Chapter 21
Energy

21.0 Summary Comparison of Alternatives

A summary comparison of important energy impacts is provided in Figure 21-0. This figure provides information on the magnitude of the most pertinent and quantifiable energy impacts that are expected to result from all alternatives. Important impacts to consider include the energy needed to construct the water conveyance facilities as well as the energy required to operate the facilities.

As depicted in Figure 21-0, each alternative, with the exception of the No Action Alternative, would require use of electric energy during the construction of the water conveyance facilities. Among the action alternatives, Alternative 9 would require the least energy, 186 gigawatt hours (GWh). Alternative 2D would require the most electric energy, 2,148 GWh. Alternatives 4, 4A, and 5A would require a similar amount of electric energy, 2,132 GWh for Alternatives 4 and 4A or 2,116 GWh for Alternative 5A.

Each alternative would require an increased amount of electric energy for the operation of the proposed conveyance facilities, compared to the No Action Alternative and Existing Conditions. Among the action alternatives, Alternative 9 would require the least electric energy, 18 GWh per year (GWh/yr). Alternative 6A would require the most electric energy, 421 GWh/yr. Alternatives 4, 4A, 2D, and 5A would fall in the low end of this range, with Alternative 4 requiring up to 62 GWh/yr under Operational Scenario H4, Alternative 4A requiring 61 GWh/yr, Alternative 2D requiring 107 GWh/yr, and Alternative 5A requiring 26 GWh/yr.

Table ES-8 in the Executive Summary provides a summary of all impacts disclosed in this chapter.

21.1 Environmental Setting/Affected Environment

Energy is consumed during the construction, operation, and maintenance of projects, both directly and indirectly. This section describes the existing energy resources available within the project area and analyzes the potential effects to these energy resources from construction and operation of the action alternatives in the study area (the area in which impacts may occur). This chapter was prepared pursuant to State CEQA Guidelines Sections 21100(b)(3) and 15126.4(a)(1)(c), and is consistent with Appendix F of the State CEQA Guidelines. The study area consists of the Plan Area (the area covered by the BDCP), which is largely formed by the statutory borders of the Delta, along with areas in Suisun Marsh and the Yolo Bypass; and the Areas of Additional Analysis (see Chapter 3, *Description of Alternatives*, Section 3.3.1). New water conveyance facilities associated with the action alternatives would be constructed, owned, and operated as a component of the State Water Project (SWP). While additional power used to move water through the new water conveyance facilities would be procured by DWR, the Delta pumping energy requirements are directly linked to the SWP and Central Valley Project (CVP) exports and the monthly water supply deliveries to the various SWP and CVP contractors. Accordingly, this section discussed the energy generation at the SWP and CVP hydropower facilities and the energy use for pumping water supplies into the various canals and tunnels in the water conveyance and distribution systems.

This chapter evaluates the energy demand for each action alternative relative to Existing Conditions (for CEQA) and No Action Alternative (for NEPA). *Existing Conditions* (also referred to as *CEQA Baseline*) is defined as the SWP and CVP energy generation and energy demand for pumping in 2010. The *No Action Alternative late long-term (LLT*) (also referred to as the *NEPA point of comparison*) and the No Action Alternative early long-term (ELT) is defined as future SWP and CVP energy generation and energy demand for pumping in 2060 and 2025, respectively The difference in energy demand between each action alternative and their respective No Action Alternative (either LLT or ELT) represents the net impact of the project under either 2060 or 2025 conditions. The difference in energy demand between each action alternative and the CEQA baseline represents net impact of the project, relative to Existing Conditions (2010).

Historic CVP and SWP energy generation and use provide the energy context for evaluating the additional energy requirements for the action alternatives. Energy effects are evaluated as the additional pumping energy requirements for the action alternatives and the additional energy for pumping increased Delta exports for some of the action alternatives. The action alternatives may cause upstream reservoir operations changes that could alter the hydropower generation in some months or alter the pumping at existing facilities in other months. These changes could increase the net energy gap between the CVP and SWP hydropower generation and the pumping energy uses. However, because most of the variations in energy generation result from hydrologic variations in runoff, the small effects from slightly different reservoir operations for each alternative are not further considered.

Hydropower energy generation is a major project purpose for the CVP and SWP. Hydropower energy has always been an important part of the benefits and financing of state, federal, and private water resources developments in California. The runoff from the Sierra Nevada and Cascade mountains provided a great potential for hydropower development, which has now been harnessed to pump water supplies into the CVP and SWP canals, San Luis Reservoir, and water distribution systems. Some additional energy is used for groundwater pumping by CVP and SWP contractors when surface water supplies are limited in dry years.

Additional pumping and Delta export energy requirements for the BDCP alternatives was simulated using the CALSIM model (version II). It is important to note that given the inherent complexity of the SWP, CVP, and Delta operation, planning tools such as CALSIM-II may not produce the same operational patterns, energy demand and generation profiles that have been observed in recent years. The ever changing regulatory environment that the SWP and CVP projects operate under is a challenge for planning tools, such as CALSIM-II. Energy calculations based on CALSIM-II represent a reasonable, though overstated, scenario based on historic monthly flows and reservoir storage. Additional details on CALSIM-II are provided in Section 21.1.3.1, *CVP and SWP Energy Generation*.

Understanding the energy evaluation will be easier with a brief introduction to some basic energy units. The basic units of electrical power (capacity) are kilowatt (kW), megawatt (MW), and gigawatt (GW). A megawatt is 1,000 kW, and a gigawatt is 1,000,000 kW or 1,000 MW. It is common for energy to be reported as the power supplied or consumed over a unit of time. For instance, generating electricity at the rate of 1 kW for 1 hour is a kilowatt hour (kWh). A 100 MW (100,000 kW) generating facility would produce 2,400,000 kWh (2,400 megawatt hours (MWh) or 2.4 gigawatt hours [GWh]) in a day.

Chapter 21 – Energy	Alternative																				
	Existing Condition	No Action ELT	No Action LLT	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9	4A	2D	5A
ENG-1: Total electric energy use for construction (GWh)	n/a	0	0	1,428	407	791	1,428	407	791	1,321	H1: 2,132 H2: 2,132 H3: 2,132 H4: 2,132	730	1,428	407	791	1,357	1,357	186	2,132	2,148	2,116
	n/a		LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA
ENG-2: Total electric energy use for Conveyance (GWh/yr)	n/a	0	0	291	176	297	328	190	322	122	H1: 62 H2: 54 H3: 61 H4: 54	78	421	244	413	193	185	18	61	107	26
	n/a		LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA

Key

Level of significance or effect **before** mitigation (Quantity of impact: number of sites, structures, acres, etc. affected)

Increasing level of significance

n/a not applicable
> greater than
< less than
≈ about equal to

Level of significance or effect **after** mitigation (CEQA Finding / NEPA Finding)

CEQA Finding
NI No Impact
LTS Less than significant
S Significant
SU Significant and unavoidable

NEPA Finding
B Beneficial
NE No Effect
NA Not Adverse
A Adverse

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Figure 21-0
Comparison of Impacts on Energy

21.1.1 CVP Hydropower Generation and Pumping Facilities

The Bureau of Reclamation (Reclamation) planned, constructed, financed, and operates the CVP energy-producing facilities. Western Area Power Administration (WAPA) is within the Department of Energy (DOE) and is responsible for providing transmission/distribution services and marketing excess energy produced by CVP facilities. WAPA is one of four national power marketing administrations that sells and transmits power generated by federal hydroelectric facilities (Western Area Power Administration 2009).

The amount of water released from CVP reservoirs controls the CVP energy generation each month or year. The CVP energy use for pumping water south of the Delta depends on the CVP pumping from the Delta and seasonal storage in San Luis Reservoir. On an annual basis CVP hydropower plants have historically generated energy in excess of the amount needed to pump CVP water, thus allowing WAPA to sell this excess energy to other electric utilities, municipalities, industrial customers, and other identified Preference Power Customers. Preference Power Customers are publicly owned systems and/or nonprofit cooperatives that are given preference by law over investor-owned utilities to receive power generated by federal projects (Bureau of Reclamation 2009). WAPA primarily markets power using long-term firm power contracts. When CVP generation is not sufficient to cover CVP pumping requirements on a daily basis, WAPA purchases needed electricity from other sources.

CVP hydropower and pumping facilities are discussed in the following sections. Table 21-1 shows energy generation and flow parameters for the CVP hydropower facilities; Table 21-2 shows pumping capacities and energy requirements of these CVP pumping facilities. Energy generation at the reservoir power plants and pumping energy at the Gianelli pumping plant depend on the reservoir storages (i.e., elevations) that controls the water heads (feet).

Table 21-1. CVP Hydropower Generation Capacity of Facilities

Facility	Water Head (feet)		Max Flow (cfs)	Max Volume (af/day)	Capacity (MW)	Max Generation (MWh)	Generator Efficiency	Max Energy Factor (kWh/af)
	Min	Max						
Trinity Dam and Powerplant	245	470	4,200	8,400	140	3,360	0.85	400
J. F. Carr Powerplant	692	712	3,300	6,600	160	3,840	0.82	582
Spring Creek Powerplant	602	636	4,200	8,400	190	4,560	0.85	543
Shasta Dam and Powerplant	260	487	18,000	36,000	710	17,040	0.97	473
Keswick Dam and Powerplant	74	87	15,000	30,000	105	2,520	0.97	84
Folsom Dam and Powerplant	197	336	8,000	16,000	210	5,040	0.94	315
Nimbus Dam and Powerplant	38	45	4,500	9,000	15	360	0.89	40
New Melones Dam and Powerplant	200	480	10,000	20,000	380	9,120	0.95	456
Gianelli Pumping-Generating Plant (Joint CVP and SWP)	100	320	16,000	32,000	400	9,600	0.94	300
O'Neill Pumping-Generating Plant (Joint CVP and SWP)	45	53	6,000	12,000	25	600	0.94	50

af = acre-feet.
cfs = cubic feet per second.
kWh = kilowatt hours.
MW = megawatts.
MWh = megawatt hours.

Table 21-2. CVP Pumping Capacity of Facilities

Pumping Plant	Pumping Head (feet)		Max Flow (cfs)	Max Volume (af/day)	Capacity (hp)	Capacity (MVA)	Efficiency	Energy Factor (kWh/af)
	Min	Max						
Red Bluff		25	2,500	5,000	8,000	6	0.87	29
C. W. "Bill" Jones		197	5,000	10,000	140,000	105	0.78	252
O'Neill Pumping-Generating Plant (Joint CVP and SWP)	45	53	4,200	8,400	36,000	27	0.69	77
Gianelli Pumping-Generating Plant (Joint CVP and SWP)	100	320	11,000	22,000	504,000	378	0.78	412

af = acre-feet.
cfs = cubic feet per second.
hp = horsepower.
kWh = kilowatt hours.
MVA = megavolt ampere.

21.1.1.1 Trinity River and Sacramento River Facilities

The Trinity River Division includes the Trinity Dam and Powerplant, the Lewiston Dam and Powerplant, the Judge Francis Carr Powerplant, and the Spring Creek Powerplant. The Trinity Dam and Powerplant were completed in 1962 with a maximum water storage capacity of 2,450 thousand acre-feet (TAF) (Bureau of Reclamation 2012). Trinity Powerplant has a capacity of 140 MW with a maximum water head of 470 feet at full storage of 2,450 TAF. The minimum head is about 245 feet at the minimum storage for power generation of about 325 TAF. The maximum flow through the penstocks is about 4,200 cubic feet per second (cfs) at full storage. With an assumed turbine/generator efficiency of 85%, the energy generation factor (kilowatt hours per acre-foot [kWh/af]) is 400 kWh/af at maximum storage and is about 200 kWh/af at minimum storage. (The energy generation factor is approximately the water head multiplied by the turbine/generator efficiency.)

Lewiston Dam and Powerplant are 7 miles downstream of Trinity Dam. Lewiston Powerplant began operation in 1964 and has one generating unit with a capacity of 500 kW (Bureau of Reclamation 2012). Lewiston Powerplant generates electricity for the plant itself and the local fish hatchery, but does not generate much additional CVP power.

J. F. Carr Powerplant receives water from Lewiston Lake through the Clear Creek Tunnel and is located at the upstream end of Whiskeytown Lake. Operation began in 1963, and the two generating units were upgraded in 1984 to the current capacity of about 160 MW (Bureau of Reclamation 2012). The Carr Powerplant was designed to allow full diversions from the Trinity River. The Trinity Restoration Program in 2002 increased the Trinity River flows and reduced the average diversion from 1,000 TAF per year (TAF/yr) to about 500 TAF/yr. This reduced the average flow through the Carr Powerplant and the Spring Creek Powerplant by about 500 TAF/yr. The maximum water head is about 712 feet, with a maximum turbine flow of 3,300 cfs. The energy generation factor is about 582 kWh/af with an efficiency of 82%.

Spring Creek Powerplant, built in 1964, receives water from Whiskeytown Lake through the Spring Creek Tunnel and discharges water to Keswick Reservoir. The current capacity is 190 MW (Bureau of Reclamation 2012). The maximum water head is about 636 feet, with a maximum turbine flow of 4,200 cfs. The energy generation factor is about 543 kWh/af with an efficiency of 85%.

The Shasta Division consists of Shasta Dam and Powerplant and Keswick Dam and Powerplant. Construction of these CVP facilities began in 1938 and was completed in 1945. Shasta Powerplant has five generating units (and two station units). The Shasta Temperature Curtain was constructed (completed in 1997) to allow low-level releases for temperature control to be made without bypassing the power outlets. This allows energy generation year-round while still providing the coolest possible water temperatures below Keswick Dam. The current capacity of Shasta is 710 MW (Bureau of Reclamation 2012). The maximum water head is about 487 feet at maximum storage and is about 260 feet at minimum storage. The maximum flow rate is 18,000 cfs with an energy factor of about 473 kWh/af and an efficiency of about 97%.

Keswick Dam and Powerplant are located downstream of the Shasta Dam on the Sacramento River. The dam regulates peaking power releases from Shasta Dam to provide a constant release from Keswick Dam to the Sacramento River. Keswick Powerplant has three generating units with a combined capacity of 105 MW (Bureau of Reclamation 2012). The water head varies from about 74 feet to 87 feet (less head at high discharge). The maximum turbine flow is about 15,000 cfs with an energy factor of about 84 kWh/af and an efficiency of about 97%.

The Sacramento River Division includes the Red Bluff Diversion Dam, Corning Pumping Plant, and Corning and Tehama-Colusa Canals, but no facilities for the generation of electricity. The Corning Pumping Plant uses electricity and the new Red Bluff Pumping Plant (under construction) that will divert water into the Tehama-Colusa Canal (without lowering the Red Bluff diversion Dam gates) will use energy in the near future. The Corning Pumping Plant has six pumping units with a combined capacity of about 32 MW. The pumping head is about 70 feet and the flow is about 425 cfs with an efficiency of 85% and a pumping energy factor of about 85 kWh/af.

21.1.1.2 American River Facilities

The American River Division includes Folsom Dam and Powerplant, Nimbus Dam and Powerplant, Folsom Pumping Plant, and the Folsom South Canal. The Folsom Powerplant consists of three generating units with an installed capacity of 210 MW (Bureau of Reclamation 2012). The maximum water head at the Folsom Powerplant is about 336 feet at maximum storage with a maximum flow of 8,000 cfs with an energy factor of 315 kWh/af and an efficiency of 94%. The Folsom Pumping Plant supplies local domestic water supplies. The Nimbus Powerplant has two generating units with a capacity of about 15 MW. The maximum water head is 45 feet and the maximum flow is 4,500 cfs with an energy factor of about 40 kWh/af and an efficiency of 89%.

21.1.1.3 Stanislaus River Facilities

The New Melones Dam and Powerplant are on the Stanislaus River. New Melones Reservoir has a water storage capacity of 2.4 million acre-feet at a maximum pool elevation of 1,088 feet. The New Melones Powerplant has two generators with a capacity of 380 MW. The maximum water head is about 480 feet and the maximum turbine flow is about 10,000 cfs with an energy factor of about 456 kWh/af and an efficiency of 95%.

21.1.1.4 CVP Delta-Mendota Canal Facilities

The C. W. "Bill" Jones Pumping Plant is north of the city of Tracy and consists of six pumps. The pumps are each rated at 22,500 horsepower (hp) (16.7 MW), for a maximum energy requirement (capacity) of about 100 MW. The pumping plant has a maximum water head of about 197 feet and a maximum flow of about 5,000 cfs. The pumping efficiency is about 78% and the pumping energy factor is about 252 kWh/af. (Bureau of Reclamation 2012). Water from the Jones pumping plant flows into the Delta-Mendota Canal. The Contra Costa Water District (CCWD) diverts CVP water from the Delta for municipal and industrial and irrigation purposes. The Rock Slough Pumping Plant and the Contra Costa Canal were built as part of the CVP, but the pumping plant is now operated by CCWD.

The California Aqueduct/Delta-Mendota Canal Intertie (Intertie) allows water to be conveyed between the Delta-Mendota Canal and the California Aqueduct (Bureau of Reclamation 2012). The Intertie Pumping Plant with a capacity of about 400 cfs allows the Jones Pumping Plant to operate at full authorized pumping capacity of 5,000 cfs year-round. The lower Delta-Mendota Canal capacity of 4,200 cfs limits the Jones pumping in the winter when no water deliveries are being made. The pumping head will is about 50 feet and the energy requirements are 2 MW (Bureau of Reclamation 2012). The O'Neill Dam and Pumping-Generating Plant are at the convergence of the O'Neill Forebay and the Delta-Mendota Canal. The dam was completed in 1967. The O'Neill Pumping-Generating Plant utilizes six pumping units to lift water about 53 feet (depending on the surface height of the water) from the Delta-Mendota Canal to the O'Neill Forebay. The pumping units have a maximum flow of 4,200 cfs and require about 2.4 MW of energy capacity. When water is released to the Delta-Mendota Canal, the six units have a maximum flow of about 1,000 cfs and generate 25 MW (Bureau of Reclamation 2012).

The Gianelli Pumping-Generating Plant was constructed as a joint CVP-SWP facility between O'Neill Forebay and San Luis Reservoir. The pumping head ranges from a minimum of 100 feet at minimum storage in San Luis Reservoir to about 320 feet at maximum storage. The plant has eight pumping-generating units that can pump a maximum of 11,000 cfs with a pumping energy factor of 412 kWh/af, with an efficiency of about 78% and an energy requirement of 380 MW. When releasing a maximum flow of 16,000 cfs from San Luis Reservoir to O'Neill Forebay, the 8 units generate a maximum of 400 MW with an energy factor of about 300 kWh/af and an efficiency of about 95%. Because the Gianelli Pumping–Generating Plant is a joint SWP and CVP facility, the water pumped or released by each agency determines the energy supplied or energy generated by each agency (Bureau of Reclamation 2012).

