SECTION 6.0

Alternatives

The following section discusses alternatives to the CPV Vaca Station (CPVVS) as proposed in this Application for Certification (AFC). These include the "no project" alternative, power plant site alternatives, linear facility route alternatives, technology alternatives, water supply alternatives, and wastewater disposal alternatives. These alternatives are discussed in relation to the environmental, public policy, and business considerations involved in developing the project. The main objective of the CPVVS is to produce economical, reliable, and environmentally sound electrical power in the Vacaville area.

The Energy Facilities Siting Regulations (Title 20, California Code of Regulations [CCR], Appendix B) guidelines titled *Information Requirements for an Application* require:

> A discussion of the range of reasonable alternatives to the project, including the no project alternative…which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and an evaluation of the comparative merits of the alternatives.

The regulations also require:

> A discussion of the applicant's site selection criteria, any alternative sites considered for the project and the reasons why the applicant chose the proposed site.

6.1 Project Objectives

The key objective of the CPVVS is to provide approximately 660 MW of cost-effective and efficient power capacity to the growing Solano County and Vacaville area market. The project site is located at the northwest corner of Lewis Road and Fry Road in Vacaville, California. The property is owned by the City of Vacaville (City) and is located to the south of the City's Easterly Wastewater Treatment Plant (EWTP). As part of this effort, the applicant is considering either two GE Energy Frame 7FA or Siemens SGT6 5000F natural gas-fired turbine-generators.

The CPVVS would provide needed electric generation capacity with improved efficiency and operational flexibility to help meet Northern California's long-term electricity needs. Pacific Gas and Electric Company (PG&E) has identified a near-term need for new power facilities that can be on line by or before 2015 and that can support easily dispatchable and flexible system operation. PG&E has recently issued a Request for Offers to obtain these energy resources from qualified bidders. The CPVVS's project objectives are consistent with this need as follows:

- Provide the most efficient, reliable, and predictable power supply available by using combined-cycle natural gas-fired combustion turbine technology capable of supporting the growing power needs of Solano County and the Vacaville area

- Use state-of-the-art technology to provide operational flexibility and rapid-start and dispatch capability
- Site the project adjacent to or near a wastewater treatment plant with the capacity to provide up to 6.3 million gallons per day of recycled water for cooling and other plant makeup water uses
- Site the project as near as possible to 230-kV high-voltage electrical transmission lines and a high-pressure natural gas transmission pipeline

In addition to technology alternatives described above, project objectives for site selection included minimizing or eliminating the length of any project linears, including gas and water supply lines, discharge lines, and transmission interconnections. These objectives both minimize potential offsite environmental impacts and the cost of construction.

In addition, to respond to the need for electrical power capacity in Solano County, the project includes the following project objectives related to site selection:

- Site control readily available
- Adjacent to or near a 115-kilovolt (kV) or 230-kV high-voltage electrical transmission lines
- Adjacent to or near high-pressure natural gas transmission lines
- Adjacent to or near recycled water supply for cooling purposes to maximize efficiency
- Industrial land use designation with consistent zoning
- Large enough to accommodate the site including construction laydown
- Located near centers of demand for maximum efficiency and system benefit
- Potential environmental impacts can be mitigated and minimized

The proposed CPVVS site meets all of these project siting objectives.

The CPVVS will provide power to the grid to help meet the demand for electricity and to help replace less-efficient fossil fuel generation resources retired because of age or cost of producing power. The CPVVS will enhance the reliability of the state's electrical system by providing power generation near the centers of electrical demand. In addition, as demonstrated by the analyses contained in this AFC, the project would not result in any significant environmental impacts. Therefore, as will be demonstrated below, there are no alternatives that would be preferred over the project as proposed.

6.2 The "No Project" Alternative

The "no project" alternative would forego all of the benefits associated with the CPVVS project. In addition, the "no project" alternative would likely result in more energy production from the existing onsite power plant than would otherwise likely occur, and these currently include older, less efficient, and less environmentally sound generating units. This would be likely to have negative economic consequences for the region's commercial and residential ratepayers and for the regional economy.

In summary, the "no project" alternative would not serve the growing needs of Solano County (County) and California's businesses and residents for economical, reliable, and environmentally sound generation resources. Moreover, the "no project" alternative would

not satisfactorily meet the project objectives specified above and thus was rejected in favor of the proposed project.

