_e is the effective dilution, S_n is the initial dilution, and S_f is the background dilution.

For instance, in the modeling of the DEC outfall under critical conditions, the initial dilution calculated is 56:1. The background dilution, determined with a separate model (DSM2), is 323:1. Using the above equation, the adjusted (or effective) dilution is 48:1.

TRANSITION MIXING/SUBSEQUENT DILUTION

The period of time after a plume has initially mixed from the influence of the diffuser jet but before the plume has fully mixed across the channel is referred to as the transition period. When modeling this transition period, often modelers will assume an initial concentration at the start of the transition period and report a dilution value which only accounts for transition mixing. In order to come up with the absolute mixing of the system, the initial concentration must be multiplied by this dilution value.

For example, the initial effective dilution calculated for the DEC critical conditions was 48:1. In the subsequent mixing period, it was determined that the dilution was an additional 2:1 before the plume hit the south shoreline. Therefore the total dilution at the location where the plume hits the shoreline is 96:1.

1980 PREDISCHARGE RECEIVING WATER MONITORING

The studies done by Brown and Caldwell (1980) supply a background knowledge of hydrodynamics of the study site. This section summarizes the relevant findings of the study. Several of the values presented in this section will be referred to later in the evaluation of the NPDES application.

MAIN FINDINGS: FIELD STUDIES

One of the main concerns with the DEC outfall is the impact of this discharge upstream on the City of Antioch water intake and downstream on the Contra Costa Water District intake at Mallard Slough. This was also a concern during the initial design of the Delta Diablo Sanitary District (DDSD) wastewater outfall and diffuser. In order to determine how long it would take water from the outfall to reach the each of these inlets, current drogues were released and their trajectories recorded. In order to evaluate the impact on Antioch, the drogues were released on slack before flood. Drogues were released on slack before ebb to look at the impact on Mallard Slough.

From the flood experiments it was determined that:

Most of the drogues remained close to the south shore; however two crossed to the north side and one passed north of West Island. (p. II-6-4)

Drogues released at peak flood reached the raw water intake at Antioch or beyond before turning around with the change of tide. All the drogues remained in the main channel on the south side and returned on essentially the same path. With one exception, all the drogues returning with the ebb reentered New York Slough. (p. II-

6-5). The study also found that the drogues that were released on slack before ebb reached the Sacramento River. Also, not all of the drogues hugged the south shore. (fig. II-9) Very few of the drogues made it to Mallard Slough. This would indicate that the impact to the Mallard Slough facility is minimal.

In addition, two dye studies were preformed in June, 1978, and February, 1979. The dye was released on flood to determine the dilution of the effluent at the Antioch intake. In the June study, an apparent dilution of 3600:1 occurred with a travel time of 2 hours. It was suggested in the study that the dye patch center was farther offshore. When the dye patch returned to the intake on ebb 9-10 hours after release, the apparent dilution was 10000:1. (p. II-6-21). In contrast, in the February study, the apparent dilution after a travel time of 2-3 hours was 100:1. The return dilution after 10 hours was 305:1.

In another dye study in which the dye patch was released on ebb during these same time periods, the dilution at Mallard slough was estimated to be between 200:1 to 285:1.

In all of the dye studies, the dilution estimates are for the dilution after the initial mixing occurred in the near field.

MAIN FINDINGS: HYDRAULIC MODEL DYE TESTS

An approach to determine the background dilution is to simulate the dye release with a model. Because the engineers on the study did not believe that the current numerical model had adequate detail about the near field (within several miles), a simulation study using dye in a physical model was performed. (p. I-1-2)
In order to determine an estimate for the background dilution, dye release tests were conducted in the Corps of Engineers' physical model of the San Francisco Bay/Delta. For this study, they used a 19 year mean tide, because *"Dye dilutions resulting from a dynamic model run (one in which river inflows and water uses and the tide are constrained to follow a simulated natural cycle) would never reach equilibrium and would be always trying to catch up."* (p. II-6-28) From this study, the estimated minimum total dilution ratio for Lower Low Water (LLW) was 400:1.

FINAL CONCLUSIONS FROM 1980 STUDY

Based on drogue releases, field dye studies, and the hydraulic physical model tests, the total dilution at the City of Antioch raw water intake ranged from 400:1 to 3000:1 (product of 30:1 computed initial dilution and 100:1 field survey results). The total dilution at the CCWD Mallard Slough intake ranged from 400:1 to 6000:1 (product of 30:1 computed initial dilution and 200:1 estimated further dilution from survey results) (p.II-6-33).