21.1.2 SWP Hydropower Generation and Pumping Facilities

The SWP is one of the largest water and power systems in the world. Hydroelectric and natural gas facilities, along with contractual arrangements, are the major power sources of SWP power operations. The multipurpose nature of the SWP affects how its facilities are operated. Most times, the top operational priority is to maximize water deliveries to State Water Contractors, within the scope of regulatory requirements. The SWP was designed and built with other important purposes in mind, including flood control, hydroelectric power generation, protection of fish and wildlife and recreation. The basic operational tools used by DWR to accomplish SWP goals have been to increase or decrease upstream water releases, change Delta pumping rates and store water conveyed through the Delta at San Luis Reservoir. For a more detailed discussion of SWP operations, refer to Section 5.1.2, *SWP and CVP Facilities and Operations* in Chapter 5, *Water Supply*.

SWP operations, especially Delta export pumping, are closely coordinated with those of the larger federal CVP (see Section 21.1.1). The pumping plants of both systems are located in the same area of the South Delta. Their aqueduct operations are also coordinated, as are storage and pumping at San Luis Reservoir, a key facility serving both systems. For more detail on the coordinated operations of CVP and SWP, see Section 5.1.2.3, *SWP/CVP Coordinated Facilities and Operations* in Chapter 5, *Water Supply*.

Table 21-3 provides an annual summary of the SWP 2001–2010 pumping and generating operations; Table 21-4 shows the monthly SWP generation at Oroville Reservoir for 2001-2010.

Table 21-3. SWP Pump Load, SWP Hydro Generation (including Castaic), and SWP Water Deliveries

Parameter	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Pump Load (GWh)	6,568	8,276	8,912	9,801	8,289	9,114	9,291	5,707	5,444	7,225
Total Generation (GWh)	3,167	4,090	4,599	5,282	4,083	5,978	4,913	2,813	3,031	3,480
Water (acre-feet)	1,534,263	2,564,857	2,890,215	2,594,999	2,826,210	2,971,851	2,081,217	1,234,240	1,232,753	1,930,929
Total Water Deliveries (acre-feet)	3,193,771	4,009,873	4,168,151	4,328,460	4,726,363	4,827,082	4,061,696	2,838,128	2,915,435	3,502,986

GWh = gigawatt hour.

Table 21-4. Hyatt-Thermalito Monthly Generation (gigawatt hours)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total for Year
2001	97.98	57.22	79.77	78.29	192.98	162.10	149.27	139.14	55.69	89.33	63.77	69.15	1,235
2002	54.06	27.76	43.08	78.70	155.01	218.52	307.66	222.95	121.50	102.66	71.77	81.97	1,486
2003	58.89	161.48	49.90	44.26	153.03	226.40	483.35	317.10	171.80	114.59	140.79	111.89	2,033
2004	95.32	155.12	235.37	257.63	172.53	261.17	374.85	296.46	124.04	111.09	108.60	101.40	2,294
2005	67.25	37.04	54.21	39.80	152.66	224.19	258.22	253.03	192.07	158.69	155.75	240.64	1,834
2006	401.36	263.32	480.71	518.53	435.88	265.87	259.89	266.94	193.04	139.52	163.05	122.69	3,511
2007	111.78	102.26	139.29	162.56	172.93	253.08	336.03	270.96	176.16	122.62	144.29	84.89	2,077
2008	43.96	39.18	27.43	117.73	126.14	174.43	142.01	121.72	57.62	46.72	48.32	56.00	1,001
2009	38.60	18.38	12.18	143.24	153.24	201.49	348.92	155.96	73.74	90.01	120.60	93.61	1,450
2010	46.14	30.12	41.37	14.71	99.70	122.41	307.05	309.12	238.19	114.37	125.46	74.96	1,524

From a power resourcing perspective, SWP has a diversified portfolio of resources to meet its annual pumping requirements. In Figure 21-1, the distribution of resources used to meet the load requirements in 2010 is shown. Nearly sixty-percent of the 2010 load was met with hydro resources including SWP system resources (Hyatt-Thermalito, Gianelli, and Warne, and Devil Canyon), long-term contract hydropower at Pine Flat and Castaic reservoirs, small hydro resources (Alamo, Mojave Siphon, and contract small hydro) as well as coal power from the RG4 facility, and the balance of SWP pumping needs met with short- and mid-term contract power purchases and daily and real-time purchases from the California Independent System Operator's (CAISO) energy market.

As DWR resources for future SWP delivery requirements, it will pursue cleaner resources to reduce SWP greenhouse gas emissions as outlined in DWR's Climate Action Plan-Phase I: Greenhouse Gas Emissions Reduction Plan (see Chapter 22, *Air Quality and Greenhouse Gas Emissions*, Section 22.3.2.3, for additional details on the CAP). For example, DWR ceased receiving coal power from the RG4 facility in July 2013. The 2020 portfolio (Figure 21-2) will be composed of a portion of the Lodi Energy Center combined cycle power plant and new renewable energy resources.

SWP hydropower and pumping facilities are discussed in the following sections. Refer to Table 21-5 for energy generation and flow parameters of the SWP hydropower facilities and Table 21-6 for pumping capacities and energy requirements of the SWP pumping facilities during the discussion of these facilities. Energy generation at the Hyatt powerplant and energy required at the Gianelli pumping plant depends on the reservoir storages (i.e., elevations) that controls the water heads (feet).

Table 21-5. SWP Hydropower Generation Capacity of Facilities

Facility	Water Head (feet)		Max Flow (cfs)	Max Volume (af/day)	Capacity (MW)	Generator Efficiency	Energy Factor (kWh/af)
	Min	Max					
Edward Hyatt Powerplant (Oroville)	410	676	16,950	33,620	819	0.86	585
Thermalito Pumping-Generating Plant	85	102	17,400	34,513	120	0.82	83
Thermalito-Low Flow	63	77	615	1,220	3	0.84	65
Warne	719	739	1,565	3,104	74	0.77	572
Gianelli Pumping-Generating Plant (Joint CVP and SWP)	100	320	16,000	32,000	400	0.94	300
O'Neill Pumping-Generating Plant (Joint CVP and SWP)	45	53	6,000	12,000	25	0.94	50
Devil Canyon		1,406	2,940	5,831	280	0.82	1,152

af = acre-feet.
cfs = cubic feet per second.
MW = megawatt.
kWh = kilowatt hour.

Table 21-6. SWP Pumping Capacity of Facilities

Pumping Plant	Pumping Head (feet)		Max Flow (cfs)	Max Volume (af/day)	Capacity (hp)	Capacity (MVA)	Efficiency	Energy Factor (kWh/af)
	Min	Max						
Hyatt Powerplant (Oroville)	500	660	5,610	11,127	519,000	387	0.79	835
Thermalito Pumping-Generating Plant	85	100	9,120	18,090	120,000	89	0.84	119
Harvey O. Banks	236	252	10,670	21,164	330,000	246	0.90	279
South Bay		566	330	655	27,750	21	0.75	759
Del Valle		38	120	238	1,000	1	0.51	75
Dos Amigos	107	125	15,450	30,645	240,000	179	0.89	140
O'Neill Pumping-Generating Plant (Joint CVP and SWP)	45	53	4,200	8,400	36,000	27	0.69	77
Gianelli Pumping-Generating Plant (Joint CVP and SWP)	100	320	11,000	22,000	504,000	378	0.78	412
Las Perillas		55	461	914	4,050	3	0.69	79
Badger Hill		151	500	992	11,750	9	0.71	212
Devil's Den		521	134	266	10,500	8	0.74	707
Bluestone		484	134	266	10,500	8	0.68	707
Polonio Pass		533	134	266	10,500	8	0.75	707
Buena Vista		205	5,405	10,721	144,500	108	0.85	241
John R. Teerink		233	5,445	10,800	150,000	112	0.94	249
Ira J. Chrisman Wind Gap		518	4,995	9,908	330,000	246	0.87	596
A. D. Edmonston		1,926	4,480	8,886	1,120,000	835	0.85	2,256
Oso		231	3,252	6,450	93,800	70	0.89	260
Pearblossom		540	2,575	5,108	203,200	152	0.76	712

af = acre-feet.
cfs = cubic feet per second.
hp = horsepower.
kWh = kilowatt hour.
MVA = megavolt ampere.

21.1.2.1 Feather River Facilities

The Oroville-Thermalito Complex includes Edward Hyatt Powerplant, Thermalito Diversion Dam and Powerplant, and the Thermalito Pumping-Generating Plant. Construction began in 1957 and the Oroville and Thermalito facilities became operational in 1968 (California Department of Water Resources 2009a, 2009b). Oroville Dam is the tallest dam in the United States, with a structural height of 770 feet with a crest elevation of 922 feet. Lake Oroville has a maximum storage capacity of 3,537 TAF with a maximum water elevation of 900 feet (California Department of Water Resources 2009a, 2009b). Table 21-6 gives the energy generation and flow parameters and the pumping capacities and energy requirements for each of the SWP facilities.

The Edward Hyatt Powerplant is an underground pumping-generating facility at the base of Oroville Dam that generates power from water released from the dam and can pump water from Thermalito Forebay for pumped-storage operations (not used very often). The water head ranges from about 410 feet at minimum operating storage to about 676 feet at maximum storage. The maximum generation capacity for the Hyatt Powerplant is 819 MW with a maximum flow of about 16,950 cfs. The energy factor is about 585 kWh/af at maximum head and is about 350 kWh/af at minimum head, with an efficiency of about 86%. When pumping water from Thermalito Forebay, the pumping units have a capacity of about 5,610 cfs with a pumping energy factor of 835 kWh/af and a pumping efficiency of about 79%. The maximum energy requirement for this pumping is about 387 MW (California Department of Water Resources 2009b).

Thermalito Diversion Dam and Powerplant are approximately 4.5 miles downstream from Oroville Dam on the Feather River. The dam diverts water to the Thermalito Forebay Canal for use at the Thermalito Pumping-Generating Plant. The small Thermalito Diversion Dam Powerplant has one generating unit with a maximum flow of 615 cfs and a water head of 63–77 feet, generating a maximum of about 3 MW with an energy factor of about 65 kWh/af and an efficiency of about 85%.

The Thermalito Pumping-Generating Plant is about 4 miles west of Oroville. The Thermalito Powerplant has four units with a maximum flow 17,400 cfs and a maximum water head of about 102 feet with a maximum energy requirement of 120 MW. The energy factor is about 83 kWh/af with an efficiency of about 82%. The pumping units lift water about 100 feet at a maximum flow of 9,120 cfs with a pumping energy factor of 119 kWh/af and a pumping efficiency of about 84%.

21.1.2.2 SWP Delta Facilities

The Harvey O. Banks Pumping Plant in the south Delta pumps water into the California Aqueduct (CA). The pumping plant utilizes 11 pumps; two are rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity. The plant lifts the water about 252 feet from the Clifton Court Forebay into the California Aqueduct. The maximum pumping capacity is about 10,670 cfs. The maximum energy requirement is about 246 MW. The pumping energy factor is about 279 kWh/af with an efficiency of 90%. Pumping is scheduled to be at maximum capacity during off-peak hours each day; the Clifton Court Forebay storage capacity of about 10 TAF allows this basic operational strategy.

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct for use by SWP contractors in Napa and Solano Counties. The current Barker Slough Pumping Plant capacity is about 150 cfs with an energy requirement of about 4 MW. The Cordelia Pumping Plant has a capacity of about 130 cfs with an energy requirement of about 4 MW. The South Bay Pumping Plant is located near the Banks Pumping Plant and pumps water about 566 feet to the South Bay Aqueduct. The South Bay Pumping Plant has nine units with a maximum flow of 330 cfs. Four additional units are currently under construction (completed in 2012) with an additional capacity of 180 cfs. The current energy requirement of 21 MW will therefore increase to 27 MW. The pumping energy factor is about 759 kWh/af with an efficiency of about 75% (California Department of Water Resources 2010).

21.1.2.3 San Luis Reservoir and Canal Facilities

The San Luis Unit was constructed in the 1960s as a joint State-Federal projects and was turned over to DWR for operation and maintenance. The San Luis Reservoir has a maximum capacity of about 2,000 TAF (Bureau of Reclamation 2012). The William R. Gianelli Pumping-Generating Plant lifts water from the O'Neill Forebay to the San Luis Reservoir in the fall and winter months when water demands are reduced. San Luis Reservoir provides seasonal storage for CVP and SWP water. When water demands increase in the spring and summer months, water is released through the generating units to O'Neill Forebay and the San Luis Canal (part of the California Aqueduct). The plant energy factors have been described under the CVP facilities.

The Dos Amigos Pumping Plant is located along the San Luis Canal 17 miles south of the O'Neill Forebay. The Dos Amigos Pumping Plant lifts water approximately 125 feet. The pumping capacity is 15,450 cfs with an energy requirement of about 179 MW. The pumping energy factor is 140 kWh/af and the pumping efficiency is about 89%. The Coastal Aqueduct connects to the California Aqueduct near Kettleman City, California, and delivers water to the Central Coast. Water is pumped through the Las Perillas, Badger Hill, Devil's Den, Bluestone, and Polonio Pass Pumping Plants. The Las Perillas Pumping Plant lifts water about 55 feet from the California Aqueduct to the first section of the coastal branch. The plant contains six pumping units with a capacity of about 461 cfs and an energy requirement of 3 MW. The Badger Hill Pumping Plant contains six pumping units that lift water 151 feet with a capacity of about 500 cfs and an energy requirement of 9 MW. Three pumping plants (Devil's Den, Bluestone and Polonio) lift water a total of 1,500 feet in a pipeline with a capacity of 130 cfs. The combined pumping energy requirement for these three plants is 24 MW. The pumping efficiency for these plants is about 75% with an energy factor of 2,000 kWh/af.

21.1.2.4 California Aqueduct Facilities

Some water is delivered to Kern County SWP contractors before reaching the Buena Vista Pumping Plant. All other water flowing to southern California SWP contractors must be lifted at several pumping plants over the Tehachapi Mountains. The Buena Vista Pumping Plant is about 24 miles southwest of Bakersfield. The plant contains ten pumping units with maximum capacity of 5,405 cfs that lift the water 205 feet. The energy requirement is about 108 MW with an energy factor of 241 kWh/af and an efficiency of 85%. The John R. Teerink Pumping Plant contains nine units that lift a maximum of 5,445 cfs about 233 feet. The plant energy requirement is about 112 MW with an energy factor of 249 kWh/af with an efficiency of 94%. The Ira J. Chrisman Wind Gap Pumping Plant contains nine units that lift a maximum of 4,995 cfs about 518 feet. The plant energy requirement is about 246 MW with an energy factor of 596 kWh/af with an efficiency of 87%. The A. D. Edmonston Pumping Plant is the highest lift pumping plant in the United States, pumping water over the Tehachapi Mountains to Southern California. The plant contains 14 pumping units each with four-stage impellers. The plant lifts water 1,926 feet and has a maximum capacity of 4,480 cfs. The energy requirement for the Edmonston Pumping Plant is 835 MW. The pumping energy factor is 2,256 kWh/af with an efficiency of about 85%.

The California Aqueduct continues over the Tehachapi Mountains into Southern California and splits into two branches—the East Branch and West Branch. The West Branch delivers water to Lake Castaic and provides water to western Los Angeles County and vicinity. The East Branch delivers water to the Antelope Valley, San Bernardino/Riverside areas, and eventually to Lake Perris near Hemet. The Oso Pumping Plant is the first major structure on the West Branch of the California Aqueduct. The plant is located approximately 7 miles east of Gorman. The plant lifts water 231 feet and has a maximum capacity of 3,252 cfs. The energy requirement is about 70 MW. The pumping energy factor is about 260 kWh/af with an efficiency of about 89%. The west branch water then flows to Pyramid Lake through the Warne Powerplant. The William E. Warne Powerplant is located at Pyramid Lake. The plant contains two units with a capacity of 1,500 cfs. The water head is about

740 feet. The generation capacity is 74 MW with an energy factor of 570 kWh/af and an efficiency of about 77%. The Warne Powerplant recovers some of the energy used to pump West Branch aqueduct water over the Tehachapi Mountains. The Castaic Powerplant is operated by the Los Angeles Department of Water and Power (LADWP). The plant is located between Pyramid Lake and the Elderberry Forebay within Castaic Lake. The Castaic Powerplant is operated as a pump-back facility, providing peaking generation for LADWP. The plant contains seven generating units with a maximum flow of 3,470 cfs and a generating capacity of 1,250 MW. Six pumping units lift water about 1,075 feet with a combined capacity of 2,300 cfs. The pumping units require a total of 1,450 MW.

The Alamo Powerplant is on the East Branch of the California Aqueduct. The plant has a head of about 140 feet with a flow of 1,740 cfs that generates about 17 MW. The energy factor is about 120 kWh/af with an efficiency of about 85%. The Pearblossom Pumping Plant is on the East Branch, about 25 miles west of Lancaster. The plant contains nine pumping units with a combined capacity of 2,575 cfs with a pumping head of 540 feet. Aqueduct capacity restrictions limit the flow to about 2,000 cfs. The energy requirement for a flow of 2,000 cfs is about 120 MW with an energy factor of about 712 kWh/af and an efficiency of 76%. The Mojave Siphon Powerplant is located at Silverwood Lake. The plant is operated at a maximum flow of 2,000 cfs due to aqueduct restrictions. The generating capacity at 2,000 cfs with a maximum head of 135 feet (Silverwood Lake at low elevation) is about 23 MW. The energy factor is about 115 kWh/af and the efficiency is about 85%. Water from Silverwood Lake flows through the San Bernardino Tunnel to the Devil Canyon Powerplant, 5 miles north of San Bernardino. The plant contains four units with a maximum flow of 2,600 cfs due to capacity restrictions at the afterbay. The water head is 1,400 feet and the maximum generation capacity is 235 MW. The energy factor is 1,150 kWh/af with an efficiency of about 82%.

21.1.3 CVP and SWP Energy Generation and Pumping Use

The generation of electrical energy at the CVP and SWP generating plants is dependent on the water runoff conditions and therefore can vary greatly from year to year. Tables 21-1, 21-2, 21-5, and 21-6 provide summaries of CVP and SWP hydropower generation capacities, but the monthly water flows (TAF) are needed to calculate the energy that would be generated (GWh) each month. Each of the generating plants has a water flow capacity, and high flows would spill (be released through other gates or spillways). The CVP and SWP facilities have been designed to utilize the majority of the flows at each generating plant. The energy required to pump and deliver water from the Delta to the CVP and SWP water contractors is totally dependent on the volume of water delivered each month and the pumping plants that are needed to deliver the water to the contractors. Because the percentage of each year's water supply that is delivered to each CVP and SWP contractor is relatively constant, and the pumping energy required to seasonally store water in San Luis or to deliver water to each contractor is constant, the total monthly energy requirement for CVP and SWP pumping can be estimated from the annual CVP and SWP pumping from the Delta.

21.1.3.1 CVP and SWP Energy Generation

For planning purposes such as this energy evaluation of the action alternatives, the monthly CVP and SWP energy generation can be estimated from the monthly flows (TAF) and reservoir storage (TAF) simulated with the CALSIM-II model for each BDCP alternative. The CALSIM-II model is a water resources simulation planning tool developed jointly by DWR and Reclamation. The CALSIM-II model is applied to the SWP, the CVP, and the Delta. The model is designed to evaluate the performance of the CVP and SWP systems for: existing or future levels of land development, potential future facilities, and current or alternative operational policies and regulatory environments. Key model output includes reservoir storage, in-stream river flow, water delivery, Delta exports and conditions, biological indicators, and operational and regulatory metrics. CALSIM-II represents the best available planning model for the CVP-SWP system.