6.3 Power Plant Site Alternatives

For comparison purposes, and to meet the requirements of the California Environmental Quality Act (CEQA) and Title 20, alternative sites were chosen that could feasibly attain most of the project's basic objectives. The alternative sites are shown in Figure 6.3-1. The key siting criteria in considering these alternatives and the proposed CPVVS site included the following factors:

- Site control (lease or ownership) feasibility
- Location near electrical transmission facilities
- Location near reliable natural gas supply
- Access to recycled water supply for cooling water
- Land zoned for industrial use
- A parcel or adjoining parcels of sufficient size for a power plant and construction laydown areas
- Location near the centers of demand for maximum efficiency and system benefit
- Ability to minimize construction impacts on existing residences and businesses
- Feasible mitigation of potential environmental impacts

6.3.1 Proposed Project Site

The proposed site for the CPVVS is south of the EWTP the corner of Fry and Lewis Roads, Vacaville, meets all of the project's objectives and, in addition, would have no significant, unmitigated, environmental impacts. The proposed site is approximately 24 acres. The site is owned by the City if Vacaville and leased by CPV Vacaville, LLC. The CPVVS site:

- Has a signed lease with the City for site control.
- Is located approximately 1 mile from PG&E's two existing 230-kV circuits, Vaca-Dixon to Lambie and Vaca-Dixon to Peabody.
- Is located near the PG&E natural gas supply Line 401. Interconnection will require an approximately 1-mile-long connection.
- Has access to reclaimed secondary treated water from the EWTP for cooling water. Interconnection will require an approximately 2,600-foot-long connection.
- Is designated as a Community Facility (CF) with zoning for utility facilities that generate greater than 50 megawatts (MW) of electricity.
- Has an adjacent parcel for construction laydown areas.
- Is located near the centers of demand for maximum efficiency and system benefit.
- Minimizes construction impacts on existing residences and businesses.
- Has feasible mitigation of potential environmental impacts.

6.3.2 Alternative 1: Creed Site

This alternative is located approximately 7 miles south of the CPVVS site approximately 1 mile west of the intersection of Creed Road and Goosehaven Road. This property is currently used for grazing and is approximately 278 acres in size. The property is zoned MG-3, General Manufacturing, 3-acre minimum, and is located within unincorporated Solano County. The site would require an approximately 1,400-foot-long electrical transmission line to connect to the 230-kV transmission line and 1-mile-long natural gas line to tie into the existing 42-inch PG&E high-pressure gas main to the east. A new switchyard would need to be built for this site to connect into the 230-kV line. It is anticipated that, because of the current siting of three simple cycle peaking plants in the general vicinity, a water source such as groundwater is available; however, because of the size and water use of the proposed CPVVS plant, it is likely this site would require a 9-mile-long pipeline to the EWTP and would not be able to use groundwater as a water source. It is currently unknown whether or not site control would be feasible at this location.