NPDES: LONG-TERM BACKGROUND DILUTION WITH DSM2

INTRODUCTION/BASIC CONCLUSION

To get an accurate estimate of the near field mixing, the near field model needs to know the background dilution value. The DSM2 model which simulates the circulation in Suisun Bay and the Delta was applied.

In order to determine the background dilution, the model was run with the hydrologic conditions of a dry, low flow year with a 19 year mean tide boundary condition. A mass concentration was released at a node introduced at the discharge site. Monthly average dilutions were then determined with the model. The report concludes that *"In the worst case conditions, dilution at the water supply intakes will be greater than 350:1. Under more normal Delta outflow conditions, the dilution will be much greater."* (p. 22) For the subsequent modeling studies, a background dilution of 323:1 was used. This dilution estimate was consistent and more conservative than what was found in Brown and Caldwell (1980).

COMMENTS

Although I agree with the overall conclusion of the modeling, I have a few comments regarding the use of the DSM2 model in this application. DSM2 does not represent the bathymetric features adequately enough to make near field estimates of concentration in the domain. In the 1980 study, a dye study in a physical model was done in lieu of a numerical model because the numerical model was not detailed enough. DSM2 is a very similar model to the numerical model rejected for that study. Several features of the complex junction of the Sacramento and San Joaquin Rivers are oversimplified. For instance, Sherman Lake is modeled as a reservoir with an inlet on the Sacramento and one on the San Joaquin. All reservoirs in this model have the feature that any concentration entering a reservoir is instantaneously mixed with the entire reservoir. In a field study conducted by the U.S. Geological Survey in September 1998, it was found that this region acts more like a channel than a lake. (Oltmann, personal communication, 1999) Therefore, the dilution predicted by the DSM2 model may be much greater than what might be actually occurring. In addition, New York and Middle Slough are represented in the model as one channel. Because the discharge site is in New York Slough, it is essential that the bathymetry in that region be correct.

The second problem is that the flow of a very complex, multi-dimensional junction is being simulated with a one-dimensional model. Because the DSM2 model is a one-dimensional representation of flow, the model consists of a series of channels and nodes which represent junctions. At each junction, all the water entering from the main channel and any tributary water during a timestep is mixed completely. The DEC facility is located very close to (3700 feet downstream) the confluence of New York Slough and Broad Slough. During flood tide, water flows from New York Slough into Broad Slough. Any concentration in New York Slough (~940 feet wide) will be mixed with the Broad Slough (~3000 feet wide) when the node is reached. This effectively mixes the concentration across the entire span of Broad Slough and increases the dilution. This is a form of numerical dispersion. Jobson and

Schoellhamer (1992), who developed the Branched Lagrangian Transport algorithm used in DSM2 state that *"Excessive use of interior junctions, may limit the ability of the model to accurately simulate dispersive fluxes. Dispersion occurs between parcels in a particular branch but not between branches. In other words, it is assumed that junctions represent points of zero dispersive flux. All mass passing through a junction, however, is mixed before entering the next branch so numerical dispersion may also occur at junctions."*

A third issue with the approach used in the modeling was the use of the 19 year mean tide. This tide is an average tide which is considered to be representative of the tides at Martinez. In reality, the spring/neap cycle plays a dominate role in the mixing of the system. The system is more dynamic on spring tides than on neap tides. As was stated in the discussion of the hydraulic model dye test, the 19 year mean tide can be used to come up with an equilibrium value. However, in reality the system never really comes to this steady state.

NPDES: INITIAL DILUTION WITH UDKHDEN

INTRODUCTION/BASIC CONCLUSION

This model was used to determine the initial mixing following the discharge through the diffuser. This is a region of intensive mixing caused by the momentum of the jet. The study of the initial dilution using UDKHDEN was very extensive, exploring a wide range of critical scenarios. The critical range of currents, densities, and stratification scenarios were reasonable. Dilution for their studies ranged from 48:1 to 281:1 for the DEC outfall. For comparison, the range for the current DDSD configuration for these scenarios was 39:1 to 181:1. A dilution value of 48:1 was used as the final value of dilution to be applied to subsequent modeling.