CVP and SWP water deliveries are simulated, in CALSIM-II, based on a method that estimates the actual forecast allocation process. The North of Delta (NOD) and South of Delta (SOD) deliveries for both the CVP and SWP contractors are determined using a set of rules for governing the allocation of water. CALSIM-II uses a water supply and water demand relationship to find delivery quantities given available water, operational constraints, and desired reservoir carryover storage volumes. CALSIM-II simulates a suite of regulations to represent the CVP and SWP systems. The regulations consist of the State Water Resources Control Board's D-1641 (also referred to as the 1995 Water Quality Control Plan "WQCP"), and the Central Valley Project Improvement Act (CVPIA) (b)(2) regulations, which implement fish protection actions and the Joint Point of Diversion (JPOD) under which water is exported or "wheeled" at the Delta pumping facilities.

Given the relatively generalized representation in CALSIM-II model of the complex physical operational environment of the SWP, CVP, and the Delta, caution is required when interpreting outputs from the model results as a basis for trying to predict energy consumption associated with water deliveries. The CALSIM-II model is not designed to reproduce actual historical operations of the different SWP and CVP system power generation and pumping plants. Also, different regulations in the CALSIM-II model would produce different allocations and system water deliveries, thereby also incidentally affecting energy consumption. For these reasons, CALSIM-II outputs represent a good starting place for assessing power consumption for related water deliveries. In DWR's experience, the CALSIM-II outputs tend to overstate, rather than understate, actual power consumption, and thus analysis tends to err on the side of overstating impacts.

Results from the CALSIM-II modeling indicate that the basic operation of each of the CVP and SWP reservoirs is largely determined by the reservoir inflow, the maximum reservoir storage (flood control) values, and the minimum downstream flow requirements for each reservoir. The seasonal energy generation follows the seasonal inflows and reservoir storage patterns. The generation energy factor (MWh/TAF) for each reservoir is highest when the reservoir is full, but the seasonal range of water heads (reservoir elevation minus tailwater elevation) is generally about 75% of the maximum value in most years. Only in a few dry year sequences (about 10% of the years) are the Trinity or Shasta storage levels low enough to reduce the water head to less than 50% of the maximum head. The monthly reservoir inflows (and releases) vary much more dramatically from the spring runoff months to the low flow summer months or between wet and dry years.

There are some variations in the seasonal storage and release patterns for a given year between alternatives, but the energy generation for each year is largely determined by the reservoir inflows. There are therefore very few differences in the monthly and annual upstream CVP and SWP energy generation patterns between the action alternatives. The small changes in the monthly reservoir release patterns between alternatives will cause only small changes in the energy generation. Therefore, the only substantial changes in the CVP and SWP energy generation patterns will be caused by the assumed future effects of climate change (ELT or LLT) on altered runoff patterns.

The energy generation calculations based on upstream reservoir operations (storage and release flows) will be demonstrated as an example for the Existing Conditions (2010) for the upstream CVP and SWP powerplants. The energy generation for the Trinity Powerplant will be shown in detail, and the energy generation at the other powerplants will be summarized. The maximum monthly generation depends on the monthly release flow (TAF) and the reservoir storage (TAF) which controls the water head and corresponding energy factor. The energy analysis assumes that the upstream energy generation at the CVP and SWP facilities would not change for the different baselines (i.e., Existing Conditions under CEQA and No Action Alternative (ELT or LLT) under NEPA) because energy generation is based on runoff and reservoir elevations, and would not change under the action alternatives. Therefore, only energy uses for pumping at the proposed north Delta intakes and associated pumping plants and at the existing CVP and SWP south of Delta pumping plants are evaluated for each of the action alternatives. The energy generation values shown in the following monthly tables provide examples of the variations in the monthly generation caused by changes in hydrology at each CVP and SWP facility for Existing Conditions; the monthly generation for the No Action Alternative (ELT or LLT) would be very similar.

Table 21-7a shows the monthly cumulative distributions of Trinity Reservoir storage (TAF) for Existing Conditions (with historical inflows) as simulated by CALSIM-II for 1922–2003. The maximum storage was about 2,400 TAF in May and June of a few years. The minimum storage was about 240 TAF (10% of maximum storage) in the fall months of a few years.

Table 21-7a. CALSIM-II -Simulated Monthly Cumulative Distributions of Trinity Storage for Existing Conditions (thousand acre-feet)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Minimum	240	240	242	250	267	355	476	533	551	541	414	276
10%	633	667	684	675	764	812	974	1,077	1,029	946	785	680
20%	895	890	926	1,027	1,019	1,146	1,288	1,319	1,270	1,188	1,047	951
30%	1,102	1,099	1,132	1,197	1,296	1,410	1,527	1,558	1,512	1,518	1,308	1,185
40%	1,241	1,216	1,252	1,316	1,422	1,601	1,747	1,819	1,740	1,641	1,461	1,320
50%	1,370	1,341	1,374	1,446	1,617	1,718	1,879	1,956	1,867	1,755	1,608	1,446
60%	1,460	1,421	1,577	1,715	1,758	1,872	2,035	2,066	1,995	1,866	1,696	1,552
70%	1,693	1,681	1,750	1,786	1,868	2,017	2,159	2,213	2,154	2,057	1,925	1,800
80%	1,909	1,838	1,838	1,866	1,950	2,050	2,178	2,259	2,263	2,226	2,116	2,004
90%	1,913	1,850	1,850	1,875	1,950	2,050	2,195	2,310	2,361	2,319	2,210	2,063
Maximum	1,913	1,850	1,850	1,875	2,054	2,154	2,200	2,360	2,434	2,359	2,210	2,063
Average	1,336	1,307	1,338	1,396	1,483	1,600	1,738	1,810	1,790	1,703	1,564	1,432

Table 21-7b shows the monthly cumulative distributions of the calculated Trinity Powerplant water head (feet) for Existing Conditions. The surface elevation is estimated from an equation that was determined from the Trinity Reservoir elevation and volume. The equation includes a factor unique to the facility based on the actual relationship to storage volume and reservoir elevation. In the equation below, the value of 2.47 is unique to Trinity; other reservoirs have their own conversion factors. The equation for Trinity elevation (similar for each reservoir) is:

Surface elevation (feet) = 2.47 x storage (acre-feet) ^ 0.3509 + 1,940 (base elevation)

Table 21-7b. Monthly Cumulative Distributions of Estimated Trinity Reservoir Head for Existing Conditions (feet)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Minimum	231	231	231	233	238	259	283	293	295	294	271	241
10%	308	313	316	314	326	333	352	363	358	349	329	315
20%	343	342	347	358	357	370	384	387	382	374	360	349
30%	366	365	369	375	385	395	405	408	404	405	386	374
40%	380	377	381	387	396	411	423	428	422	415	400	387
50%	392	389	392	398	413	421	433	438	432	424	412	398
60%	400	396	409	420	424	432	444	446	441	432	419	407
70%	419	418	423	426	432	443	452	456	452	445	436	427
80%	435	430	430	432	438	445	454	459	459	457	450	442
90%	435	431	431	433	438	445	455	462	466	463	456	446
Maximum	435	431	431	433	445	452	455	466	470	465	456	446
Average	389	386	389	394	402	411	422	428	426	420	408	397

The tailwater elevation for the Trinity Powerplant (upstream end of Lewiston Reservoir) is normally about 1,900 feet. The maximum head for the Trinity Powerplant was about 470 feet and the median monthly heads range from 390 feet in the fall months to 430 feet in the spring months when the reservoir is highest. The minimum head was about 230 feet. The generating plant cannot operate below a minimum water elevation (penstock opening).

Table 21-7c shows the monthly cumulative distributions of Trinity Powerplant release flow (TAF) for the No Action Alternative as simulated by CALSIM-II for 1922–2003. Because the maximum penstock flow is about 4,200 cfs (260 TAF per month) there are some months with flow that must be released from the river gates, without generating energy. Most of the release flows were in the spring and summer months. Releases were made in every month to supply Trinity River flows below Lewiston Reservoir. The Trinity generating plant was at maximum capacity in May for about half of the years. This is the month with the peak flow requirements for the Trinity River.

Table 21-7c. CALSIM-II Simulated Monthly Cumulative Distributions of Trinity Powerplant Flow for Existing Conditions (thousand acre-feet)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	12	9	16	16	14	16	24	98	55	44	43	39	576
10%	38	18	18	18	16	17	27	171	61	120	99	76	812
20%	38	18	18	18	16	18	34	187	91	130	120	86	972
30%	69	24	24	24	18	18	36	195	121	151	120	116	1,011
40%	69	24	24	24	22	24	41	256	137	160	123	116	1,064
50%	69	37	25	25	22	24	45	257	149	160	135	116	1,130
60%	94	47	33	34	22	30	51	260	152	160	151	146	1,197
70%	119	47	34	51	30	33	56	260	169	172	151	146	1,288
80%	133	48	34	93	32	61	61	260	194	191	194	171	1,410
90%	147	54	86	160	65	114	101	260	252	231	222	182	1,640
Maximum	226	252	260	260	235	260	172	260	252	260	231	213	2,198
Average	88	40	46	58	39	49	55	225	148	163	146	126	1,184

Table 21-7d shows the monthly cumulative distributions of calculated Trinity Powerplant energy generation (GWh) for Existing Conditions for 1922–2003. The maximum generation is about 103 MW at the maximum release flow at the highest head. The generation efficiency is about 85% and the generation energy factor is the head times the efficiency. The seasonal generation pattern can be summarized with the median monthly values; the generation is highest in May and moderately high in June-September and much less in October–April. The median annual generation for Existing was calculated to be about 400 GWh and the average annual generation was 418 GWh. [This represents about $20 million in energy value assuming an average energy cost of $50/MWh]. The range in annual generation reflects the range in annual runoff from the Trinity watershed. The 10% cumulative annual generation was 241 GWh (0.6 x median) and the 90% cumulative annual generation was 622 GWh (1.55 x median).

Table 21-7d. Monthly Cumulative Distributions of Estimated Trinity Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	2.4	1.7	3.6	3.6	3.5	3.9	7.6	27.9	15.3	11.0	11.1	9.6	152
10%	10.4	5.4	5.3	5.0	4.6	5.2	9.5	44.6	18.8	33.0	32.0	21.8	241
20%	11.2	5.9	5.9	6.1	5.2	6.1	10.6	64.0	30.9	41.2	38.0	25.5	290
30%	19.8	6.6	7.0	7.1	6.0	6.7	13.1	70.3	43.0	52.9	44.3	36.9	347
40%	22.9	7.1	7.6	7.9	7.0	8.0	14.5	85.5	49.6	57.0	45.6	38.2	378
50%	24.3	12.0	8.2	8.8	7.6	8.7	16.2	94.7	56.7	59.1	49.6	41.7	401
60%	32.2	15.4	11.1	11.0	8.0	9.9	17.5	98.4	58.9	60.7	52.3	50.0	435
70%	37.2	15.9	11.7	17.8	10.0	11.3	19.8	100.6	60.6	62.3	54.8	52.5	479
80%	48.4	16.8	12.3	31.2	11.6	23.1	21.4	101.6	71.8	68.9	61.2	56.2	527
90%	51.0	19.6	31.4	49.1	24.2	42.9	38.9	102.3	98.2	81.6	74.1	68.1	622
Maximum	81.7	91.5	95.3	95.7	89.0	100.1	66.4	103.0	100.7	103.0	86.2	75.6	841
Average	29.1	13.4	15.9	20.2	13.9	17.8	19.9	82.3	54.7	58.0	50.1	43.2	418

Table 21-7e shows the monthly cumulative distributions of calculated Trinity Powerplant energy generation (GWh) for the No Action Alternative (LLT) for 1922–2003. The average inflow was slightly modified, with some inflow (rainfall) shifted into the early spring months with less snowmelt runoff in May and June, but the release patterns and energy generation were nearly identical to the Existing Conditions. The average annual Trinity Powerplant energy generation was 415 GWh, reduced by about 1% from the Existing Conditions.

Table 21-7e. Monthly Cumulative Distributions of Estimated Trinity Powerplant Energy Generation for the No Action Alternative (LLT) (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	0.0	1.7	1.8	1.8	3.6	3.7	7.7	20.8	14.0	11.4	1.3	1.4	126
10%	5.8	4.5	4.4	4.7	4.4	4.9	9.3	46.1	17.7	27.0	28.2	12.2	247
20%	10.7	6.0	5.5	5.7	5.1	6.0	11.2	64.3	31.4	36.6	37.1	23.8	274
30%	11.8	6.6	6.5	6.4	5.8	6.5	13.5	69.5	42.8	45.1	44.6	26.0	323
40%	19.5	7.1	7.1	7.2	6.6	7.4	15.3	84.1	56.9	56.5	46.0	35.4	362
50%	23.3	7.3	7.7	7.9	7.0	8.3	16.6	91.5	58.7	58.9	53.0	41.7	401
60%	24.7	15.4	10.9	11.3	7.8	9.3	18.1	97.6	70.2	59.8	54.0	50.0	440
70%	33.4	15.9	11.3	11.8	8.3	10.9	19.9	99.3	80.7	61.7	55.1	51.6	478
80%	36.2	17.3	11.8	33.3	20.1	19.7	24.5	101.1	90.4	66.4	62.2	59.1	538
90%	46.7	40.2	16.0	61.2	42.7	52.6	41.9	102.0	97.2	74.1	72.0	68.4	652
Maximum	81.7	76.1	95.3	96.7	90.7	102.2	94.0	103.0	100.7	103.0	81.2	83.7	836
Average	24.1	15.8	12.8	20.3	16.5	17.9	21.5	81.7	59.9	54.3	49.6	40.9	415

Although not shown here (see Chapter 5, *Water Supply*), the Trinity Reservoir storage patterns and the Trinity release patterns were nearly identical for all of the action alternatives. The energy generation at all of the CVP and SWP generation plants was nearly identical for each of the action alternatives. The only major factor affecting the monthly and annual CVP and SWP energy generation was the hydrology (inflow) conditions.

Tables 21-8a through 21-8h show the calculated monthly cumulative distribution of energy generated at each of the other major upstream CVP and SWP facilities for Existing Conditions. Table 21-8a shows the monthly generation patterns for the Carr Powerplant, and Table 21-8b shows the monthly generation patterns for the Spring Creek Powerplant. Both of these power plants are dependent on the Trinity River exports that are greatest in the summer months of July-October, with occasional exports in high flow winter months. The average annual generation was 294 GWh for the Carr Power Plant and 378 GWh for the Spring Creek Powerplant. Table 21-8c shows the monthly generation patterns for the Shasta Powerplant, and Table 21-8d shows the monthly generation patterns for the Keswick Powerplant. The Shasta generation was highest in the months of May through August, because of high reservoir elevations (i.e., head) and high releases. The annual average Shasta generation was 2,049 GWh. The Keswick generation was more uniform in all months but was highest in June–August. The annual average generation was 469 GWh. Table 21-8e shows the monthly generation patterns for Folsom and Table 21-8f shows the monthly generation for Nimbus. Both power plants had fairly uniform energy generation, with the highest generation in January–July, and the lowest generation in September. The annual average generation was 579 GWh at Folsom and 72 GWh at Nimbus. Table 21-8g shows the monthly generation patterns at the New Melones Powerplant. The highest generation was in the months of April-July, corresponding to peak snowmelt and irrigation diversions. The annual average generation was 477 GWh. Table 21-8h shows the monthly generation pattern for the Hyatt and Thermalito Power Plants (combined). These are the two SWP power plants on the Feather River. The highest generation was in the months of May through September. The lowest generation was in October–December. The annual average generation was 2,292 GWh.

Table 21-8a. Monthly Cumulative Distributions of Estimated Carr Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	0	0	0	0	0	0	0	0	0	0	1	0	83
10%	8	0	0	0	0	0	0	0	0	43	42	8	158
20%	8	0	0	0	0	0	0	0	0	51	51	33	199
30%	25	0	0	0	0	0	3	0	2	51	51	42	225
40%	25	3	3	3	0	3	5	0	8	51	52	49	257
50%	25	4	3	3	3	3	8	0	8	51	59	49	291
60%	25	15	8	4	3	3	10	0	25	59	68	65	318
70%	42	16	8	8	3	6	13	3	25	68	68	65	350
80%	60	16	12	20	3	8	16	8	25	75	85	82	387
90%	66	30	31	61	8	28	41	8	42	112	100	85	456
Maximum	112	68	59	88	31	112	86	81	105	112	112	108	643
Average	34	11	10	15	3	9	13	6	17	60	63	53	294

Table 21-8b. Monthly Cumulative Distributions of Estimated Spring Creek Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	4	0	0	0	0	0	0	0	0	0	6	3	113
10%	13	3	0	0	2	0	0	0	0	38	39	24	201
20%	14	5	1	5	5	3	0	0	0	47	47	31	263
30%	26	6	4	8	10	6	0	0	2	47	48	46	292
40%	29	11	7	16	16	13	1	1	5	48	51	46	339
50%	32	17	9	21	25	18	7	3	7	50	56	49	377
60%	45	19	16	26	28	24	15	5	15	55	63	62	407
70%	60	22	24	40	34	36	19	8	19	63	67	63	426
80%	65	25	32	51	40	44	26	10	24	80	84	73	446
90%	73	31	46	85	62	64	43	21	39	106	106	85	548
Maximum	116	90	110	138	125	131	89	109	111	117	138	104	951
Average	40	17	19	33	27	26	15	9	15	59	63	54	378

Table 21-8c. Monthly Cumulative Distributions of Estimated Shasta Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	36	39	46	0	30	43	50	79	126	102	45	32	875
10%	65	58	53	48	49	58	72	118	198	203	139	57	1,269
20%	78	74	64	60	58	69	91	133	210	236	161	72	1,456
30%	93	81	71	69	64	78	98	161	227	250	178	86	1,603
40%	101	88	75	75	72	86	115	169	238	268	197	96	1,760
50%	107	99	84	86	83	95	133	183	247	275	203	108	1,917
60%	112	121	91	96	96	109	148	201	257	291	212	136	2,281
70%	124	142	111	145	176	167	162	219	262	303	223	184	2,457
80%	139	177	195	206	385	259	183	229	276	320	232	228	2,656
90%	156	204	333	419	464	409	243	260	302	332	256	255	2,907
Maximum	194	491	509	513	489	539	532	390	413	369	301	321	3,605
Average	108	123	136	150	175	164	150	189	246	271	197	139	2,049