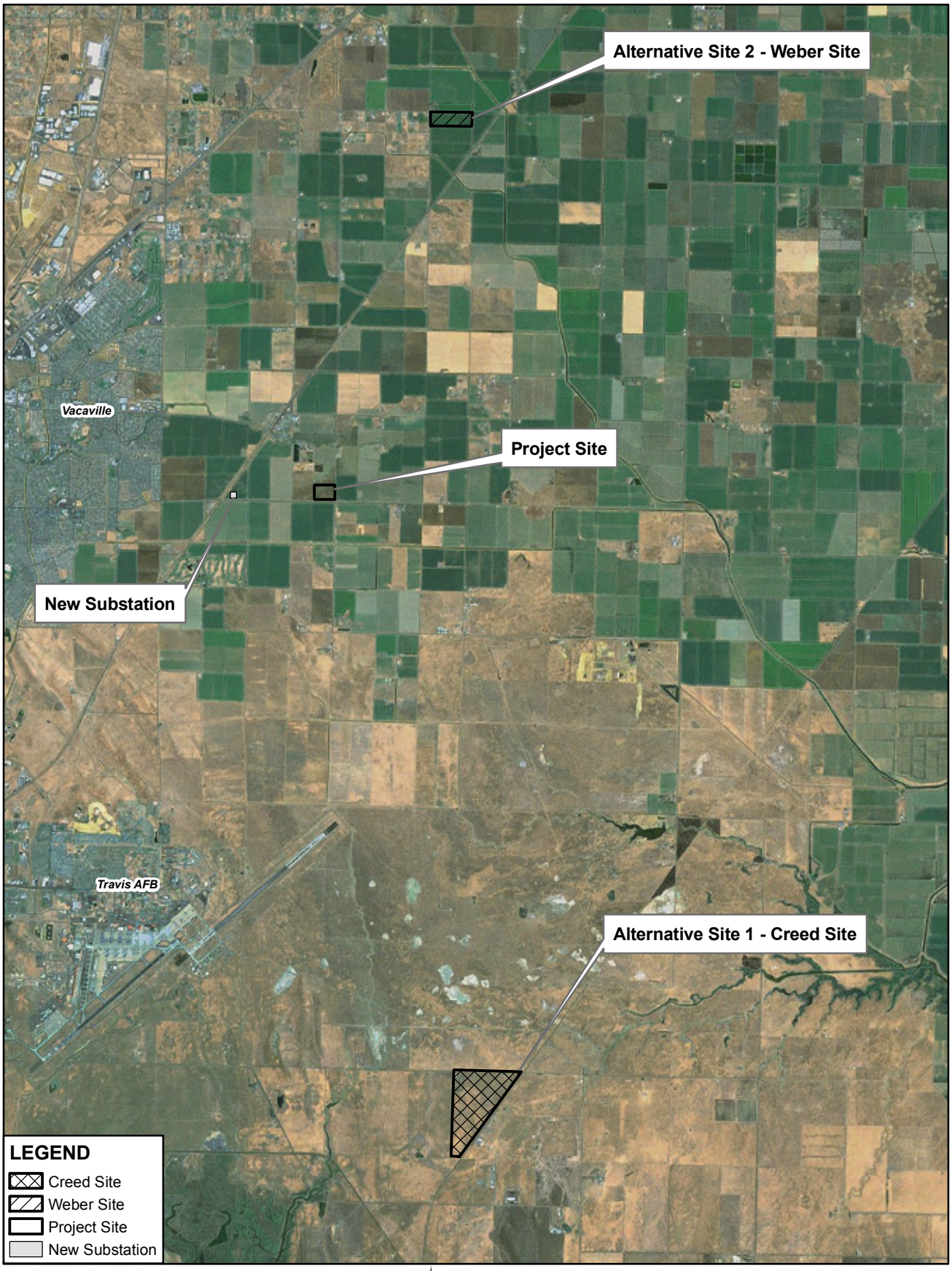
6.3.3 Alternative 2: Weber Site

This alternative is located approximately 4.5 miles northeast of the CPVVS site at the southeast intersection of Weber Road and Fox Road. This property is currently farmed, and is approximately 50 acres in size. This property is zoned A-40, Exclusive Agriculture, and is located within unincorporated Solano County. Secondary-treated water from the EWTP would require the installation of an approximately 5.25-mile-long water line. This site could tie into the existing 230-kV transmission towers, which are located along the western side of the property, however an onsite substation would need to be constructed. Alternatively, if a substation was not desired onsite, a 2.3-mile-long electrical transmission line would need to be constructed to tie this site to the Vaca-Dixon Substation. This site would also require a 2.3-mile-long natural gas line to tie into the high-pressure PG&E Line 400/401 which runs adjacent to the Vaca-Dixon Substation. In addition, it is currently unknown whether or not site control would be feasible at this location.

6.4 Comparative Evaluation of Alternative Sites

In the discussion that follows, the sites are compared in terms of each of the 16 topic areas required in the AFC, as well as in terms of project development constraints. The most useful topics for comparison are as follows:

- **Project Development Constraints—**Are there site characteristics that would prohibit or seriously constrain development, such as significant contamination problems, or lack of fuel, transmission capacity, or water?
- **Land Use Compatibility—**Is the parcel zoned appropriately for industrial use and compatible with local land use policies?



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

FIGURE 6.3-1
ALTERNATIVE SITE LOCATIONS
CPV VACA STATION
VACAVILLE, CA

CH2MHILL

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- **Routing and Length of Linear Facilities—**Can linear facilities be routed to the site along existing transmission lines, pipelines, and roads? Will linear facilities be significantly shorter for a given site?
- **Visual Resources—**Are there significant differences between the sites in their potential for impact on valuable or protected viewsheds?
- **Biological Resources—**Would there be significant impacts on wetlands or threatened or endangered species such that mitigation of these effects would be unduly expensive or constrain the supply of available mitigation resources?
- **Contamination—**Is there significant contamination on site, such that cleanup expense would be high or such that cleanup would cause significant schedule delay?
- **Noise—**Is the site sufficiently near a sensitive receptor area such that it would be difficult to mitigate potential noise impacts to below the level of significance?
- **Use of Previously Disturbed Areas—**Has the site been previously disturbed? Does the site minimize the need for clearing vegetation and otherwise present low potential for impact on biological and cultural resources?
- **Other Environmental Categories—**Are there significant differences between the sites in their potential for impact in other environmental categories?