ASSUMPTIONS MADE IN UDKHDEN MODELING

In order to determine the conditions of the receiving water required for the initial dilution modeling, observed conditions from nearby monitoring stations and results from the DSM2 model were examined.

CURRENT VELOCITY, WATER SURFACE ELEVATIONS

The range of current velocities and water surface elevations near the discharge site were generated from DSM2 model runs. The DSM2 model run incorporated average monthly flows and the 19 year mean tide. The 19 year mean tide is considered by the California Department of Water Resources to be a representative of the tide stage at Martinez. This tide does not account for the spring-neap cycle. However, since this was used just as initial estimate of the current velocities, this is a reasonable approach.

The currents generated from the DSM2 runs varied from 0.19-3.14 ft/s. These values are in the range of what is generally observed in this system. In a tidal system, the currents generally do not fall to 0.0 ft/s because of frictional effects which cause shoal areas to turn with the tide before the main channel region. Therefore, the water body never reaches a stagnant state.

From the DSM2 velocity information, the current was broken down into a percentile of ambient current speed for water year 1990. The 1-percentile current was 0.19 ft/s and the 10-percentile current was 0.47 ft/s. These currents were used in the evaluation of the critical dilution conditions.

For all runs the stage was set at Mean Lower Low Water (MLLW). During a 24 hour period of time, the system experiences two high tides and two low tides. The lowest low tide occurs after the highest high tide. Mean Lower Low Water is the average of the lowest low water. This value is the benchmark used for NOAA maps and is considered the lowest stage that a water body will experience. Since a surfacing plume will get the minimal amount of dilution with the minimal depth, this stage was used in the evaluation of critical dilution conditions.

SURFACE TEMPERATURE AND CONDUCTIVITY DATA

Surface temperature and conductivity data was determined from a station directly downstream of the site from water year 1990 data. Minimum temperatures ranged from 47.3 F in Fall to 70.2 F in Summer.

The conductivity data from water year 1990 was used to determine a range of densities for ambient conditions for the initial screening runs. These values were not used in the critical case runs.

CRITICAL STRATIFICATION

Water column profiles for years 1988-1997 were examined to identify stratification worst case scenarios. The highest stratification occurred 10 Dec 1991. The second highest stratification was 26 Oct 1994. The worst case scenario, however, was third highest stratification (2 Nov 1988) because the density change is steepest in the vicinity of the discharge depth which limits mixing in that region. The selection of the critical case stratification, maximum density case (12 Dec 1989) and the minimum density case (14 Jun 1989) all seem reasonable.

SCREENING RUNS

The screening runs were initial tests used to determine the overall performance of the diffuser. Both DEC diffuser and the DDSD diffuser were analyzed.

For the DEC diffuser, the model simulated currents ranging from 0.00 ft/s to 3.14 ft/s, high and low ambient densities, and flows ranging from 1.2 mgd to 2.1 mgd which is the predicted operation range of the diffuser. The dilutions predicted for these initial runs ranged from 50:1 to over 3000:1. Therefore, the diffuser was shown to work well under the anticipated operating range.

For the DDSD diffuser, the conditions models were: a current of 0.0 ft/s and 7.5 ft/s, high and low ambient densities, and flow magnitudes of 13 mgd and 5.2-7.3 mgd. (The existing discharge of the DDSD diffuser is 13 mgd, this would be reduced to 7.3 mgd with the DEC facility.) The dilutions predicted for the DDSD facility ranged from 56:1 to 2124:1 for the 13 mgd flow which represents the current conditions. For the lower flow scenarios, the dilutions ranged from 51:1 to 5112:1. Therefore, this diffuser works well under the lower flow scenario.

CRITICAL CASE RUNS AND EFFECTIVE DILUTION

The critical case runs determined the worst case conditions and the lowest initial dilution. These runs were performed with the previously identified stratification configurations, MLLW stage, and 1-percentile and 10-percentile currents. The 1-percentile currents are extremely conservative (give lower dilutions than probably occur).

The DEC outfall results for the 1-percentile current (.19 ft/s) dilutions ranged from 48:1 to 156:1. With the 10-percentile current (.47 ft/s), dilutions ranged from 67:1 to 218:1.

The DDSD outfall values ranged from 29:1 to 181:1 for the existing discharge of 13 mgd. With the reduced discharge because of DEC operation, the dilutions ranged from 32:1 to 236:1.

These results would indicate there is a higher overall dilution with both facilities operating than with the DDSD operating alone.