Table 21-8d. Monthly Cumulative Distributions of Estimated Keswick Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	13	15	15	15	14	15	15	17	33	40	33	15	268
10%	20	16	15	15	14	15	17	25	40	49	40	20	317
20%	23	18	15	15	14	15	20	28	43	54	42	22	338
30%	26	19	16	15	14	15	20	30	44	57	44	25	367
40%	27	21	18	18	16	18	24	32	45	59	47	26	393
50%	28	23	18	20	19	21	25	35	47	61	49	29	429
60%	29	26	20	21	19	21	28	38	49	64	50	36	492
70%	31	31	25	34	39	38	32	41	51	69	51	44	532
80%	34	40	40	48	63	55	34	42	54	69	55	54	580
90%	40	44	69	70	63	70	52	50	57	69	59	59	677
Maximum	46	68	70	70	63	70	68	70	68	70	66	68	934
Average	29	28	31	38	43	39	31	36	48	61	49	36	469

Table 21-8e. Monthly Cumulative Distributions of Estimated Folsom Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	5	5	6	10	8	4	4	4	4	4	4	3	76
10%	11	11	11	12	16	14	15	15	20	23	14	12	250
20%	20	20	20	21	19	17	23	20	26	43	20	18	323
30%	22	23	24	25	21	25	26	25	31	49	30	23	372
40%	23	28	30	27	27	29	32	32	39	55	36	29	474
50%	24	30	31	28	43	40	40	49	47	68	40	37	556
60%	25	34	31	43	68	56	50	62	53	75	46	45	665
70%	25	48	32	75	84	70	71	74	70	80	52	63	720
80%	25	53	52	105	108	91	85	89	85	85	63	68	807
90%	27	67	110	121	116	130	111	148	124	87	70	75	922
Maximum	57	125	129	129	117	134	136	148	143	111	78	80	1,328
Average	23	38	41	53	57	54	53	60	58	61	42	41	579

Table 21-8f. Monthly Cumulative Distributions of Estimated Nimbus Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	0.9	0.9	0.9	1.5	1.3	0.6	0.6	0.6	0.6	0.7	0.6	0.6	12
10%	1.5	1.4	1.5	1.5	1.9	1.6	1.8	1.8	2.2	3.2	1.8	1.6	31
20%	2.6	2.5	2.6	2.8	2.4	2.0	2.5	2.2	3.1	4.8	2.7	2.4	38
30%	2.8	2.9	3.1	3.1	2.4	2.8	2.9	2.7	3.1	5.4	3.4	2.7	44
40%	2.8	3.4	3.7	3.1	3.1	3.2	3.3	3.2	4.1	5.9	4.2	3.5	53
50%	2.8	3.6	3.7	3.2	4.9	4.5	4.3	5.1	4.9	7.0	4.6	4.3	61
60%	2.8	4.0	3.7	5.0	7.8	6.2	5.3	6.2	5.4	8.5	5.2	5.4	73
70%	2.8	5.5	3.7	8.5	8.3	7.7	7.4	7.4	7.0	9.2	5.9	7.0	93
80%	2.8	6.3	5.9	9.2	8.3	9.2	8.9	8.9	8.9	9.2	6.7	7.6	109
90%	3.1	7.8	9.2	9.2	8.3	9.2	8.9	9.2	8.9	9.2	7.4	8.5	124
Maximum	6.2	8.9	9.2	9.2	8.3	9.2	8.9	9.2	8.9	9.2	8.2	8.9	183
Average	2.7	4.9	6.0	8.1	8.3	6.8	5.8	6.4	6.3	6.7	4.7	4.8	72

Table 21-8g. Monthly Cumulative Distributions of Estimated New Melones Powerplant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	6	3	1	0	0	4	18	36	27	29	29	17	214
10%	14	8	7	3	2	11	45	47	35	38	35	21	298
20%	21	9	8	5	5	16	51	54	41	43	42	23	339
30%	24	9	8	8	6	22	58	61	43	45	44	26	376
40%	26	9	9	8	9	28	62	66	46	48	47	27	394
50%	28	11	9	9	11	34	69	78	50	49	48	29	429
60%	31	13	10	10	13	43	77	85	69	57	52	32	481
70%	33	14	11	10	15	51	81	89	78	62	57	35	523
80%	35	16	13	15	19	56	83	94	84	68	62	38	573
90%	40	19	14	15	31	62	89	101	86	72	65	43	729
Maximum	54	94	138	221	161	162	100	117	201	197	127	94	1,390
Average	28	14	13	16	18	39	68	75	62	58	53	34	477

Table 21-8h. Monthly Cumulative Distributions of Estimated Combined Hyatt and Thermalito Power Plant Energy Generation for Existing Conditions (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	26	20	21	19	20	19	47	54	109	40	40	33	721
10%	36	25	26	23	31	24	72	103	141	219	80	56	1,183
20%	41	33	42	28	40	39	92	118	155	295	143	75	1,447
30%	68	49	54	46	50	58	97	125	173	354	194	116	1,559
40%	89	55	56	55	54	73	105	127	190	395	261	148	1,815
50%	114	70	59	58	57	138	116	133	212	415	273	160	1,985
60%	131	82	92	59	103	201	126	139	234	424	300	255	2,470
70%	142	85	121	67	212	248	153	193	250	451	310	320	2,880
80%	156	89	156	199	379	357	226	329	271	471	325	376	3,337
90%	169	94	229	540	563	549	358	481	350	490	336	416	3,581
Maximum	223	561	670	669	623	671	666	698	569	508	377	441	4,777
Average	107	75	119	148	182	203	170	216	232	380	244	217	2,292

21.1.3.2 CVP and SWP Energy Use for Water Pumping

The monthly CVP and SWP energy use for pumping water from the Delta into the Delta-Mendota Canal and California Aqueduct can be reliably estimated from the monthly pumping flows (TAF) at each of the CVP and SWP pumping plants. The pumping energy used at the Gianelli Pumping Plant to seasonally store CVP and SWP water in San Luis Reservoir depends on the San Luis Reservoir elevation (water head) estimated from storage. There is some generation of energy at the Gianelli and O'Neill Power Plant as water is released from San Luis Reservoir during the summer months. There is considerable generation of energy at other SWP power plants along the East and West Aqueducts, which recover some of the energy required to pump water over the Tehachapi Mountains. The net energy required for CVP pumping and for SWP pumping can be calculated from the monthly sequence of flows simulated by CALSIM-II for each alternative. As discussed in Section 21.1, *Environmental Setting/Affected Environment*, the energy calculations based on CALSIM-II presented in this chapter represent a reasonable assessment of actual energy requirements for the action alternatives.

The net energy use for CVP deliveries and SWP deliveries can be calculated from the average CVP Jones pumping (TAF/yr) and the average SWP Banks Pumping. The distribution of CVP water to each contractor is somewhat variable from year to year but the average energy use reflects the normal portion of the deliveries that are seasonally stored in San Luis Reservoir. The Existing Conditions CALSIM-II results were used as an example of the baseline to calculate the CVP and SWP energy generation and pumping uses for south of Delta CVP and SWP water deliveries. The energy analysis assumes that the upstream operations and energy generation for Existing Conditions and the No Action Alternative (ELT in 2025 and LLT in 2060) would be generally the same since upstream generation is a function of runoff and reservoir elevations.

The energy factors for CVP and SWP exports were determined from the results of the CVP and SWP energy models, developed from the CALSIM results for the initial No Action Alternative (2010). The energy model calculations include the individual pumping plants and deliveries from the DMC and California Aqueducts, and include the energy generation at the south of Delta hydropower plants. Tables 21-9a through 21-9d show the monthly and annual summary of CVP and SWP pumping and energy use for delivery to south of Delta CVP and SWP contractors for the initial No Action Alternative (2010). These tables were estimated from the monthly and annual pumping volumes (TAF) at each CVP and SWP pumping plant and the assumed pumping energy factors (MWh/TAF). For evaluation purposes, the average annual energy factor for SWP deliveries and the annual average energy factor for CVP deliveries were calculated and combined to compare the energy needed to pump and deliver CVP and SWP Delta exports for each alternative.

Table 21-9a shows the monthly and annual cumulative distributions of CVP Jones pumping (TAF) for the initial No Action Alternative (2010). The average annual CVP pumping was 2,237 TAF, slightly less than the CVP pumping for Existing Conditions (2010), which did not include the Fall X2 outflow requirements. Although the CVP exports were slightly less, the net energy use for pumping and delivery to CVP south of Delta contractors was the important result from this energy use model.

Table 21-9a. Monthly and Annual Cumulative Distributions of CALSIM-II-Simulated CVP Delta Pumping (thousand acre-feet)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	81	81	90	46	36	35	36	49	36	39	37	48	984
10%	149	131	181	122	70	57	48	49	48	129	130	146	1,525
20%	176	165	222	144	114	116	48	49	57	218	216	166	1,929
30%	190	198	239	165	130	138	48	49	92	247	283	207	2,126
40%	200	229	247	189	157	146	48	49	102	279	283	242	2,189
50%	216	243	262	200	175	162	51	49	138	280	283	273	2,301
60%	237	274	283	208	187	188	54	49	153	283	283	274	2,364
70%	257	274	283	211	205	216	58	55	168	283	292	274	2,458
80%	279	274	283	236	220	256	67	69	205	283	321	274	2,619
90%	283	340	283	272	255	283	96	103	274	283	330	281	2,769
Maximum	283	399	283	283	265	283	162	267	274	380	343	336	3,007
Average	218	236	249	192	166	171	62	68	140	244	260	233	2,237

Table 21-9b shows the monthly and annual cumulative distributions of CVP energy use (GWh) for CVP water pumping at Jones and all other pumping plants along the Delta-Mendota Canal, including CVP pumping at O'Neill and Gianelli pumping plants to store water in San Luis Reservoir. The CVP energy generation at the O'Neill and Gianelli generating plants was subtracted from the monthly CVP energy use values. The average net energy factor for CVP exports was about 363 MWh/TAF, based on the average CVP Jones pumping of 2,237 TAF/yr and the average net CVP energy use of 814 gigawatt hours per year (GWh/yr).

Table 21-9b. Monthly and Annual Cumulative Distributions of Estimated CVP Net Energy Use for Delta Export Pumping and Delivery (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	12	28	41	21	11	-1	-17	-31	-25	-16	-16	-25	277
10%	46	52	92	60	29	13	-12	-20	-14	21	25	34	495
20%	55	68	113	74	47	44	-8	-16	-4	55	60	53	695
30%	63	83	122	84	61	51	-5	-11	2	67	72	64	744
40%	68	101	128	96	73	55	-3	-9	5	73	79	81	774
50%	75	113	135	103	83	67	-1	-7	14	75	82	93	828
60%	83	125	142	107	89	85	3	-4	27	80	87	94	856
70%	92	132	144	112	102	97	7	-2	33	82	91	95	920
80%	102	135	146	125	116	125	12	4	58	85	103	96	979
90%	108	157	150	147	129	138	32	22	89	87	107	106	1,075
Maximum	147	186	161	169	150	157	66	112	99	127	111	126	1,275
Average	77	107	128	100	80	75	5	-1	25	67	75	77	814

Table 21-9c shows the monthly and annual cumulative distributions of SWP Banks pumping (TAF) for the initial No Action Alternative (2010). The average annual SWP pumping was 2,614 TAF, slightly less than the SWP pumping for Existing Conditions (2010), which did not include the Fall X2 outflow requirements. Although the SWP exports were slightly less, the net energy use for pumping and delivery to SWP south of Delta contractors was the important result from this energy use model.

Table 21-9c. Monthly and Annual Cumulative Distributions of CALSIM-II-Simulated SWP Delta Export Pumping (thousand acre-feet)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	59	18	81	18	21	18	18	18	18	18	18	55	896
10%	107	18	172	134	105	81	42	43	38	333	24	125	1,723
20%	136	18	228	151	138	140	42	43	58	375	295	202	2,154
30%	154	63	242	177	168	154	42	43	84	400	338	239	2,277
40%	167	107	257	189	185	179	48	43	95	408	347	268	2,424
50%	182	140	276	202	198	215	51	44	113	411	358	277	2,588
60%	197	172	348	208	217	248	55	50	150	411	393	296	2,811
70%	219	228	378	216	269	288	63	56	167	411	411	363	3,006
80%	253	319	431	241	328	376	71	69	223	411	411	394	3,272
90%	297	397	435	338	406	446	96	103	303	411	411	397	3,477
Maximum	411	397	472	523	472	465	364	380	397	411	411	397	4,433
Average	196	166	306	217	229	237	63	68	146	381	324	279	2,614

Table 21-9d shows the monthly and annual cumulative distributions of SWP net energy use for SWP water pumping (GWh) at Banks and all other pumping plants along the California Aqueduct, including the SWP pumping at O'Neil and Gianelli pumping plants. The SWP energy generation at the Gianelli generating plant and the SWP generating plants on the west and east branches of the aqueduct in southern California (which recovers a fraction of the energy required to pump the water over the Tehachapi Mountains) is subtracted from the monthly energy use values. The average net energy factor for SWP exports was about 2,420 MWh/TAF, based on the average SWP Banks pumping of 2,614 TAF/yr and the average net SWP energy use of 6,327 GWh/yr.

Table 21-9d. Monthly and Annual Cumulative Distributions of Estimated SWP Net Energy Use for Delta Export Pumping and Delivery (gigawatt hours)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Minimum	124	77	113	46	88	120	151	53	42	272	32	155	2,290
10%	216	183	258	140	165	217	293	374	264	521	383	332	4,283
20%	396	344	350	154	215	294	417	461	317	671	654	552	5,145
30%	438	400	392	186	285	355	425	482	471	683	676	586	5,693
40%	459	441	464	217	389	408	438	496	507	699	693	618	6,115
50%	517	469	503	347	485	502	481	508	536	723	719	657	6,564
60%	544	483	535	431	592	658	503	538	562	746	737	671	6,955
70%	564	503	597	508	704	721	523	562	592	760	752	687	7,231
80%	603	532	626	716	751	813	547	576	637	788	780	710	7,638
90%	678	602	712	765	801	891	592	668	734	851	831	759	8,038
Maximum	903	782	896	933	888	960	837	881	853	890	891	858	9,930
Average	492	441	491	399	489	538	470	516	503	704	673	611	6,327

The average energy factor for combined CVP and SWP south of Delta pumping can be estimated as the flow weighted average of the CVP and SWP energy factors. The average CVP pumping was 2,237

TAF/yr with an energy factor of 363 MWh/TAF. The average SWP pumping was 2,614 TAF/yr with an energy factor of 2,420 MWh/TAF. The combined CVP and SWP export pumping was 4,851 TAF/yr and the average energy use was 7,141 GWh, so the combined energy factor was about 1.5 GWh/TAF (1,500 MWh/TAF).

The net energy use factor (MWh/TAF) for south of Delta CVP and SWP water deliveries is assumed to remain the same for each of the other baselines and for each of the action alternatives; the energy use for south of Delta water deliveries would vary with the annual deliveries. Because each of the baselines has different average annual water deliveries, the CEQA Existing Conditions (2010) and the NEPA No Action Alternative (ELT in 2025 or LLT in 2060) each has slightly different average annual energy uses for south of Delta water deliveries.

21.1.4 Energy Transmission for the Action Alternatives

In California, energy is generated throughout the state and is owned or purchased by utility companies, generally within defined areas of service, and by other users. Electric energy is distributed to consumers by the electrical grid, which is made up of transmission lines (high voltage for longer distances) and distribution lines (low voltage for shorter distances). Substations take high voltage energy from the transmission lines and reduce the voltage for distribution lines. There are several Balancing Authorities that operate within the state, including the CAISO and Balancing Authority of Northern California (BANC). The Balancing Authorities are responsible for ensuring there are sufficient resources to balance the grid within their jurisdictional areas. The CAISO provides transmission access and a power market within its Balancing Authority Area. Scheduling and management of transmission and energy for the action alternatives would be similar to scheduling and management of transmission and energy for the CVP and SWP pumping plants in the south Delta. The additional energy needed for the action alternatives would be provided from the power portfolios of SWP and CVP and in proportion to their participation in the selected alternative. The energy needed for CVP's portion of the project will be provided from existing CVP hydroelectric generation in accordance with the federal statutes that created the CVP. The energy needed for SWP's portion of the project will be provided in accordance with DWR's existing procurement practices and the 2012 Greenhouse Gas Reduction Plan (GHGRP). Energy needed for pumping water would be provided from a mix of CVP and SWP hydroelectric generation, power purchase contracts, power exchanges, and power markets.

DWR has the flexibility to regulate SWP pumping on an hourly basis and thus manages the system to make the most economic decisions for acquisition of power. By scheduling as much off peak pumping as possible, DWR is able to take advantage of less expensive surplus electrical generation. Conversely, DWR maximizes its power generation for the benefit of the interconnected electrical grid during the on-peak hours when electrical demand is highest. In this manner, DWR is able to manage a comprehensive power resources program that helps minimize the cost of water deliveries to SWP water supply contractors while maximizing the benefits of the statewide electrical grid.

The total peak construction electrical load for the action alternatives is approximately 254 megavolt-amperes (MVA), however, the north portion is about 103 MVA while the south portion is about 151 MVA. The peak intake pumping demand during operation of the system is estimated at approximately 60 MVA if located in the south and 70 MVA if located in the north.

Three electric utilities could potentially provide transmission interconnection and service to support the supply of power to the proposed action alternative: Pacific Gas and Electric Company

(PG&E), under the CAISO Balancing Authority, and the Sacramento Municipal Utility District (SMUD), and WAPA, both under the BANC. While interconnection with multiple utilities is possible, only SMUD or PG&E would be utilized in the North based on feasibility reviews indicating significant technical issues with a WAPA interconnection, and only WAPA or PG&E may be utilized in the South due to the geographic limitations of SMUD.

DWR has engaged PG&E, SMUD and WAPA to conduct System Impact Studies (SIS) to assess each utility's ability to potentially provide electrical transmission grid interconnection and service to deliver power to the project for both construction and operational loads. Because there are several project locations spread over more than 40 miles that would require power, interconnection to more than one utility is possible except for the limitations noted above. Several interconnection options have been studied and preliminary SIS results indicate that some electrical upgrades would be needed primarily to accommodate the large load during construction. The interconnection options provide one point of interconnection to support the project construction load at the new Intermediate Forebay and north of this location, and at a second point of interconnection to support the remaining project load south of this location. To the extent possible, new interconnection facilities serving temporary construction would be repurposed to serve operational, or permanent, pumping plant operation. In addition, whenever such facilities built to serve construction are repurposed to serve permanent operation, an evaluation would be done to appropriately convert electrical substations and resize electrical ratings where needed. Impacts that may result from the construction and operation of new transmission infrastructure are addressed throughout the individual resource sections. The Interconnection options are described below along with preliminary descriptions of the upgrades that would be needed to mitigate electrical impacts.

21.1.4.1 Interconnection in the North

Described below are the potential interconnection options for the northern portion of the project. While options are presented for both PG&E and SMUD, ultimately only one of these options will be utilized.

North Option – PG&E

An existing PG&E 115kV transmission line located near the new intake facilities provides a potential point of interconnection for the project's northern construction load and would be repurposed subsequently to serve the operational load if it is located in the north. This interconnection option would consist of at least 4 substations and require the reconfiguring and reconductoring of various existing lines and the construction of new lines to transform the electrical voltage in various locations. These new substations and lines would serve construction load, including construction load consisting of launch shafts and tunneling and at vent shafts northwest of the Intermediate Forebay. The electrical voltage levels of the lower voltage lines are assumed to range between 34.5 kV and 12 kV but would be selected in coordination with PG&E. The new substations would include electrical transformers, breakers, and control and communication equipment.