There is no precise mathematical weighting system established for considering potential impacts in alternatives analyses. Some of the criteria used to compare the alternatives are more or less important to consider than others. For example, an impact that could affect public health and safety or could result in significant environmental impacts is obviously of greater concern than a purely aesthetic issue associated with an advisory design guideline. It is important in comparing alternatives to focus on the key siting advantages and the potential adverse environmental effects of a particular site. Comparing each of the environmental disciplines and giving each discipline equal weight would provide a misleading analysis because effects in one area are not necessarily equivalent in importance to effects in another area.

For example, although the sites may differ in terms of available local road and street capacities and the current levels of traffic congestion, the number of workers during the operational phase of the project is low and would be unlikely to have a significant effect on local traffic. The sites may differ widely in the amount of traffic congestion they would cause during construction, but this is a temporary impact and should not be a strong consideration in site selection, as long as measures to mitigate this impact are feasible. The sites would not differ significantly in terms of geological hazards, though proximity to a major fault would call for more rigorous and expensive seismic engineering. Hazardous materials handling and worker health and safety issues would be the same or nearly the same for most sites. Though the risk of a release of hazardous materials during transport might be seen as more or less likely depending on location (roadway hazards, in particular), the record of safe transport and handling of such materials is clear. Further, the sites considered here are all in or near urban areas that are served by good transportation networks and are close to the sources of supply.

Project effects on paleontological and cultural resources are not often consequential in comparing alternatives. Once an initial screening for effects on highly significant sites is completed, the probabilities of encountering hidden paleontological or cultural resources during construction are difficult to calculate or compare.

6.4.1 Project Development Constraints

As indicated in the introductory descriptions of each of the alternative sites, the basic needs of power plant siting for land, access to electrical transmission, gas supply, and water are met at the CPVVS site. The Creed site is well located in this regard, as natural gas and electrical transmission are located within a 1-mile radius; however, the site would require a 9-mile reclaimed water supply pipeline. The Weber site would require construction of a new onsite substation and could tie directly into a 230-kV transmission line that runs along the western portion of the property. The Weber site, however, would require a 2.3-mile-long natural gas line, and a 5.25-mile reclaimed water supply pipeline.

6.4.2 Air Quality

The quantity of emissions from project operation would be the same at any of the sites. Each of the sites has similar contributions to airsheds and would, therefore, be subject to similar review, emission reduction crediting, and permitting requirements. Each site is located in relatively flat terrain that will help to promote dispersion of emissions. The differences between the sites in terms of their distances from the nearest residences should not make a significant difference in air quality impacts at these residences. Mitigation would bring any potential impacts to a level below significance for any of the alternatives.

6.4.3 Biological Resources

The CPVVS site has some biological resources or habitat value. The entire site consists of a fallow agriculture field that has not been farmed actively for several years and may provide some limited habitat. The Weber site is under cultivation at this time, and there appears to be limited habitat at this site. The Creed site is located in a biologically sensitive area, with many vernal pools in the vicinity. This site also is located near areas with known threatened and endangered species. Mitigation as well as permitting (both state and federal) for biological resources may be required to develop the Creed site.

6.4.4 Cultural Resources

There are no known significant cultural resources at the CPVVS site. Resources of the Creed and Weber sites are unknown. Each of the sites has approximately the same general cultural resource sensitivity.

6.4.5 Geological Resources and Hazards

There would be no significant difference between the sites in terms of geological resources and hazards. There are no geological resources located on or near any of the sites.

6.4.6 Hazardous Materials Handling

There would be no significant difference between the site locations in terms of hazardous materials handling. The uses of hazardous materials would be the same for any of the sites.

Though there might be differences in the distances that trucks carrying hazardous materials would travel to deliver the materials, these differences would be minor and would not necessarily be consequential, given the effective mitigation measures available and the excellent safety record for transport of these materials.

6.4.7 Land Use and Agriculture

The proposed CPVVS site is zoned Community Facility, which allows for the use of power plants producing greater than 50 MW. The Creed site is zoned MG-3, General Manufacturing, and is located adjacent to three existing peaker power plants. Neither of these sites would present a significant land use conflict. The Weber site, however, is zoned A-40, Exclusive Agricultural, and would present a significant land use conflict.

The proposed CPVVS site is designated by the California Department of Conservation as Prime Farmland. The Creed site is designated as Grazing Land, and the Weber site is designated approximately 50 percent Prime Farmland and 50 percent Unique Farmland. Neither the CPVVS site nor the Creed site has a Williamson Act contract. The Weber site does have a Williamson Act contract that went into effect in December 1976 and would require a cancellation filing and fee payment to the Solano County Resource Management Department (Casazza, 2008).