IMPACT OF TEMPERATURE

Studies were also run to determine the effect of temperature on dilution. In order to look at the effect of temperature variations of the effluent, the effluent density was varied from 0.99905 to 0.99509 g/m^3 (equivalent to a temperature range of 60 F to 90 F). Results found that dilution increased with increased temperature. At the lowest temperatures, the dilution ranged from approximately 28:1 to 43:1.

The increase in temperature of receiving water due to effluent mixing was also modeled. The predicted increase in water temperature was less than 1 F for almost every case. The worst case was an increase of 1.05 F when the effluent was 90 F during the spring. It is very unlikely that this scenario would occur due to the cool weather.

NPDES: SUBSEQUENT DILUTION WITH MODIFIED BROOKS

BACKGROUND/BASIC CONCLUSION

After a plume has gone through the initial mixing caused by the momentum of the diffuser jet, there is a transition zone where the plume is not fully mixed with the channel but is in equilibrium with the density and momentum of the surrounding water. This region is referred to as the transition zone. There are two main approaches to modeling this region. The first approach is using simplified solutions to model lateral spreading of the plume. The second approach is to apply a two or three-dimensional advective-diffusive numerical model to calculate this lateral spreading in the plume. Although the second approach gives a detailed view of what is happening in the system, it is very costly to develop this type of model. Models for this region are now only in research stages of development.

One of the simplified approaches often used to determine lateral diffusion of a plume is the Brooks Method. (Fischer, p. 409). The Modified Brooks Method incorporates an additional terms which incorporate vertical diffusion. In general, vertical diffusion does not have a significant influence on the dilution of the system. However, in cases where the plume is much wider than it is thick, vertical diffusion can be important. Because a tidal system can have both the extremes of a fully mixed system and a negligibly slow mixing process during different times of the tidal cycle, the modified version of the Brooks Method was applied.

The modeling done for this application only looked at the influence of the plume downstream from the discharge site. The modeling showed that both the DDSD discharge and the DEC discharge would hit the southern shoreline of New York Slough 2500-5000 feet downstream of the discharge under average conditions. The plume is not predicted to hit the north shore. For the DDSD discharge, the dilution at the point when the plume hits the shoreline is 96:1 if vertical mixing is not taken into account. If the vertical mixing is considered, the dilution is 263:1, which would not be discernable from long-term background levels.

COMMENTS

The dilution values that were obtained for the downstream case seem reasonable. The dilution value of 96:1 is an overly conservative value because vertical diffusion is probably important. Because of the curvature of the channel, it is logical that the plume would hit the southern shore. Based on the drogue studies that were done in 1980, it might be possible that the plume could reach the north shore as well.

The analysis done with the Modified Brooks approach appeared only to have accounted for the ebb scenario. The NPDS application does not mention a similar study for the flood scenario. From the 1980 study, it appears that the plume would likely stay on the south bank near Antioch during flood. Therefore, the flood period would have been a good scenario to investigate. However, based on the dye study done in 1980, the dilution at Antioch is about 400:1 to 3000:1 which is a much higher dilution than the predicted background concentration of 323:1. Therefore, this scenario might not have been modeled because the impact at Antioch was assumed to be minimal based on previous studies.

CONCLUSION

I agree with the overall dilution values that were produced for the modeling. The background dilution for the system is in the range of 323:1. The initial dilution from the DEC diffuser will range from 48:1 to 281:1 for the critical scenarios. For comparison, the range for the current DDSD configuration for these scenarios ranged form 39:1 to 181:1. Looking at the transition zone, the plume will likely hit the south shore during ebb 2500-5000 ft downstream of the discharge with a dilution between 96:1 to 263:1 under average conditions. The overall model results indicate that impact of the discharge on the Antioch and Mallard Slough intakes will be minimal.

The study of the initial dilution using UDKHDEN was very extensive exploring a wide range of critical scenarios. The range of currents, densities, and stratification were reasonable. The subsequent dilution with Modified Brooks approach gave reasonable conclusions in the downstream scenario. However, the Modified Brooks approach should have been applied in the flood direction as well to complete the analysis. The DSM2 model gave acceptable results for background dilutions. However, DSM2 does not represent the bathymetry features adequately enough to make near field estimates of concentration in the domain of interest because the complex, multi-dimensional junction is represented by a one-dimensional model.

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