In addition to these new interconnection facilities in the north, preliminary feasibility reviews indicate this option would consist of extensive reconductoring of approximately 16 miles of 115kV lines.

North Option – SMUD

Existing SMUD transmission facilities located approximately 9 miles northeast of the new Intermediate Forebay provide a potential point of interconnection to serve northern construction load and would be repurposed to serve the operational load if it is located in the north. This interconnection option consists of a new 69kV line from SMUD's planned 230 kV substation to near the intakes area where the line would be tapped to a new substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load consisting of a launch shaft and tunneling at Intake 2. The 69kV line continues from this first tap to a second tap and substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load at a junction structure near intake #3. This same 69kV line continues from this second tap to a third tap and substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load at vent shafts northwest of the Intermediate Forebay. The 69kV line continues from this third tap and terminates at a new 69kV substation near the Intermediate Forebay that transforms the electrical voltage to a lower voltage line to serve construction load consisting of launch shafts and tunneling. The electrical voltage levels of the lower voltage lines described above are assumed to range between 34.5 kV and 12 kV but will be selected in coordination with SMUD. The new substations would include electrical transformers, breakers, and control and communication equipment.

In addition to these new interconnection facilities, this option also will add additional equipment, substations, voltage support and overhead lines stretching approximately 12 to 20 miles to assist in interconnection with SMUD's system.

21.1.4.2 Interconnection in the South

Described below are the potential interconnection options for the southern portion of the project. While options are presented for both PG&E and WAPA, ultimately only one option will be utilized.

South Option – PG&E

Approximately 10 miles northwest of CCF exists PG&E's 230 kV Brentwood Substation that provides a potential point of interconnection for the project's southern construction load and would be repurposed to serve operational load if located in the south. This interconnection option consists of a new 230 kV line from Brentwood Substation to the northeast of CCF where the line terminates at a new 230kV substation that transforms the electrical voltage to either 115kV or 69kV, depending on final design. Two new lines at the same selected voltage would continue from this first substation where one line goes to Bouldin Island and terminates at a second new substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load consisting of launch shafts and tunneling at Bouldin Island and vent shafts at Mandeville Island. The other, second line terminates at a third new substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load consisting of launch shafts and tunneling at CCF, vent shafts at Victoria Island, and retrieval shafts at Bacon Island. The electrical voltage levels of the lower voltage lines described above are assumed to range between 34.5 kV and 12 kV but would be selected in coordination with PG&E. Lines less than 69kV are expected to be installed as underbuild, or physically lower on the same structure that supports the higher voltage lines. The new substations would include electrical transformers, breakers, and control and communication equipment.

In addition to these new interconnection facilities in the south, this option also consists of modifications to Brentwood Substation, including breaker replacements and possible expansion, and requires PG&E to install reactive voltage support to help stabilize low voltage observed on the electrical facilities interconnecting the project.

South Option – WAPA

Existing WAPA transmission facilities located approximately 8 miles south of CCF provide a potential point of interconnection to serve the southern construction load and would be repurposed to serve the operational load if located in the south. This interconnection option consists of a new 230kV line from WAPA's existing 230 kV Tracy Substation to the northeast of CCF where the line terminates at a first new 230kV substation that transforms the electrical voltage to either 115kV or 69kV, depending on final design. Two new lines at the same selected voltage would continue from this first substation where one line goes to Bouldin Island and terminates at a second new substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load consisting of launch shafts and tunneling at Bouldin Island and vent shafts at Mandeville Island. The other, second line terminates at a third new substation that transforms the electrical voltage to a lower voltage line, depending on final design, to serve construction load consisting of launch shafts and tunneling at CCF, vent shafts at Victoria Island, and retrieval shafts at Bacon Island. The electrical voltage levels of the lower voltage lines described above are assumed to range between 34.5 kV and 12 kV but would be selected in coordination with WAPA. Lines less than 69kV are expected to be installed as underbuild, or physically lower on the same structure that supports the higher voltage lines. The new substations would include electrical transformers, breakers, and control and communication equipment.

In addition to these new interconnection facilities in the south, this option also consists of modifications to Tracy Substation, including new breakers or replacements and possible expansion. This option also requires WAPA to curtail construction load under a few emergency conditions where specific transmission lines or transformers experience unplanned outages and also under a few planned maintenance outages, however, no additional equipment installation is needed to implement this.

A modification to this option consists of using a 69kV line from Tracy Substation in place of the 230kV line, however, voltage selection would depend on more detailed design. Selection of a 69kV line requires WAPA to install reactive voltage support to help stabilize low voltage observed on the electrical facilities interconnecting the project.

In addition to the options noted above, DWR has entered into an agreement to mitigate the impacts to Contra Costa Water District, which may require that transmission or distribution facilities be built to power the construction and operation of pumping facilities on Victoria Island.

For Alternatives 4A, 2D, and 5A, a permanent substation would be constructed adjacent to the proposed pumping plants at Clifton Court Forebay. Electrical power would be transformed from 230 kV to appropriate voltages for the pumps and other facilities at the pumping plant site. For operation of the intake facilities and intermediate forebay, it is assumed for the purposes of analysis that existing distribution lines would be used to power gate operations, lighting, and auxiliary equipment at these facilities.

21.2 Regulatory Setting

Energy generation at CVP facilities is managed by WAPA. SWP energy generation is managed and sold by DWR. Regulations applicable to energy generation and transmission that are relevant to evaluating the potential impacts of the action alternatives on energy generation and use are discussed in this section.

21.2.1 Federal Plans, Policies, and Regulations

21.2.1.1 Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) regulates transmission and wholesale marketing of oil, natural gas, and electricity in interstate commerce. FERC also licenses and inspects private, municipal, and state hydropower projects, and supervises environmental concerns related to hydroelectricity and major electricity policy initiatives. FERC monitors and investigates energy markets and ensures the reliability of interstate transmission systems (Federal Energy Regulatory Commission 2006). Various activities of the energy utilities in the Delta region are subject to the regulations of FERC.

FERC passed Order No. 888 and Order No. 889 in April 1996. These orders work to establish fair competition of the wholesale power marketplace and establish lower cost power for consumers in the United States. Order No. 888 requires utilities that own, control, or operate interstate electric energy transmission facilities to have open access, nondiscriminatory tariffs on transmission. Order No. 888 also allows public utilities and transmitting utilities to seek the recovery of stranded costs associated with providing open access and Federal Power Act Section 211 transmission services. Order No. 889 requires public utilities and transmitting utilities that own, control, or operate interstate electric energy transmission facilities to create or participate in an Open Access Same-Time Information System program. Such programs provide existing and potential open access transmission customers with available transmission capacity, price, and additional information to enable them to obtain open access nondiscriminatory transmission service (Federal Energy Regulatory Commission 2009a, 2009b).

Licensing for Oroville Facilities

FERC approved DWR's Settlement Agreement for the Oroville facilities on the Feather River to permit DWR to continue to own, operate, and maintain them. The Settlement Agreement was developed during the FERC relicensing process. The Settlement Agreement will be implemented after pending litigation is resolved. FERC has the authority to license the construction and operation of non-federal hydroelectric development. Although no additional facilities are planned for Oroville, DWR's license application proposes several programs to enhance habitats, improve recreational use of the facilities, and address the protection of cultural resources (California Department of Water Resources 2006). Oroville is the only facility in the study area to have recently undergone the relicensing process.

21.2.1.2 Western Area Power Administration

WAPA markets and delivers power from multiuse water projects that are operated by Reclamation, the U.S. Army Corps of Engineers (USACE), and the International Boundary and Water Commission. WAPA markets and delivers CVP's installed capacity of 2,099 MW through 865 circuit-miles of transmission lines (Western Area Power Administration 2009). WAPA is organized into five regions throughout the western and central United States. The CVP is within WAPA's Sierra Nevada Region.

21.2.1.3 Other

Many of the energy operations within the Delta are subject to the following federal acts: the Rivers and Harbors Appropriation Act of 1899, Section 10; the Rivers and Harbors Act of 1935; the Rivers and Harbors Act of 1937; the Rivers and Harbors Act of 1940; the Auburn-Folsom South Unit Authorization Agreement; the Emergency Relief Appropriation Act of 1935; the Flood Control Act of 1944; the federal Endangered Species Act; and the CVPIA Section 3406 (b)(2). The Rivers and Harbors Appropriation Act of 1899 assigned the USACE responsibility for the regulation of navigable waters of the United States. In 1935, the federal government approved the Emergency Relief Appropriation Act and in doing so approved $20 million in Emergency Relief Funds for the CVP. The Flood Control Act of 1944 approved the construction of the Shasta, Folsom, and New Melones Dams for the CVP.

The Rivers and Harbors Act of 1937 reauthorized the CVP and stated purposes of the project. Energy operations within the statutory Delta are also subject to regulations within the CVPIA. These acts are discussed further in Chapter 5, *Water Supply*, Section 5.2.1. Congress adopted the Auburn-Folsom South Unit Authorization Agreement in 1965 to authorize the construction and operation of the Auburn-Folsom South Unit and the development of recreational facilities associated with the unit. This agreement is further discussed in Chapter 5, *Water Supply*, Section 5.2.1. Energy operations are also subject to the federal Endangered Species Act, which is discussed in Chapter 11, *Fish and Aquatic Resources*, Section 11.2.1.1, and Chapter 12, *Terrestrial Biological Resources*, Section 12.2.1.2.

21.2.2 State Plans, Policies, and Regulations

21.2.2.1 California Public Utilities Commission

The California Public Utilities Commission (CPUC) regulates investor-owned utilities to establish safe and reliable utility service, protect consumers against fraud, provide service at reasonable costs, and promote a healthy state economy. The CPUC regulates privately owned natural gas, electric, telecommunications, water, railroad, rail transit, and passenger transportation companies (California Public Utilities Commission 2007). The CPUC does not, however, regulate CVP or SWP energy facilities or pumping plants, nor WAPA or SMUD.

21.2.2.2 California Independent System Operator

CAISO was created in 1996 by an act of California Legislature and became operational in 1998 as a not-for-profit public benefit corporation to act as the independent operator of California's transmission grid. While transmission lines remain owned by utility companies, CAISO ensures that non-discriminatory open access to transmission service is available to all users. Starting in 2009, CAISO manages transmission congestion through use of locational marginal pricing and manages an integrated forward market for energy purchases and sales. Additionally, CAISO coordinates transmission usage and energy flows with neighboring Balancing Authorities. (California Independent System Operator 2009).

21.2.2.3 California Energy Commission

The Warren-Alquist Energy Resources Conservation and Delivery Act, also called the Warren-Alquist Act, was passed in 1974. The Warren-Alquist Act established the CEC and granted it statutory authority (California Energy Commission 2009b).The CEC promotes energy efficiency throughout the state, supports renewable energy and public interest energy research, and plans and directs the state's responses to energy emergencies. The CEC provides one-stop permitting for new energy facilities. The CEC also provides funds for a variety of technologies that would reduce greenhouse gases (GHGs) (California Energy Commission 2009a).

21.2.2.4 CEQA Guidelines

State CEQA guidelines Appendix F, *Energy Conservation*, outlines analysis requirements for the evaluation of potential energy impacts of proposed projects. Particular emphasis is placed on "avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy." Moreover, the CEQA guidelines state that significant energy impacts should be "considered in an EIR to the extent relevant and applicable to the project." The review of potential impacts should include a discussion of project energy requirements, effects on local and regional energy supplies, effects on peak and base period demands, compliance with energy standards, and effects on energy resources. Alternatives should be compared in terms of total and inefficient energy use. Mitigation for potential significant energy impacts could include a variety of strategies, including measures to reduce wasteful energy consumption and project siting.

21.3 Environmental Consequences

This section describes the potential effects of the action alternatives on energy generation at CVP and SWP hydropower facilities and energy uses for water supply pumping plants. The estimated electrical energy required for construction of the water conveyance facilities associated with the action alternatives are also described. The relatively large energy requirements for pumping CVP and SWP water supplies from the Delta are well described and understood (California Energy Commission 2005; Natural Resources Defense Council 2004).

Effects on energy production and use have been evaluated for the existing CVP and SWP facilities, as well as the proposed conveyance and pumping facilities. The existing transmission lines, switching stations, and substations have been designed and constructed to accommodate the normal seasonal patterns of energy generation at the CVP and SWP hydropower facilities and the electrical energy uses at water supply pumping plants. DWR has coordinated with the three utilities to conduct system impact studies and associated affected systems studies to assess the impact, if any, on the electrical grid both in the CAISO and neighboring balancing area authorities. Impacts on the grid would be mitigated pursuant to this technical assessment such proposed electrical facilities would result in no impacts on the grid or neighboring affected systems. Because the additional energy requirements for the proposed water conveyance facilities are moderate relative to the normal seasonal energy transmission capacity, there would not be any impacts on electrical grid capacity or electrical grid reliability associated with the increased energy uses for the action alternatives.

The potential effects of the BDCP alternatives are discussed under 2060 (LLT) conditions, whereas the potential effects of Alternatives 4A, 2D, and 5A (the non-HCP alternatives) are discussed under 2025 (ELT) conditions. Potential effects of climate change on hydrology (runoff and sea level rise) may modify CVP and SWP operations and all action alternatives may have slightly different energy requirements within these two future periods. Results from the monthly CALSIM-II water resources model were used to determine the monthly flows and diversions for each action alternative at the appropriate timeframe (ELT or LLT) so that monthly and annual electrical energy requirements could be calculated and compared.

The following energy effects have been evaluated.

- Monthly or annual changes in hydroelectric energy generation that would affect the regional energy supply.
- Monthly or annual increases in energy consumption (pumping) that would affect the regional energy consumption.
- Monthly or annual changes in energy use that would cause additional energy generation at facilities with higher pollutant or GHG emissions during operation (or construction). These are considered more fully in Chapter 22, *Air Quality and Greenhouse Gases*, Sections 22.3.3.2 through 22.3.3.16 and Sections 22.3.4.2 through 22.3.4.4.

21.3.1 Methods for Analysis

This section discusses the methods to analyze the electrical energy required for the construction of the water conveyance facilities and the additional energy required for pumping at either the north Delta intakes and associated conveyance facilities or at the pumping plants at Clifton Court Forebay. The additional energy would be related to the monthly north Delta intake pumping or diversion patterns for each action alternative, and would depend on the hydraulic head losses associated with each conveyance alignment (pipeline/tunnel, east, or west). Larger pumps and a greater canal/tunnel capacity would be required for alternatives with higher maximum flows. The required monthly pumping energy would be proportional to the monthly north Delta water diversion volume and would depend on the pumping head (lift) necessary for each action alternative.

21.3.1.1 Construction

Electrical energy needs for construction were evaluated based on the estimated annual energy required for each alternative. The construction energy requirements were estimated from the facilities that would require electrical energy during construction, as described in DWR design documents for each alternative. The construction-related energy demand is considered temporary (i.e., will cease once construction is complete). Construction of the water conveyance facility would require the use of electricity for lighting, tunnel ventilation, tunnel boring, earth removal from the tunnels, and other construction machinery. Annual electrical energy use estimates for each alternative were provided by DWR and are summarized in Table 21-10.

Table 21-10. Temporary Annual Electrical Use Estimates for Construction (megawatt hours)

Year	Alt 1A, 2A, 6A	Alt 7, 8	Alt 3	Alt 4, 4A	Alt 5	Alt 1C, 2C, 6C	Alt 1B, 2B, 6B	Alt 9	Alt 2D	Alt 5A
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	2,829	2,688	2,618	5,518	1,446	1,568	806	368	5,518	5,518
2019	16,255	15,445	15,040	20,635	8,308	9,008	4,630	2,115	20,635	20,635
2020	80,318	76,318	74,318	121,707	41,051	44,508	22,878	10,449	121,712	121,703
2021	213,837	203,188	197,863	320,898	109,294	118,498	60,910	27,820	321,914	319,881
2022	300,279	285,325	277,848	446,895	153,475	166,400	85,532	39,066	448,788	445,002
2023	267,305	253,993	247,337	395,671	136,621	148,127	76,140	34,776	398,032	393,311
2024	278,819	264,934	257,991	408,350	142,506	154,508	79,419	36,274	410,173	406,527
2025	188,090	178,723	174,040	280,555	96,134	104,230	53,576	24,470	283,179	277,930
2026	67,151	63,807	62,134	103,088	34,321	37,212	19,127	8,736	105,811	100,366
2027	12,826	12,187	11,868	23,587	6,555	7,107	3,653	1,669	25,604	21,571
2028	339	322	314	4,456	173	188	97	44	5,467	3,445
2029	10	9	9	1,061	5	6	3	1	1,757	366
Total	1,428,059	1,356,939	1,321,380	2,132,422	729,890	791,359	406,771	185,788	2,148,589	2,116,255

Project construction would consume gasoline and diesel through operation of heavy-duty construction equipment and vehicles. Materials manufacturing would also consume energy, although information on the intensity and quantity of fuel used during manufacturing is currently unknown and beyond the scope of project-level environmental analyses. Accordingly, this analysis focuses on energy associated with physical construction of the water conveyance facilities (i.e., fuel consumed by heavy-duty equipment and vehicles), and an analysis of energy associated with materials manufacturing is considered speculative and is not presented.

DWR and 5RMK Inc. (5RMK) developed construction assumptions for diesel and gasoline consumption as part of an economic analysis (cost estimate) for Alternatives 4 and 4A. The cost estimate included daily fuel use values for off-road equipment (e.g., bulldozers), onsite vehicles (e.g., dump trucks), marine vessels, and locomotives. Fuel data from the cost estimate for these equipment and vehicles types were directly incorporated into the energy analysis. Diesel and gasoline consumption by offsite vehicles (i.e., employee commute vehicles and material delivery vehicles) was calculated by converting GHG emissions calculated by the air quality analysis (refer to Chapter 22, *Air Quality and Greenhouse Gases*) using the rate of carbon dioxide (CO_2) emitted per gallon of combusted gasoline (8.78 kilograms/gallon) and diesel (10.21 kilograms/gallon) (Climate Registry 2015). Anticipated fuel use by the other action alternatives was scaled from the estimate for Alternatives 4 and 4A using CO_2 as a proxy for fuel consumption.

Table 21-11 summarizes total construction-related diesel and gasoline consumption.