6.4.8 Noise

Developments at each site would be able to meet the appropriate City and County noise standards. The proposed CPVVS site is located approximately 800 feet from the nearest residence, while the Creed site is approximately 3,900 feet from the nearest residence and the Weber site is located directly across the street (approximately 300 feet) from the nearest residence.

6.4.9 Paleontology

There would be no significant difference between the sites in terms of potential effects on paleontological resources. The probability of encountering significant fossils is approximately the same at each site.

6.4.10 Public Health

The project would not be likely to cause significant adverse long-term health impacts (either cancer or non-cancer) from exposure to toxic emissions, regardless of the site chosen.

6.4.11 Socioeconomics

All three sites are located in Solano County. The number of workers, construction costs, payroll, and property tax revenues would be nearly the same for the project at each of the sites. The majority of the workers would come from the Solano County area, depending on the site. Most workers would commute daily or weekly to the plant site. Some may move temporarily to the local area during construction, causing site-specific impacts on schools, utilities, and emergency services. These impacts would be temporary. Disproportionate impacts on minority and low-income populations would be unlikely because minority populations are not concentrated in an area or areas that are also high potential impact

areas. The project is not likely to cause significant adverse public health impacts on areas that are disproportionately minority or low income.

6.4.12 Soils

Use of the proposed CPVVS, Creed, or Weber sites would involve the conversion of agricultural land to industrial uses. The CPVVS site has not been farmed for several years. The Weber site is currently farmed; the Creed site is in use for grazing and does not appear to be farmed.

6.4.13 Traffic and Transportation

The number of employees working at a given time during project operation (approximately two) will not significantly impact local traffic conditions at any of the sites. The peak number of employees during construction (654) will have much more impact. The impact will be temporary and can be mitigated by transportation management planning. Therefore, the effect on construction-phase traffic should not figure as a major consideration in evaluating or comparing the sites.

6.4.14 Visual Resources

None of the sites are located in an area with protected viewshed or in a designated viewshed corridor. From the proposed CPVVS site, the project would be visible to local residents because of the open and agricultural nature of the area surrounding the site. The EWTP would provide some screening from viewers located to the north or northwest of the proposed CPVVS site; however, several structures at the plant would extend above the current structures at the EWTP. Although the CPVVS would be a large structure, there are few residential viewers in the nearby area.

The Creed site also is located in a predominantly agricultural area; however, three peaking power plants are present to the east and southeast within 1.5 miles of the site. Although the area is not predominantly industrial in nature, the addition of another power plant to the area, particularly a larger, combined-cycle power plant, would have the possibility of changing the character of this area such that it would appear more to be an industrial area in a rural setting, rather than an isolated power plant in an agricultural area. The Weber site is situated in a wholly agricultural area, with no industrial screening available. An industrial facility such as the power plant would be visible from all directions.

6.4.15 Water Resources

Both the proposed CPVVS and Weber sites could use secondary treated recycled water for power plant cooling from the EWTP. This is consistent with the State Water Resources Control Board's Policy 75-58 indicating that water for combined-cycle power plant cooling should avoid using fresh inland waters if other waters (such as treated wastewater) are available. The CPVVS site would require a 2,600-foot-long corridor to connect to the EWTP, while the Weber site would require a 5.2-mile pipeline along rural roads. It is anticipated that, because of the proximity of three peaking plants near the Creed site, groundwater is available at this site. Alternatively, the Creed site would require a 9-mile-long pipeline to the EWTP to obtain secondary treated recycled water.

6.4.16 Waste Management

The management of wastes would not differ between the proposed project site and the two alternatives. The three sites are vacant; no demolition would be necessary. Waste generated at the three sites during operations would be similar.

6.4.17 Summary and Comparison

Based on the site selection criteria as described in Section 6.3, it is clear that power plant siting is feasible at all three sites. Following is a summary of site selection factors:

- **Location near the centers of electrical demand—**Each of the sites is located within Solano County and near the cities of Vacaville and Fairfield, where electrical demand is high.
- **Land zoned for industrial use—**Two of the sites (proposed CPVVS site and the Creed site) are zoned appropriately for siting of a power plant. The Weber site is zoned agricultural.
- **Location near a sufficient source of cooling water, preferably treated wastewater—** The proposed CPVVS site is located adjacent to a sufficient source of reclaimed water from the EWTP. The CPVVS site would require an approximately 2,600-foot-long utility corridor to be constructed. The Weber site could also connect to the EWTP via a new 5.2-mile long pipeline. The Creed site is located 9 miles from the EWTP and would either require a new pipeline of this length or the use of groundwater for cooling.
- **Location near electrical transmission facilities—**The CPVVS site will require a 1-mile-long transmission line to be constructed to the west to connect the site to two existing 230-kV circuits, the Vaca-Dixon to Lambie and Vaca-Dixon to Peabody transmission lines. A new substation would need to be constructed at the corner of Fry and Meridian roads to tie into these lines. The Creed site also would tie into an existing 230-kV transmission line corridor, located approximately 1,400 feet to the west. The Weber site would be able to tie into an existing 230-kV transmission line located on the western side of the property. A new substation would be needed both at the Creed and Weber sites to allow interconnection into the 230-kV transmission lines. Alternatively, if a switchyard is not desired at the Weber site, a 2.3-mile-long transmission line would need to be constructed to the west to tie into the existing Vaca-Dixon Substation.
- **Location near ample natural gas supply—**Each of the sites is located near a sufficient source of fuel gas. Line 401 is located 1 mile to west of the CPVVS site. The Weber site would require a 2.3-mile-long natural gas line to tie into Line 401 near the Vaca-Dixon Substations. The Creed site would require an approximately 1-mile-long tie-in to a 42-inch high-pressure PG&E gas line located to the east.
- **Parcel or adjoining parcels of sufficient size for a power plant—**There is sufficient land available at each parcel to develop a power plant.
- **Site control feasible—**Site control is feasible at the CPVVS site. It is unknown whether or not the Creed or Weber sites are available for lease or purchase. Therefore, site control feasibility for these sites is undetermined.

- **Mitigation of potential impacts feasible—**Mitigation of potentially significant environmental impacts appears feasible at the CPVVS site. Because of the zoning of the Weber site, it is unknown if mitigation will be possible. Because of the propensity for biological resources at the Creed site, it is unknown if mitigation will be possible.

When taking into account the comparative analysis provided above, the CPVVS site best meets the project objectives as compared to the Creed and Weber sites. Specifically, the CPVVS site is located more than 800 feet from the nearest residential area; therefore, visual and noise impacts on any sensitive receptors would be minimal and/or mitigatable. The CPVVS site has a known supply of secondary treated wastewater for cooling and would require the shortest utility corridor. Transmission corridors are similar for the three sites, all requiring a tie-in to an existing 230-kV transmission corridor, and all three sites would require the construction of a new substation.

Both the CPVVS site and the Creed site are zoned appropriately for power plant uses and, although located in agricultural areas, have some pre-existing industrial facilities nearby. In addition, neither the CPVVS nor the Creed site has a Williamson Act contract in place. The Weber site is zoned agricultural and may require modification of the zoning to allow for construction of a power plant. Additionally, the Weber site has a Williamson Act contract that would require filing a cancellation and paying a fee to develop the property. The proposed CPVVS site and Weber sites are similar in terms of biological resource impacts because they are located in areas where farming is prevalent. The Creed site is located in an area with known biological resources, such as vernal pools and threatened and endangered species. Additional mitigation and time-intensive permitting with state and federal entities would be needed to construct a power plant at this site. Additionally, it is unknown whether the Creed or Weber sites are available for long-term lease or purchase. Because the Creed site has three existing peaker plants in the near vicinity, it is possible that a fourth plant would encounter resistance from the local community.

The CPVVS site best meets the project objectives without resulting in any adverse environmental impacts as compared to the Creed or Weber sites. As a result, the Creed and Weber sites were rejected in favor of the CPVVS site. Table 6.4-1 provides a summary of the environmental and project development constraints for all three sites.

6.5 Alternative Project Design Features

The following section addresses alternatives to some of the CPVVS design features, such as the locations of the natural gas supply pipeline, electrical transmission line, and water supply pipeline.

6.5.1 Alternative Natural Gas Supply Pipeline Routes

The preferred natural gas supply pipeline would extend south from the project site and east approximately 1 mile along Fry Road to PG&E Line 401. Because of the short distance and direct route, no other alternatives were analyzed.