Table 21-11. Gasoline and Diesel Estimates for Construction (million gallons)

Alternative	Gasoline and Diesel
1A, 2A, 6A	147
1B, 2B, 6B	134
1C, 2C, 6C	154
2D	128
3	99
4, 4A	104
5	87
5A	95
7, 8	117
9	81

21.3.1.2 Operation

Energy effects from operating the action alternatives were generally evaluated as the increase in energy use for conveyance because this additional energy must be supplied from other energy sources that may have subsequent environmental consequences (e.g., land disturbance, air pollution, GHG impacts) and higher costs (economic effects). Energy effects were evaluated under 2060 (LLT) conditions for the BDCP alternatives because assumed effects of climate change on hydrology (runoff and sea level rise) may modify operations and cause these alternatives to have slightly different energy effects. Energy effects for Alternatives 2D, 4A, and 5A were evaluated under 2025 (ELT) conditions, which included smaller effects of climate change on hydrology (runoff and sea level rise). The potential energy of a water volume that is pumped to a higher elevation is calculated as the weight of water (gravity) times the elevation difference plus energy losses (Total Dynamic head). The potential energy of 1 acre-foot (af) of water with 1 foot of head is equal to 2,712,481 lb_f/ft^3, and conveniently, 1 kWh of energy is equal to 2,655,224 ft-lb_f. Therefore, the energy required to pump 1 af of water can be estimated as:

Energy (kWh/af) = 1.02* Total Dynamic Head (feet) / pumping efficiency

Pumping efficiency represent the wire to water efficiency of a motor/pump setup and could be in the 80–90% range. For comparative calculations, the formula above can be simplified by ignoring the energy losses (using the elevation head instead), and the 1.02 coefficient, which results in:

Energy (kWh/af) = elevation head (feet) / pumping efficiency

For example, the energy required to pump water at the CVP Jones pumping plant is estimated to be about 252 kWh/af because the elevation head is about 197 feet and the efficiency is about 78% (Table 21-2). The pumping energy factor for the SWP Banks pumping plant is estimated to be about 279 kWh/af because the elevation head is about 252 feet and the efficiency is about 90% (Table 21-6).

The CALSIM-II monthly volumes (TAF) diverted (pumped) at the north Delta intakes for each action alternative were used to calculate the monthly and annual energy requirements. Energy effects were evaluated from these monthly and annual energy requirements for each action alternative compared with Existing Conditions and No Action Alternative (ELT or LLT). As described above, the upstream CVP and SWP energy generation was assumed to be very similar for each of the baselines and action alternatives, because the upstream reservoir operations are largely controlled by natural runoff conditions. The energy requirements for the CVP and SWP south Delta pumping plants (total Delta exports) may shift with each action alternative, because the monthly and annual exports (Delta operations) may shift. The energy requirements for pumping and seasonal storage in San Luis Reservoir would remain similar for CVP and SWP deliveries. Therefore, for this analysis, the changes in energy requirements for each action alternative depends on the CALSIM-II simulated monthly north Delta diversions and the total CVP and SWP monthly Delta exports. The baseline (Existing Conditions or No Action Alternative) pumping energy factor for CVP and SWP south of Delta pumping (1.5 GWh/TAF) has been described in Section 21.1, *Environmental Setting/Affected Environment*.

The energy requirements were estimated from the monthly north Delta diversions (pumping) operations simulated with the monthly CVP and SWP operations model (CALSIM-II) for each alternative. The monthly energy requirements were calculated by multiplying the monthly pumping volume (TAF) by the energy requirement per water volume pumped, referred to as the pumping energy factor (MWh/TAF). The pumping energy factor could be different for each alternative. The pumping energy factor for the intake pumps and for canal sections remains constant. The pumping energy factor for a tunnel or pipeline section increases as the flow is increased, because the head loss in a pipeline or tunnel section is proportional to the water velocity squared. The derivation of these energy factors for each alternative is summarized below.

Alternatives 1A, 2A, and 6A would include two 35-mile long tunnels with inside diameters of 33 feet, constructed between the north forebay near Hood and the Byron Tract Forebay, adjacent to Clifton Court Forebay. The maximum capacity for the tunnels would be 15,000 cfs. Five screened intake facilities, with a pumping capacity of 3,000 cfs each, would be constructed along the Sacramento River between Freeport and Courtland. Pipelines or canals would carry water from these intakes to pumping plants to the north (intermediate) forebay. The intermediate forebay would have a water surface elevation of about 25 feet (NAVD 88 datum) and would provide temporary storage to regulate the tunnel flow and allow a pumping schedule that might vary with the tides. The intermediate forebay would provide enough energy head (water elevation) to allow some water to flow by gravity to Byron Tract Forebay, which would have a water surface elevation of 0–5 feet. Preliminary hydraulic calculations indicate that a flow of about 3,000 cfs in each of the 33-foot-diameter tunnels would be possible under gravity. Additional pumping would be required for higher flows.

The Darcy-Weisbach energy loss equation for pipes was used to estimate the head losses for the 33-foot-diameter tunnels, with a Darcy friction factor of 0.0125 corresponding to relatively smooth (concrete lined) tunnels. The Darcy-Weisbach formula is:

$$\text{Energy loss (ft)} = f \times \text{Length (ft)} \times \text{Velocity}^2 / [\text{Diameter (ft)} \times 2\,g]$$

In this formula, f is the friction coefficient (0.0125 assumed), velocity has units of ft/sec, and g is the gravitational force of 32.2 (ft/sec^2). Table 21-12 shows the energy loss calculations for a tunnel 33 feet in diameter and 35 miles long, and for a tunnel 40 feet in diameter and 35 miles long. This was the basis for estimating the gravity flow capacity, the capacity and lift for the low-lift pumps (with a maximum capacity of 4,500 cfs), and the maximum lift for the high-lift pumps (with a maximum capacity of 7,500 cfs).

Table 21-12. Energy Losses for Flow of 500 cfs to 7,500 cfs in a 35-mile Tunnel, Estimated with the Darcy-Weisbach Pipe Formula

	35-Mile Tunnel 33-Foot Diameter			35-Mile Tunnel 40-Foot Diameter	
Flow (cfs)	Velocity (ft/sec)	Energy Loss (feet)	Flow (cfs)	Velocity (ft/sec)	Energy Loss (feet)
500	0.6	0.4	500	0.4	0.1
1,000	1.2	1.5	1,000	0.8	0.6
1,500	1.8	3.3	1,500	1.2	1.3
2,000	2.3	5.9	2,000	1.6	2.3
2,500	2.9	9.3	2,500	2.0	3.5
3,000	3.5	13.4	3,000	2.4	5.1
3,500	4.1	18.2	3,500	2.8	7.0
4,000	4.7	23.8	4,000	3.2	9.1
4,500	5.3	30.1	4,500	3.6	11.5
5,000	5.8	37.1	5,000	4.0	14.2
5,500	6.4	44.9	5,500	4.4	17.2
6,000	7.0	53.5	6,000	4.8	20.4
6,500	7.6	62.8	6,500	5.2	24.0
7,000	8.2	72.8	7,000	5.6	27.8
7,500	8.8	83.6	7,500	6.0	31.9

cfs = cubic feet per second.
ft/sec = feet per second.

Alternatives 1A, 2A, and 6A would have intake pumps and two sets of pumps at the intermediate forebay to provide two pumping options: 1) additional energy head (lift) of about 25 feet for a total energy head of about 50 feet, which would allow a maximum flow of 4,500 cfs (capacity of low-head pumps) in each tunnel, and 2) additional energy head (lift) of 65 feet for a total energy head of about 90 feet, which would allow a maximum flow of 7,500 cfs in each tunnel. When low-head or high-head pumping is required, all the tunnel flow must be pumped. This dual-pumping design would reduce the energy required, because no intermediate pumping would be required for daily average flows of less than 6,000 cfs, and only a moderate pumping energy (25 feet) would be required for daily average flows of 6,000 cfs to 9,000 cfs. Full pumping energy (65 feet) would be required for daily flows of more than 9,000 cfs. The intake pumps will lift the water to the intermediate forebay and this pumping energy will be required for any daily flow. Flows of less than 6,000 cfs have a pumping energy factor of about 35 MWh/TAF, assuming an average lift (energy head) of 30 feet with an efficiency of about 0.8. Flows of 6,000 cfs to 9,000 cfs have an energy factor of about 65 MWh/TAF, and flows of more than 9,000 cfs have an energy factor of about 115 MWh/TAF.

The CALSIM-II results for monthly pumping at the north Delta intakes were used to estimate the monthly energy use for Alternatives 1A, 2A, 6A. Figure 21-3 shows the monthly north Delta pumping flows for Alternative 1A under 2060 (LLT) conditions. Most of the months (75%) had flows of less than 6,000 cfs and required only intake pumping with an energy factor of 35 MWh/TAF. About 10% of the months had flows between 6,000 cfs and 9,000 cfs, and required intake pumping and low-head intermediate pumping with an energy factor of 95 MWh/TAF. About 15% of the months had flows of greater than 9,000 cfs and required intake pumping and high-head intermediate pumping, with an energy factor of 115 MWh/TAF. Figure 21-4 shows the relationship between monthly pumping flow (cfs) and monthly pumping energy (GWh) for Alternative 1A under 2060 (LLT) conditions. The monthly energy generally increases with monthly flow, but the slope of the relationship is greater for flows that require the low-head intermediate pumping (6,000 cfs to 9,000 cfs) or the high-head intermediate pumping (9,000 cfs to 15,000 cfs). The average energy factor for Alternative 1A under 2060 conditions was calculated to be 75 MWh/TAF, because about 37% of the water volume (in 75% of the months) would require only the intake pumping, 23% of the water volume (in 10% of the months) would require intake pumping and low-head intermediate pumping, and 40% of the water volume (in 15% of the months) would require intake pumping and high-head intermediate pumping.

The pumping energy factors for Alternative 2A and 6A were slightly different than for Alternative 1A because the monthly north Delta pumping flows simulated with CALSIM-II were slightly different. The average energy factor for Alternative 2A was calculated to be about 112 MWh/TAF. The average energy factor for Alternative 6A was calculated to be about 115 MWh/TAF. More months with simulated north Delta pumping flows of greater than 6,000 cfs increase the average energy factor for these alternatives.

Alternatives 1B, 2B and 6B include five intakes pumping to a canal section on the east side of the Sacramento River, with a water surface elevation of about 20 feet (NAVD 88). The canal would have a slope of less than 6 inches per mile (similar to the Delta-Mendota Canal and the California Aqueduct), but there would be about 2.5 miles of dual 33-foot-diameter tunnels and about 3 miles of large culverts (four adjacent 26-foot-by-26-foot box culverts) designed for the maximum flow of 15,000 cfs that would cause additional energy losses, Therefore, an intermediate pumping plant with a lift of about 30 feet would be required. Because all flows would require these two pumping lifts at the intakes and at the intermediate pumping plant (50 feet total), the pumping energy factor for Alternative 1B would be about 65 MWh/TAF).

Alternatives 1C, 2C, and 6C include five intakes pumping to a canal section on the west side of the Sacramento River, with a water surface elevation of about 30 feet (NAVD 88). The canal would have a slope of less than 6 inches per mile, but there would be 17 miles of dual 33-foot-diameter tunnels and about 3 miles of large culverts (four adjacent 26-foot-by-26-foot box culverts) designed for the maximum flow of 15,000 cfs that would cause additional energy losses,. Therefore, an intermediate pumping plant with a lift of about 55 feet would be required. Because the canal water surface at the intermediate pumping plant would be about 15 feet (NAVD 88) and the Byron Tract Forebay elevation would be about 5 feet, there is the possibility of about 2,500 cfs of gravity flow; however, Alternative 1C does not include a gravity flow bypass. Therefore, all flows would require two pumping lifts at the intakes and at the intermediate pumping plant (85 feet total), and the pumping energy factor for Alternative 1C would be about 110 MWh/TAF.

Alternative 3 includes two intakes for a maximum capacity of 6,000 cfs. The intermediate forebay and two 33-foot-diameter tunnels would be the same as for Alternative 1A. Because a maximum of 6,000 cfs would be pumped, the tunnels would operate under gravity flow without the need for intermediate pumping. Therefore, the pumping energy factor for Alternative 3 would be about 35 MWh/TAF.

Alternative 4 was modified from the other alternative to use gravity flow from three intakes to an intermediate forebay and to Clifton Court Forebay with a maximum capacity of 9,000 cfs. The two tunnels from the intermediate forebay to the proposed expanded Clifton Court Forebay and pumping station would be larger than for the other alternatives, with inside diameters of 40 feet, to allow the maximum flow of 9,000 cfs to flow in the tunnels under gravity and without the need for intermediate pumping (Table 21-12). The pumping head at the Clifton Court pumping plant would depend on the water flow from the north Delta intakes. The average pumping energy factor was determined to be about 25 MWh/TAF. The construction energy required for boring and spoils disposal for these larger tunnel sections would be greater (see Table 21-10). DOE has estimated that the energy for constructing two 40-foot-diameter tunnels (2,132 GWh) for Alternative 4 would be about 50% more than the electrical energy needed for construction of the 33-foot-diameter tunnels associated with Alternatives 1A, 2A and 6A (1,428 GWh). The additional tunnel construction energy (704 GWh) would allow the pumping energy factor for Alternative 4 to be reduced to about 25 MWh/TAF. Without the larger tunnels, Alternative 4 would have required intakes pumps to an intermediate forebay with a low-head pumping plant for flows of more than 6,000 cfs; the additional energy was calculated to be about 90 GWh/yr, which would be "recovered" after several years of Alternative 4 operations. Alternative 4 includes four slightly different Delta outflow operations scenarios (H1 to H4); these shifted the monthly patterns of north Delta diversions and changed the average annual north Delta diversion slightly, but did not change the average energy factor for the tunnels and Clifton Court pumps.

Alternative 5 includes one intake and one 33-foot-diameter tunnel. The flow in the tunnel would be less than the gravity flow capacity (Table 21-12) so the Alternative 5 energy factor would be about 35 MWh/TAF for pumping water to the intermediate forebay.

Alternatives 7 and 8 would have three intakes (9,000 cfs capacity) with two 33-foot-diameter tunnels; the energy factor would be 35 MWh/TAF for flows of less than 6,000 cfs and would be 65 MWh/TAF for flow of greater than 6,000 cfs. The average energy factor for Alternative 7 was calculated to be 53 MWh/TAF. The average energy factor for Alternative 8 was calculated to be 56 MWh/TAF. More months with simulated north Delta pumping flows of greater than 6,000 cfs would increase the average energy factor for these alternatives.

Alternative 9 would require additional pumping energy to provide a constant pumping flow of 500 cfs (1 TAF per day) between tidal channels that would be separated with barriers in the south Delta. Although the difference in water elevations would be less than 5 feet, DOE estimated that the pumping energy (lift) would be about 35 feet (energy factor of about 44 MWh/TAF); the additional pumping energy for Alternative 9 was estimated to be a constant 2 MW (18 GWh/yr).

The monthly energy loss under Alternatives 2D, 4A, and 5A would depend on the monthly north Delta diversion flows and the variable energy loss (Table 21-12) for the 40-foot tunnels. The analysis of Alternative 4A was identical to the analysis of Alternative 4, but used a slightly different Delta outflow operations scenario that was generally between H3 and H4. The variable pumping heads (Table 21-12) for the 40-foot-diameter tunnels were used with the CALSIM-II monthly diversion flows to calculate the average energy factor of 25 MWh/TAF, which was the same as the average energy factor for the Alternative 4 operations scenarios. The variable energy factor for Alternative 2D would average 35 MWh/TAF because of higher average flows through the tunnels, and the variable energy factor for Alternative 5A would average 20 MWh/TAF because, although the water would flow by gravity in the large tunnels, some pumping would be required to lift the water to Clifton Court Forebay.

21.3.2 Determination of Effects

The effects of the action alternatives on energy consumption may result from both construction and operation of the alternatives features. Construction fuel consumption and electricity use estimates were derived from data provided by DWR and 5RMK. The total amount and intensity of gasoline and diesel consumption may vary substantially from day to day, depending on the level of activity and the specific type of operation. Tunnel boring activities would primarily influence daily electricity use.

The amount of electricity needed each year for an alternative would be proportional to the water pumped from the north Delta (times the energy factor assumed for each alternative) and the amount of water pumped from the south Delta (times the overall energy factor for the CVP and SWP deliveries). As described above, the overall energy factor for the CVP and the SWP is assumed to remain constant for all action alternatives, so the overall energy use for pumping and delivery from the Delta would be proportional to the total Delta exports. The total electricity use for an alternative was calculated from the north Delta diversion (pumping) electricity use added to the electricity used for pumping and delivery of Delta exports to CVP and SWP contractors.

Total electricity use for each action alternative was compared to Existing Conditions and No Action Alternative (ELT or LLT) to determine total electricity use. At the south Delta, additional electricity use is directly related to the change in the total CVP and SWP Delta exports, and represents a greater utilization of the existing (2010) pumping facilities, rather than a new requirement for electricity beyond the generating capacity of existing facilities. Because the existing CVP and SWP pumping facilities at the south delta have been planned and previously operated for a maximum monthly energy requirement that is greater than the energy requirement estimated for action alternatives, increased use of the existing pumping facilities is not considered a new energy impact and is not discussed further.

Under State CEQA guidelines Appendix F, *Energy Conservation*, a project should consider the effects on the local and regional energy supplies and requirements for additional capacity. The review of these effects and the discussion of potential impacts should include particular emphasis on avoiding or reducing inefficient consumption of energy. Accordingly, for the purposes of this analysis, an adverse energy effect would occur if the project resulted in wasteful or unnecessary energy consumption during either construction or operation, or imposes adverse impacts on regional energy supplies.

21.3.2.1 Potential for New Energy Resources

Power planning for loads within California is the responsibility of the CEC on a state-wide basis and the loads' Local Regulatory Authority (LRA) on a Load Serving Entity (LSE) basis. The CEC develops and adopts an Integrated Energy Policy Report (IEPR) every two years and an update every other year. Preparation of the IEPR involves close collaboration with federal, state, and local agencies and a wide variety of stakeholders in an extensive public process to identify critical energy issues and develop strategies to address those issues. The draft 2015 report was released on October 12, 2015 and the 2014 IEPR update was completed in February 2015. The proposed water conveyance facilities were not included in the studies for the 2014 IEPR Update or Draft 2015 IEPR. However, with 447 MW maximum construction load (for Alternative 4A) and 20 MW maximum capacity for Alternative 4A conveyance facilities, would be approximately 1% and 0.06%, respectively, of the state's electricity load (about 35,000 MW).

According to a final Order issued by the FERC on January 22, 2007, the SWP is considered a LSE for Resource Adequacy (RA) purposes. In response to an earlier Order from FERC, on August 31, 2006, DWR's executive management signed documentation that established DWR as the LRA over the SWP. DWR most recent version of its RA Program requires that the SWP comply with the CAISO Tariff Section 40.1 regarding RA requirements of an LSE within the CAISO's Balancing Authority. Pursuant to the RA Program and CAISO Tariff, SWP submits demand forecasts to CEC and CAISO on a year-ahead and month-ahead basis. SWP also submits RA compliance demonstrations to the CAISO on a year-ahead and month-ahead basis. In addition, the RA Program includes a 15% Planning Reserve Margin on all firm load. Consequently, SWP will procure power and capacity for the selected action alternative through long-term and mid-term contracts, and the CAISO power markets, sufficient to meet the power and RA capacity requirements of the CAISO Tariff and DWR's RA Program. No new or expanded electrical power generation facilities will be developed specifically for the water conveyance project; rather, any additional power needs will be addressed through SWP power purchase programs.

21.3.3 Effects and Mitigation Approaches

A summary of average annual energy requirements for each action alternative is provided in Table 21-13. The average annual north Delta intake pumping and associated energy requirements for each action alternative are summarized for easy comparison. The average annual Delta export pumping and associated energy uses for CVP and SWP water deliveries are also included in Table 21-13. This allows the average annual net energy use for each action alternative to be compared to Existing Conditions and the No Action Alternative (ELT and LLT).

The pumping energy factor for south of Delta CVP and SWP water deliveries are assumed identical under Existing Conditions and No Action Alternative (1.5 GWh/TAF/yr). No new energy demand at the north Delta would be created under Existing Conditions or the No Action Alternative. Accordingly, the CEQA (Existing Conditions) and NEPA (No Action Alternative) baselines have different total energy uses that are proportional to the simulated CVP and SWP exports (TAF). However, each of the baselines use the same amount of energy for each TAF of water deliveries that are pumped from the south Delta. In other words, the average required energy for CVP and SWP south of the Delta water deliveries under the NEPA and CEQA baselines is identical (1.5 GWh/TAF/yr).

Table 21-13. Summary of Annual Average Pumping and Net Energy Use for Action Alternatives[a]

							Relative to NEPA Point of Comparison		Relative to CEQA Baseline	
BDCP Alternative	Condition	North Delta Pumping (TAF/yr)	North Delta Energy (GWh)	Energy Factor (MWh/TAF)	Total Delta Pumping (TAF/yr)	South of Delta Energy (GWh)	Increased Energy Use (GWh)	Percent Increase (%)	Increased Energy Use (GWh)	Percent Increase (%)
Existing Conditions[b]	2010	0	0	0	5,144	7,716	–	–	–	–
No Action Alternative (ELT)	2025	0	0		4,728	7,092				
No Action Alternative (LLT)[c]	2060	0	0	0	4,441	6,662	–	–	–	–
Alternative 1A Pipeline/Tunnel-Variable energy factor	2060	2,704	208	77	5,456	8,184	1,730	26%	676	9%
Alternative 1B East Alignment-65 MWh/TAF	2060	2,704	176	65	5,456	8,184	1,699	25%	644	8%
Alternative 1C West Alignment-110 MWh/TAF	2060	2,704	297	110	5,456	8,184	1,820	27%	765	10%
Alternative 2A 15,000 cfs Pipeline/Tunnel- Variable energy factor	2060	2,930	234	80	5,068	7,602	1,174	18%	120	2%
Alternative 2B East Alignment-65 MWh/TAF	2060	2,930	190	65	5,068	7,602	1,131	17%	76	1%
Alternative 2C West Alignment-110 MWh/TAF	2060	2,930	322	110	5,068	7,602	1,263	19%	208	3%
Alternative 2D 35 MWh/TAF	2025	3,066	107	35	5,382	8,073	1,088	15%	464	6%
Alternative 3 6,000 cfs Pipeline/Tunnel-35 MWh/TAF	2060	1,864	65	35	5,371	8,057	1,460	22%	406	5%
Alternative 4 (Scenario H1) 25 MWh/TAF	2060	2,463	62	25	5,255	7,883	1,283	19%	229	3%
Alternative 4 (Scenario H2) 25 MWh/TAF	2060	2,149	54	25	4,710	7,065	457	7%	-597	-8%
Alternative 4 (Scenario H3) 25 MWh/TAF	2060	2,435	61	25	4,945	7,418	817	12%	-237	-3%

BDCP Alternative	Condition	North Delta Pumping (TAF/yr)	North Delta Energy (GWh)	Energy Factor (MWh/ TAF)	Total Delta Pumping (TAF/yr)	South of Delta Energy (GWh)	Relative to NEPA Point of Comparison		Relative to CEQA Baseline	
							Increased Energy Use (GWh)	Percent Increase (%)	Increased Energy Use (GWh)	Percent Increase (%)
Alternative 4 (Scenario H4)										
Large Diameter Pipeline/Tunnel-25 MWh/TAF	2060	2,144	54	25	4,414	7,418	13	<1%	-1,041	-13%
Alternative 4A										
25 MWh/TAF	2025	2,432	61	25	4,918	7,377	346	5%	-278	-4%
Alternative 5										
3,000 cfs Pipeline/Tunnel-35 MWh/TAF	2060	1,191	41	35	4,786	7,179	558	8%	-496	-6%
Alternative 5A										
20 MWh/TAF	2025	1,284	26	20	5,166	7,749	683	10%	59	1%
Alternative 6A										
15,000 cfs Pipeline/Tunnel-Variable energy factor	2060	3,758	300	80	3,759	5,639	-723	-11%	-1,777	-23%
Alternative 6B										
East Alignment-65 MWh/TAF	2060	3,758	244	65	3,759	5,639	-779	-12%	-1,834	-24%
Alternative 6C										
West Alignment-110 MWh/TAF	2060	3,758	413	110	3,759	5,639	-610	-9%	-1,665	-22%
Alternative 7										
9,000 cfs Pipeline/Tunnel-Variable energy factor	2060	2,338	124	53	3,754	5,631	-907	-14%	-1,961	-25%
Alternative 8										
9,000 cfs Pipeline/Tunnel-Variable energy factor	2060	2,182	120	55	3,098	4,647	-1,895	-28%	-2,949	-38%
Alternative 9										
Through Delta/Separate Corridors	2060	0	18	0	4,377	6,566	-78	-1%	-1,133	-15%

– = not used for energy comparison.
cfs = cubic feet per second.
GWh = gigawatt hours.
MWh = megawatt hours.
TAF = thousand acre-feet.

[a] Energy calculations based on CALSIM-II represent a reasonable, though overstated, scenario based on historic monthly flows and reservoir storage.

[b] Installed SWP and CVP capacity in 2010.

[c] Future SWP and CVP capacity in 2060 independent of BDCP actions.

For alternatives that would not meet south of Delta water supply demands, alternative water sources for south of the Delta service areas could be accessed to supplement deliveries. New south of Delta surface water storage, groundwater pumping, and desalination plants could provide some of the necessary supplies but would create additional energy demands. While it is important to acknowledge this possibility, it is difficult to quantify and analyze the variety of supplemental water sources and the associated energy requirements in a meaningful way. The uncertainty around additional water supplies and their associated energy requirements would need to be addressed and analyzed on a case by case basis as they become feasible alternatives.

21.3.3.1 No Action Alternative Late Long Term

The No Action Alternative (LLT) assume continued energy generation and use at CVP and SWP facilities similar to those for recent operations (Existing Conditions) in the year 2060. Slight variances would be expected from the potential reoperation of reservoirs and energy generation facilities to accommodate changes in future precipitation and snowmelt runoff patterns and increased release flows in some months to improve habitat conditions in the rivers and tidal sloughs of the Plan Area.

The energy use for south of Delta pumping and delivery of water to CVP and SWP contractors was estimated from the CALSIM-II simulations of CVP and SWP pumping and deliveries for 1922–2003. Because the No Action Alternative (LLT) included the assumed effects from climate change on runoff, these CALSIM-II results showed moderate reductions in the CVP and SWP exports compared to Existing Conditions (2010). The energy use for CVP and SWP south of Delta pumping would be reduced accordingly, because the energy factor for combined CVP and SWP exports was assumed to remain constant at 1.5 GWh/TAF.

As discussed previously, the upstream generation of energy from CVP and SWP hydropower plants was assumed to remain similar for the No Action Alternative (LLT) because the shifted runoff patterns would not substantially change the annual energy production at the CVP and SWP hydropower plants. The combined SWP/CVP energy factor for Delta exports would remain about 1.5 GWh/TAF. Accordingly, the No Action Alternative (LLT) would not increase the existing energy use factor and would not result in an adverse effect on energy resources (i.e., wasteful or inefficient use).

Climate Change and Catastrophic Seismic Risks

The Delta and vicinity are within a highly active seismic area, with a generally high potential for major future earthquake events along nearby and/or regional faults, and with the probability for such events increasing over time. Based on the location, extent and non-engineered nature of many existing levee structures in the Delta area, the potential for significant damage to, or failure of, these structures during a major local seismic event is generally moderate to high. In the instance of a large seismic event, levees constructed on liquefiable foundations are expected to experience large deformations (in excess of 10 feet) under a moderate to large earthquake in the region. While there are no set thresholds for salinity, bromide, or other contaminants at which the Banks and/or Jones Pumping Plants would cease operations, an event that would alter the hydrology of the Delta such that brackish water or seawater is drawn into the southwest portion of the Delta would likely result in these pumps shutting down until freshwater flows can be reestablished and flush the brackish water/seawater from the vicinity of these pumping plants' intakes. (See Appendix 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water Supplies*, for more detailed discussion) Depending on the duration of the interruption, this could result in a substantial decrease in energy use at the SWP and CVP Delta pumping plants. This decrease in energy use could be offset if south of Delta water uses switch to alternative water supplies. To reclaim land or rebuild levees after a catastrophic event due to climate change or a seismic event would create an increase in energy use during construction.

***CEQA Conclusion*:** The energy use factor (1.5 GWh/TAF) under the No Action Alternatives (ELT or LLT) and Existing Conditions would be identical. Because the No Action Alternatives (ELT or LLT) would not increase the energy use factor, it would not result in a significant impact on energy resources. The energy use for the No action Alternatives (ELT or LLT) would be reduced in comparison with Existing Conditions, because the average annual Delta exports would be reduced.

21.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1A includes a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 182 MW for pumping (and associated equipment) to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 1A is 108 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,428 GWh. That is an average of 119 GWh/yr, with a peak use of 300 GWh occurring in 2022, concurrent with expected tunnel boring activity. It is estimated that Alternative 1A would consume approximately 147 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.2, construction of the water conveyance facilities associated with Alternative 1A includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies will help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 1A equate to 1,428 GWh during the construction period. Alternative 1A would also consume approximately 147 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.2, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 1A would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 1A, the average north Delta intake pumping would be 2,704 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping was estimated to be 208 GWh/yr for LLT (2060) conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1A would not result in wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 1A would require an additional 208 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1A would not result in wasteful or inefficient energy use. In addition, the additional energy required by Alternative 1A would be provided through increases in renewable energy procurement. Because Alternative 1A would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the Renewable Energy Procurement Plan (REPP) to accommodate Alternative 1A would be identified to ensure that Alternative 1A activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its climate action plan (CAP). These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 1A would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: Constructing the proposed water conveyance facilities (Conservation Measure [CM]1) and implementing CM2–CM21 could result in the potential for incompatibilities with plans and policies related to energy resources. A number of plans and policies that coincide with the study area provide guidance for energy resource issues as overviewed in Section 21.2, *Regulatory Setting*. This overview of plan and policy compatibility evaluates whether Alternative 1A is compatible or incompatible with such enactments, rather than whether impacts are adverse or not adverse or significant or less than significant. If the incompatibility relates to an applicable plan, policy, or regulation adopted to avoid or mitigate energy effects, then an incompatibility might be indicative of a related significant or adverse effect under CEQA and NEPA, respectively. Such physical effects of Alternative 1A on energy resources are addressed in Impacts ENG-1 and ENG-2. The following is a summary of compatibility evaluations related to energy resources for plans and policies relevant to the BDCP. Note that as discussed in Chapter 13, *Land Use,* Section 13.2.3, state and federal agencies are not generally subject to local land use regulations; incompatibilities with plans and policies are not, by themselves, physical consequences to the environment.

- Alternative 1A would be constructed and operated in compliance with regulations related to energy resources enforced by FERC and other federal agencies. The alternative would not interfere or obstruct FERC Order No. 888 and Order No. 889, or CAISO Tariff Section 40.1. Compatibility with other federal acts, including the Rivers and Harbors Appropriation Act of

1899, Section 10; the Rivers and Harbors Act of 1935; the Rivers and Harbors Act of 1937; the Rivers and Harbors Act of 1940; the Auburn-Folsom South Unit Authorization Agreement; the Emergency Relief Appropriation Act of 1935; the Flood Control Act of 1944; the federal Endangered Species Act; and CVPIA Section 3406 (b)(2) is discussed in Chapter 5, *Water Supply*; Chapter 11, *Fish and Aquatic Resources*; and Chapter 12, *Terrestrial Biological Resources*.

- Alternative 1A will not conflict with the Warren-Alquist Act, which promotes energy efficiency throughout the state.
- Alternative IA is consistent with CEQA Guidelines, Appendix F, *Energy Conservation*.

CEQA Conclusion: Physical effects associated with implementation of Alternative 1A are discussed in impacts ENG-1 and ENG-2, and no additional CEQA conclusion is required related to the consistency of Alternative 1A with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1B would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the east alignment canal. The maximum power requirements to operate the alternative would be about 82 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 1B is 65 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 407 GWh. This is an average of 34 GWh/yr, with a peak use of 86 GWh occurring in 2022. It is estimated that Alternative 1B would consume approximately 134 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.3, construction of the water conveyance facilities associated with Alternative 1B includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies will help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 1B equate to 407 GWh during the construction period. Alternative 1B would also consume approximately 134 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.3, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 1B would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 1B, the average north Delta intake pumping would be 2,704 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and east alignment conveyance was estimated to be 176 GWh/yr under 2060 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1B would not result in wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 1B would require an additional 176 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1B would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 1B would be provided through increases in renewable energy procurement. Because Alternative 1Bwould result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 1B would be identified to ensure that Alternative 1B activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 1B would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 1B would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.4 Alternative 1C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario A)

Alternative 1C would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the west alignment canal. The maximum power requirements to operate the alternative would be about 138 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 1C is 110 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 791 GWh. That is an average of 66 GWh/yr, with a peak use of 166 GWh in 2022. It is estimated that Alternative 1C would consume approximately 154 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases,* Section 22.3.3.4, construction of the water conveyance facilities associated with Alternative 1C includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that would reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 1C equate to 791 GWh during the construction period. Alternative 1C would also consume approximately 154 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.4, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 1C would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 1C, the average north Delta intake pumping would be 2,704 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and west alignment conveyance was estimated to be 297 GWh/yr under 2060 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1C would not result in a wasteful or inefficient energy use. There would be no adverse effect. No mitigation is required.

***CEQA Conclusion*:** Operation of Alternative 1C would require an additional 297 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 1C would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 1C would be provided through increases in renewable energy procurement. Because Alternative 1C would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 1C would be identified to ensure that Alternative 1C activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 1C would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 1C would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five Intakes (15,000 cfs; Operational Scenario B)

Alternative 2A would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 182 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 2A is 80 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,428 GWh. That is an average of 119 GWh/yr, with a peak use of 300 GWh in 2022. Diesel and gasoline consumption would be similar to Alternative 1A and would equate to approximately 147 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.5, construction of the water conveyance facilities associated with Alternative 2A includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that would reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 2A equate to 1,428 GWh during the construction period. Diesel and gasoline consumption would be similar to Alternative 1A and would equate to approximately 147 million gallons over the construction period. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.5, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 2A would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 2A, the average north Delta intake pumping would be 2,930 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and tunnel conveyance was estimated to be 234 GWh/yr, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2A would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion: Operation of Alternative 2A would require an additional 234 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2A would not result in a wasteful or inefficient energy use. In addition, the additional energy required by the Alternative 2A would be provided through increases in renewable energy procurement. Because Alternative 2Awould result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 2A would be identified to ensure that Alternative 2A activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 2A would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 2A would be compatible with applicable plans and policies related to energy sources.

CEQA Conclusion: Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five Intakes (15,000 cfs; Operational Scenario B)

Alternative 2B would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the east alignment. The maximum power requirements to operate the alternative would be about 82 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 2B is 65 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 407 GWh. This is an average of 34 GWh/yr, with a peak use of 86 GWh in 2022. Diesel and gasoline consumption would be similar to Alternative 1B and would equate to approximately 134 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.6, construction of the water conveyance facilities associated with Alternative 2B includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 2B equate to 407 GWh during the construction period. Diesel and gasoline consumption would be similar to Alternative 1B and would equate to approximately 134 million gallons over the construction period. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.6, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 2B would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 2B, the average north Delta intake pumping would be 2,930 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and east alignment conveyance was estimated to be 190 GWh/yr for LLT, which is greater than the No Action Alternative. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2B would not result in a wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 2B would require an additional 190 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2B would not result in a wasteful or inefficient energy use. In addition, the additional energy required by the Alternative 2B would be provided through increases in renewable energy procurement. Because Alternative 2B would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 2B would be identified to ensure that Alternative 2B activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 2B would be required to include renewable energy so as to meet goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 2B would be compatible with applicable plans and policies related to energy sources.

CEQA Conclusion**:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario B)

Alternative 2C would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the west alignment. The maximum power requirements to operate the alternative would be about 138 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 2C is 110 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 791 GWh. This is an average of 66 GWh/yr, with a peak use of 166 GWh in 2022. Diesel and gasoline consumption would be similar to Alternative 1C and would equate to approximately 154 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.7*,* construction of the water conveyance facilities associated with Alternative 2C includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion**:** Energy requirements for construction of the water conveyance facilities associated with Alternative 2C equate to 791 GWh during the construction period. Diesel and gasoline consumption would be similar to Alternative 1C and would equate to approximately 154 million gallons over the construction period. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.7, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 2C would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 2C, the average north Delta intake pumping would be 2,930 TAF/yr under 2060 conditions. The additional energy use for north Delta intake pumping and west alignment conveyance was estimated to be 322 GWh/yr. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2C would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion**:** Operation of Alternative 2C would require an additional 322 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2C would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 2C would be provided through increases in renewable energy procurement. Because Alternative 2C would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 2C would be identified to ensure that Alternative 2C activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 2C would be required to include renewable energy so as to meet goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 2C would be compatible with applicable plans and policies related to energy sources.