TABLE 6.4-1
Environmental and project development constraints of the CPVVS and alternative sites

Site or Alternative	CPVVS Site	Weber	Creed
Site control	Yes	No	No
Land Use and zoning	Zoned as CF – Community Facility, power plants over 50 MW are a permitted use	Zoned as AG-40 – Agricultural use only	Zoned as MG-3 – General Manufacturing greater than 3 acres in size
California Department of Conservation Designation	50% Prime Farmland	50% Prime Farmland 50% Unique Farmland	100% Grazing Land
Williamson Act Contract	No	Yes	No
Sensitive noise receptors nearby	Few nearby residences	Few nearby residences	Few nearby residences
Visual resources	EWTP located to the north of the proposed site blocking views for residents to north and northwest. Limited residences in surrounding area.	No industrial facilities in nearby vicinity. Facility would be visible from all directions.	Three existing peaking power plants within 1.5 miles of proposed site. Some industrial activities present in area.
Biological resources	Land has not been farmed in many years, may provide habitat for wildlife and ground-nesting birds.	Site is currently farmed; provides limited habitat for wildlife	High sensitivity to biological resources. Site is located in area with a known concentration of vernal pools. Habitat for threatened and endangered species is likely at the site.
Cultural resources	No	No	No
Significant unmitigated impacts or costly mitigation?	No	Site would need to be rezoned and the Williamson Act contract cancelled. A long pipeline would be needed to supply recycled water.	A several-mile-long pipeline would be needed to supply recycled water. High density of vernal pools, which are habitat for threatened and endangered species, means a long and costly permitting and mitigation process.

6.5.2 Electrical Transmission System Alternatives

The preferred transmission alternative is to connect with a new substation to be located at the northwest corner of Fry and Meridian roads, which will be constructed as part of this project. The substation will connect directly into the two existing 230-kV circuits, Vaca-Dixon to Creed and Vaca-Dixon to Peabody, located approximately 1 mile to the west of the proposed CPVVS site. The alternative route analyzed would instead cross Fry Road at

the CPVVS site, run along the south side of Fry Road to Meridian Road, then cross back to the north side of Fry Road and enter the substation.

6.5.3 Water Supply Alternatives

The EWTP will supply secondary treated wastewater for the proposed project through a proposed 2,600-foot-long utility corridor located north of the proposed CPVVS site. Other sources of water might include potable water from the onsite well used to supply potable water to the EWTP or potable water from the City's supply. Reclaimed water better meets the project objectives because it provides for beneficial use of treated wastewater, which might otherwise be wasted. Using potable water from either the onsite wells or local system would involve consuming large quantities of scarce fresh water for power plant cooling that could be more beneficially used for other purposes.

6.6 Technology Alternatives

The configuration of the CPVVS was selected from a wide array of technology alternatives. These include generation technology alternatives, fuel technology alternatives, combustion turbine alternatives, and nitrogen oxide (NO_x) control alternatives.

6.6.1 Generation Technology Alternatives

Selection of the power generation technology focused on those technologies that can utilize the natural gas readily available from the existing transmission system. Following is a discussion of the suitability of such technologies for application to the CPVVS that were each rejected for failing to meet project objectives for the reasons described below.

6.6.1.1 Conventional Boiler and Steam Turbine

This technology burns fuel in the furnace of a conventional boiler to create steam. The steam is used to drive a steam turbine-generator, and the steam is then condensed and returned to the boiler. This is an outdated technology that can achieve thermal efficiencies up to approximately 36 percent when utilizing natural gas, although efficiencies are somewhat higher when utilizing oil or coal. Because of this low efficiency and large space requirement, the conventional boiler and steam turbine technology was eliminated from consideration.

6.6.1.2 Simple-Cycle Combustion Turbine

Aero-derivative turbine-generator units are able to achieve thermal efficiencies up to approximately 38 percent. A simple-cycle combustion turbine has a quick startup capability and lower capital cost than that of a combined-cycle, and is very appropriate for peaking applications. Because of its relatively low efficiency, conventional simple-cycle technology tends to emit more air pollutants per kilowatt-hour. Because of this relatively low efficiency, simple-cycle combustion turbine technology was eliminated from consideration.

6.6.1.3 Kalina Combined-Cycle

This technology is similar to the conventional combined-cycle, except a mixture of ammonia and water is used in place of pure water in the steam cycle. The Kalina cycle could potentially increase combined-cycle thermal efficiencies by several percentage points. This

technology is still in the development phase and has not been commercially demonstrated; therefore, it was eliminated from consideration.

6.6.1.4 Internal Combustion Engines

Internal combustion engine designs are also available for small peaking power plant configurations. These are based on the design for large marine diesel engines, fitted to burn natural gas. Advantages of internal combustion engines are that they use very little water for cooling because they use a closed-loop coolant system with radiators and fans; provide quick-start capability (on-line at full power in 10 minutes); and are responsive to load-following needs because they are deployed in small units (for example, 10 to 14 engines in one power plant) that can be started up and shut down at will. Disadvantages of this design include somewhat higher emissions than comparable combustion turbine technology. Additionally, internal combustion engine installations are generally deployed at less than 150 MW and so would not meet the project objective to generate 660 MW of power.

6.6.2 Power Plant Cooling Alternatives

Dry cooling technology was evaluated as an alternative to the use of recycled water for power plant cooling. In the dry cooled system using an air-cooled condenser (ACC) system, exhaust steam from the steam turbine is cooled and condensed in a large external heat exchanger, using atmospheric air as the cooling medium. Large, electric motor-driven fans move large quantities of air across finned tubes (similar in principle to an automobile radiator), through which the exhaust steam is flowing. Heat transfer from the hot steam to the air cools the steam, which condenses and is returned to the steam cycle.

At 97 °F, use of dry cooling would result in an overall performance loss of approximately 5.4 MW and a heat rate impact of approximately 1 percent. This represents a significant loss of power plant efficiency with no significant environmental or economic benefit. The facility would have to burn additional fuel and its air emissions would increase. Recycled water is readily available in this location and is currently unused. Further, the air cooled-condenser array necessary for a power plant of this scale would require a massive structure for which there is inadequate space on the CPVVS site. In addition, the air-cooled condensers would be highly visible and would generate more noise than a conventional cooling tower. For these reasons, dry cooling was rejected as a power plant cooling technology. There are no other technologies currently available that are capable of adequately cooling the CPVVS.

6.6.3 Fuel Technology Alternatives

Technologies based on fuels other than natural gas were eliminated from consideration because they do not meet the project objective of utilizing natural gas available from the existing transmission system. Additional factors rendering alternative fuel technologies unsuitable for the proposed project are as follows:

- No geothermal or hydroelectric resources exist in Solano County.
- Biomass fuels such as wood waste are not locally available in sufficient quantities to make them a practical alternative fuel, and CPVVS site space is limited.

- Solar and wind technologies are not flexible and dispatchable resources because they must respond to available wind or solar radiation; CPVVS space is limited and these technologies require large expanses of land.
- Coal and oil technologies emit more air pollutants than technologies utilizing natural gas.
- The availability of the natural gas resource provided by PG&E and the environmental and operational advantages of natural gas technologies make natural gas the logical choice for the proposed project.

6.6.4 NO_x Control Alternatives

To minimize NO_x emissions from the CPVVS, the combustion turbine generators (CTGs) will be equipped with water injection combustors and selective catalytic reduction (SCR) using aqueous ammonia as the reducing agent. The following combustion turbine NO_x control alternatives were considered:

- Steam injection (capable of 25 to 42 parts per million [ppm] NO_x)
- Water injection (capable of 25 to 42 ppm NO_x)
- Dry low NO_x combustors (capable of 15 to 25 ppm NO_x)

Water injection or dry low NO_x were selected because these allow for lower acceptable NO_x emissions while being able to achieve an output turndown rate of 30 percent. This turndown is necessary to meet variable load demand.

Two post-combustion NO_x control alternatives were considered:

- SCR
- $SCONO_x$™

SCR is a proven technology and is used frequently in combined-cycle applications. Ammonia is injected into the exhaust gas upstream of a catalyst. The ammonia reacts with NO_x in the presence of the catalyst to form nitrogen and water.

$SCONO_x$™ consists of an oxidation catalyst, which oxidizes carbon monoxide to carbon dioxide and nitric oxide to nitrogen dioxide. The nitrogen dioxide is adsorbed onto the catalyst, and the catalyst is periodically regenerated.

The level of emission control effectiveness between the $SCONO_x$ and SCR technologies is approximately the same. However, the $SCONO_x$ technology does not use ammonia to reduce air emissions. The California Energy Commission recently summarized in the U.S. Environmental Protection Agency's opinion (Colusa Generating Station Final Staff Assessment, CEC 2007) "that $SCONO_x$ is no more effective for reducing air quality impacts than selective catalytic reduction…, and it also found $SCONO_x$ to be significantly more expensive and arguably less reliable, particularly for larger facilities." Therefore, $SCONO_x$ was not considered for the CPVVS project.

The following reducing agent alternatives were considered for use with the SCR system:

- Anhydrous ammonia
- Aqueous ammonia
- Urea

Anhydrous ammonia is used in many combined-cycle facilities for NO_x control, but is more hazardous than diluted forms of ammonia. Aqueous ammonia (a 19 percent ammonia, 81 percent water solution) is proposed for the CPVVS because of its safety characteristics. Urea has not been commercially demonstrated for long-term use with SCR and was eliminated from consideration.

6.7 References

Casazza, Les/Solano County Assessor Property Appraiser. 2008. Personal communication with Wendy Haydon/CH2M HILL. June 10, 2008.

California Energy Commission (CEC). 2007. Final Staff Assessment for the Colusa Generating Station Power Plant. November.