CEQA Conclusion**:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and Intakes 1 and 2 (6,000 cfs; Operational Scenario A)

Alternative 3 would require energy transmission and use for a pumping capacity of 6,000 cfs at north Delta intakes and conveyance through the proposed tunnel. The maximum power requirements to operate the alternative would be about 33 MW for pumping to transport a maximum flow of 6,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 3 is 35 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,321 GWh. This is an average of 110 GWh/yr, with a peak use of 278 GWh in 2022. It is estimated that Alternative 3 would consume approximately 99 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.8, construction of the water conveyance facilities associated with Alternative 3 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 3 equate to 1,321 GWh during the construction period. Alternative 3 would also consume approximately 99 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.8, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 3 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 3, the average north Delta intake pumping would 1,864 TAF/yr under 2060 conditions. The additional energy use for north Delta intake pumping and tunnel conveyance was estimated to be 65 GWh/yr for LLT. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 3 would not result in a wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 3 would require an additional 65 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 3 would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 3 would be provided through increases in renewable energy procurement. Because Alternative 3 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 3 would be identified to ensure that Alternative 3 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 3 would include renewable energy so as to meet goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 3 would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3

21.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Alternative 4 would require energy transmission and use for a pumping capacity of 9,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 50 MW for pumping to transport a maximum flow of 9,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 4 is 25 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 2,132 GWh. This is an average of 178 GWh/yr, with a peak use of 446 GWh in 2022. Alternative 4 would also consume approximately 104 million gallons of diesel and gasoline (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.9, construction of the water conveyance facilities associated with Alternative 4 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 4 would equate to 2,132 GWh during the construction period. Alternative 4 would also consume approximately 104 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.9, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 4 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 4, the average north Delta intake pumping under Scenario H1 would be 2,463 TAF/yr under 2060 conditions. Under Scenario H4, average north Delta intake pumping would 2,144 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and tunnel conveyance was estimated to be 62 GWh/yr (2060 conditions) and 54 GWh/yr (2060 conditions) for Scenarios H1 and H4, respectively. These two scenarios reflect the range of effects that would result from the four potential outflow requirements under Alternative 4. While all scenarios would increase energy demand for the north Delta intakes, relative to the No Action Alternative, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 4 would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion: Operation of Alternative 4 under Scenario H1 would require an additional 62 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. Operation of Alternative 4 under Scenario H4 would require an additional 54 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. Operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 4 would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 4 would be provided through increases in renewable energy procurement. Because Alternative 4 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 4 would be identified to ensure that Alternative 4 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals are outlined in the CAP. Consequently, additional energy required by Alternative 4 would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 4 would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3

21.3.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

Alternative 5 would require energy transmission and use for a pumping capacity of 3,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 16 MW for pumping to transport a maximum flow of 3,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 5 is 35 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 730 GWh. This is an average of 61 GWh/yr, with a peak use of 153 GWh in 2022. It is estimated that Alternative 5 would consume approximately 87 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.10, construction of the water conveyance facilities associated with Alternative 5 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 5 equate to 730 GWh during the construction period. Alternative 4 would also consume approximately 87 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.10, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 5 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 5, the average north Delta intake pumping would be 1,191 TAF/yr under 2060 conditions. The additional energy use for north Delta intake pumping and tunnel conveyance for Alternative 5 is estimated to be 41 GWh/yr for 2060 conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 5 would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion**:** Operation of Alternative 5 would require an additional 41 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 5 would not result in a wasteful or inefficient energy use. In addition, the additional energy required by the Alternative 5 would be provided through increases in renewable energy procurement. Because Alternative 5 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 5 would be identified to ensure that Alternative 5 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 5 would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 5 would be compatible with applicable plans and policies related to energy sources.

CEQA Conclusion**:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3

21.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and Intakes 1-5 (15,000 cfs; Operational Scenario D)

Alternative 6A would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 182 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 6A is 80 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,428 GWh. This is an average of 119 GWh/yr, with a peak use of 300 GWh in 2022. Diesel and gasoline consumption would be similar to Alternative 1A and would equate to approximately 147 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.11, construction of the water conveyance facilities associated with Alternative 6A includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 6A equate to 1,428 GWh during the construction period. Alternative 6A would also consume approximately 147 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.11, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 6A would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 6A, the average north Delta intake pumping would be 3,758 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and tunnel conveyance was estimated to be 300 GWh/yr for 2060 conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6A would not result in a wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 6A would require additional energy for north Delta pumping of 300 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6A would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 6A would be provided through increases in renewable energy procurement. Because Alternative 6 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 6A would be identified to ensure that Alternative 6A activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required Alternative

6A would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 6A would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG -2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Alternative 6B would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the east alignment. The maximum power requirements to operate the alternative would be about 820 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 6B is 65 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 407 GWh. This is an average of 34 GWh/yr, with a peak use of 86 GWh occurring in 2022. Diesel and gasoline consumption would be similar to Alternative 1B and would equate to approximately 134 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.12, construction of the water conveyance facilities associated with Alternative 6B includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 6B equate to 407 GWh during the construction period. Alternative 1B would also consume approximately 134 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.12, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 6B would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 6B, the average north Delta intake pumping would be 3,758 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and east alignment conveyance was estimated to be 244 GWh/yr for 2060 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6B would not result in a wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 6B would require an additional 244 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6B would not result in a wasteful or inefficient energy use. In addition, the additional energy required by the Alternative 6B would be provided through increases in renewable energy procurement. Because Alternative 6B would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 6B would be identified to ensure that Alternative 6B activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 6B would be required to include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 6B would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario D)

Alternative 6C would require energy transmission and use for a pumping capacity of 15,000 cfs at north Delta intakes and conveyance through the west alignment. The maximum power requirements to operate the alternative would be about 138 MW for pumping to transport a maximum flow of 15,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The north Delta intakes and conveyance energy factor for Alternative 6C is 110 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 791 GWh. This is an average of 66 GWh/yr, with a peak use of 166 GWh occurring in 2022. Diesel and gasoline consumption would be similar to Alternative 1C and would equate to approximately 154 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.13, construction of the water conveyance facilities associated with Alternative 6C includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 6C equate to 791 GWh during the construction period. Alternative 1C would also consume approximately 154 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.13, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 6C would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 6C, the average north Delta intake pumping would be 3,758 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and west alignment conveyance was estimated to be 413 GWh/yr for 2060 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6C would not result in a wasteful or inefficient energy use. There would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 6C require additional energy for north Delta pumping of 413 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 6C would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 6C would be provided through increases in renewable energy procurement. Because Alternative 6C would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 6C would be identified to ensure that Alternative 6C activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 6C include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 6C would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3

21.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational Scenario E)

Alternative 7 would require energy transmission and use for a pumping capacity of 9,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 80 MW for pumping to transport a maximum flow of 9,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 7 is 53 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,357 GWh. This is an average of 113 GWh/yr, with a peak use of 285 GWh in 2022. It is estimated that Alternative 7 would consume approximately 117 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.14, construction of the water conveyance facilities associated with Alternative 7 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 7 equate to 1,357 GWh during the construction period. Alternative 7 would also consume approximately 117 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.14, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 7 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 7, the average north Delta intake pumping would be 2,338 TAF/yr under 2060 conditions. The energy use for north Delta intake pumping and tunnel conveyance was estimated to be 124 GWh/yr for 2060 conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 7 would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion: Operation of Alternative 7 would require additional energy for north Delta pumping of 124 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 7 would not result in a wasteful or inefficient energy use. In addition, the additional energy required by Alternative 7 would be provided through increases in renewable energy procurement. Because Alternative 7 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 7 would be identified to ensure that Alternative 7 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals are outlined in the CAP. Consequently, additional energy required by the Alternative 7 include renewable energy so as to meet goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 7 would be compatible with applicable plans and policies related to energy sources.

CEQA Conclusion: Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

Alternative 8 would require energy transmission and use for a pumping capacity of 9,000 cfs at north Delta intakes and conveyance through the tunnel. The maximum power requirements to operate the alternative would be about 80 MW for pumping to transport a maximum flow of 9,000 cfs from the Sacramento River near Hood to the SWP Clifton Court Forebay near Tracy. The average north Delta intakes and conveyance energy factor for Alternative 8 is 55 MWh/TAF.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 1,357 GWh. This is an average of 113 GWh/yr, with a peak use of 285 GWh in 2022. Diesel and gasoline consumption would be similar to Alternative 8 and would equate to approximately 117 million gallons over the construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.15, construction of the water conveyance facilities associated with Alternative 8 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 8 equate to 1,357 GWh during the construction period. Alternative 8 would also consume approximately 117 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.15, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 8 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, for Alternative 8, the average north Delta intake pumping would be 2,182 TAF/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. The energy use for north Delta intake pumping and tunnel conveyance was estimated to be 120 GWh/yr for 2060 conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 8 would not result in a wasteful or inefficient energy use. Accordingly, there would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 8 would require an additional 120 GWh/yr under 2060 conditions for north Delta pumping, relative to Existing Conditions. However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 8 would not result in a wasteful or inefficient energy use. In addition, the additional energy required by the Alternative 8 would be provided through increases in renewable energy procurement. Because Alternative 8 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 8 would be identified to ensure that Alternative 8 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 8 would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP. Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 8 would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; Operational Scenario G)

There would be no additional pumping energy required for north Delta diversions for Alternative 9. Existing diversions from the Sacramento River to the Delta Cross Channel and to Georgiana Slough would continue, but Sacramento River fish would be protected from diversion with large fish screens. This alternative would require very small additional energy use for south Delta circulation pumps with a total capacity of 500 cfs. These circulation pumps would be used continuously. DWR has estimated the electrical energy requirements for construction to be about one-half of the east alignment construction energy. This estimate may be high relative to the size of the pumping stations and other facilities required to construct the San Joaquin River separate corridor along Old River, the fish screens at Delta Cross Channel and Georgiana Slough, and the tidal gates at Threemile Slough. DWR has estimated the two pumping plants would require an electrical capacity of 2 MW. The additional annual energy use would therefore be about 18 GWh. The energy factor for this circulation pumping would be 48 MWh/TAF, which appears high for the relatively low energy head of 5–10 feet.

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Table 21-10 indicates that the total construction energy use estimate for the construction period would be about 186 GWh. This is an average of 15 GWh/yr, with a peak use of 39 GWh in 2022. Diesel and gasoline consumption would likely be slightly lower than Alternative 4 (see Table 21-11), due to reduced equipment and vehicle activity required to construct Alternative 9. It is estimated that Alternative 9 would consume approximately 81 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.16, construction of the water conveyance facilities associated with Alternative 9 includes all feasible control measures to improve equipment efficiency and reduce energy use. Although energy will be consumed as a result of construction activities, BMPs will ensure that only high-efficiency equipment is utilized during construction. Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1 also outlines an equipment exhaust control plan that will reduce unnecessary equipment idling and ensure all construction equipment is in proper working condition according to manufacturer's specifications. These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect.

CEQA Conclusion**:** Energy requirements for construction of the water conveyance facilities associated with Alternative 9 equate to 186 GWh during the construction period. Alternative 9 would also consume approximately 81 million gallons of diesel and gasoline. As discussed in Chapter 22, *Air Quality and Greenhouse Gases*, Section 22.3.3.16, construction activities would include all feasible control measures to improve equipment efficiency and reduce energy use. Construction of the water conveyance facilities associated with Alternative 9 would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, this impact would be less than significant and no mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: The CALSIM-II simulated total exports for Alternative 9 were 4,377 TAF/yr under 2060 conditions. Table 21-13 shows that Alternative 9 annual energy use for circulation pumping would be about 18 GWh/yr. This small increase in energy use, relative to the No Action Alternative (2060), would be managed to maximize efficient energy use. Accordingly, implementation of Alternative 9 would not result in a wasteful or inefficient energy use. There would be no adverse effect.

CEQA Conclusion**:** Operation of Alternative 9 would require an additional 18 GWh/yr under 2025 and 2060 conditions for circulation pumping in the south Delta. This small increase in energy use, relative to Existing Conditions, would be managed to maximize efficient energy use. Accordingly, implementation of Alternative 9 would not result in a wasteful or inefficient energy use.

In addition, the additional energy required by Alternative 9 would be provided through increases in renewable energy procurement. Because Alternative 9 would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 9 would be identified to ensure that Alternative 9 activities do not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 9 would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP.

Accordingly, this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and CM2–CM21 with Plans and Policies

NEPA Effects: The potential for inconsistencies with plans or polices would be similar to the discussion in Alternative 1A, Impact ENG-3. Construction and implementation of Alternative 9 would be compatible with applicable plans and policies related to energy sources.

***CEQA Conclusion*:** Physical effects associated with implementation of the alternative are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the consistency of the alternative with relevant plans and polices. The relationship between plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13, *Land Use,* Section 13.2.3.

21.3.4 Effects and Mitigation Approaches—Alternatives 4A, 2D, and 5A

21.3.4.1 No Action Alternative Early Long-Term

The effects of Alternatives 4A, 2D, and 5A are evaluated in comparison with the No Action Alternative (ELT) for 2025 conditions. The No Action Alternative (ELT) includes less assumed climate change shifting of runoff and resulted in greater average Delta exports than the No Action Alternative (LLT) for 2060 conditions. The No Action Alternatives (ELT) assume continued energy generation and use at CVP and SWP facilities similar to those for recent operations (Existing Conditions 2010). Slight variations in the monthly generation patterns would be expected from the potential reoperation of reservoirs and energy generation facilities to accommodate changes in future precipitation and snowmelt runoff patterns.

The energy use for south of Delta pumping and delivery of water to CVP and SWP contractors was estimated from the CALSIM-II simulations of CVP and SWP pumping and deliveries for 1922–2003. Because the No Action Alternative (ELT) included the assumed effects from climate change on runoff, these CALSIM-II results showed moderate reductions in the CVP and SWP exports compared to Existing Conditions (2010). The energy use for CVP and SWP south of Delta pumping would be reduced accordingly, because the energy factor for combined CVP and SWP exports was assumed to remain constant at 1.5 GWh/TAF.

Because these alternatives include two 40-foot-diameter tunnels between the north Delta intakes and Clifton Court Forebay, the average conveyance energy factors for these alternatives were relatively small. The average energy factor for Alternative 4A was 25 MWh/TAF, the average energy factor for Alternative 2D was 35 MWh/TAF, and the energy factor for Alternative 5A was 20 MWh/TAF. The energy factors are slightly different because the average pumping flows (friction losses) were different.

21.3.4.2 Alternative 4A—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

NEPA Effects: Total construction energy use (2,132 GWh and 104 million gallons of diesel and gasoline) and the potential for Alternative 4A to result in a wasteful, inefficient or unnecessary consumption of construction energy would be identical to Alternative 4. Construction BMPs would ensure that only high-efficiency equipment is utilized during construction (see Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1) and that construction activity would not result in an adverse effect on energy resources.

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 4A would equate to 2,132 GWh during the construction period. Alternative 4A would also consume approximately 104 million gallons of diesel and gasoline. Construction BMPs would ensure that only high-efficiency equipment is utilized during construction and that construction activity would result in a less-than-significant impact on energy resources. No mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

Modeling for Alternative 4A was conducted for Operational Scenario H3+, a point that generally falls between Scenario H3 and H4 operations, as the initial conveyance facilities operational scenario. As specified in Chapter 3, *Description of Alternatives*, Section 3.6.4, the Delta outflow criteria under Scenario H for Alternative 4A would be determined by the ESA and California Endangered Species Act Section 2081 permits, and operations to obtain such outflow would likely be between Scenarios H3 and H4. Modeling results for Scenarios H3 and H4 using the 2015 CALSIM II model are shown in Appendix 5E, *Supplemental Modeling Requested by the State Water Resources Control Board Related to Increased Delta Outflows*, Attachment 1. In addition, following the initial operations, the adaptive management and monitoring program could be used to make long-term changes in initial operations criteria to address uncertainties about spring outflow for longfin smelt and fall outflow for delta smelt, among other species.

Future conveyance facilities operational changes may also be made as a result of adaptive management to respond to advances in science and understanding on how operations affect species. Conveyance facilities would be operated under an adaptive management range represented by Boundary 1 and Boundary 2 (see Section 5E.2 of Appendix 5E for additional information on Boundary 1 and Boundary 2). Impacts as a result of operations within this range would be consistent with the impacts discussed for the range of alternatives considered in this EIR/EIS. As shown in Appendix 5F, water supply modeling results for H3+ are within the range of results for Scenarios H3 and H4, and are consistent with the impacts discussed in the RDEIR/SDEIS. The following analysis of Alternative 4A impacts reflects modeling results of Operational Scenario H3+.

NEPA Effects: As shown in Table 21-13, energy use for north Delta intake pumping and tunnel conveyance for Alternative 4A would be 61 GWh/yr under 2025 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity.

Accordingly, implementation of Alternative 4A would not result in a wasteful or inefficient energy use and there would be no adverse effect.

CEQA Conclusion: Operation of Alternative 4A would require an additional 61 GWh/yr under 2025 conditions for north Delta pumping, relative to Existing Conditions. Operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity.

In addition, the additional energy required by Alternative 4A would be provided through increases in renewable energy procurement. Because Alternative 4A would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 4A would be identified to ensure it does not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 4A would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP.

Accordingly, implementation of Alternative 4A would not result in a wasteful or inefficient energy use and this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and Environmental Commitments 3, 4, 6–12, 15, and 16 with Plans and Policies

NEPA Effects: Constructing the water conveyance facilities and implementing the Environmental Commitments under Alternative 4A would generally have the same potential for incompatibilities with one or more plans and policies related to energy resources as described for Alternative 4. As described for Alternative 4, the project would be constructed and operated in compliance with regulations related to energy resources enforced by Federal Energy Regulatory Commission (FERC) and other federal agencies. The project would not conflict with the Warren-Alquist Act or State CEQA Guidelines, Appendix F, *Energy Conservation*

CEQA Conclusion: The potential incompatibilities with plans and policies listed above indicate the potential for a physical consequence to the environment. The physical effects they suggest are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the compatibility of Alternative 4A with relevant plans and policies.

21.3.4.3 Alternative 2D—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 1, 2, 3, 4, and 5 (15,000 cfs; Operational Scenario B)

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

Alternative 2D would include the same physical/structural components as Alternative 4, but would include two additional intakes, similar to Alternative 1A as described in Section 21.3.3.2. Construction electricity required for Alternative 2D would therefore be slightly higher than Alternative 4, as shown in Table 21-10. Diesel and gasoline consumption would also be higher than Alternative 4 (see Table 21-11), due to increased equipment and vehicle activity required to construct two additional intakes. Based on the analysis presented in Chapter 22, *Air Quality and*

Greenhouse Gases, it is estimated that Alternative 2D would result in 23% more CO_2 from equipment and vehicles than Alternative 4. Using CO_2 as a proxy for fuel consumption, Alternative 2D would consume approximately 128 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

NEPA Effects: Total construction electricity for Alternative 2D would be about 2,148 GWh of electricity over the 14-year construction period (see Table 21-10). Alternative 2D would also consume approximately 128 million gallons of diesel and gasoline.

While Alternative 2D would require slightly more construction energy than Alternative 4, the potential for Alternative 2D to result in a wasteful, inefficient or unnecessary consumption of construction energy would be similar to Alternative 4 because, under both alternatives, project proponents would implement all feasible control measures to improve equipment efficiency and reduce energy use (refer to Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1). These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect on energy resources.

***CEQA Conclusion*:** Energy requirements for construction of the water conveyance facilities associated with Alternative 2D would equate to approximately 2,148 GWh during the construction period. Alternative 2D would also consume approximately 128 million gallons of diesel and gasoline. Construction BMPs would ensure that only high-efficiency equipment is utilized during construction and that construction activity would result in a less-than-significant impact on energy resources. No mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, energy use for north Delta intake pumping and tunnel conveyance for Alternative 2D would be 107 GWh/yr under 2025 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 2D would not result in a wasteful or inefficient energy use and there would be no adverse effect.

***CEQA Conclusion*:** Operation of Alternative 2D would require an additional 107 GWh/yr under 2025 conditions for north Delta pumping, relative to Existing Conditions. Operation of the water conveyance facility under both scenarios would be managed to maximize efficient energy use, including off-peak pumping and use of gravity.

In addition, the additional energy required by Alternative 2D would be provided through increases in renewable energy procurement. Because Alternative 2D would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate the Alternative 2D would be identified to ensure it does not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 2D would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP.

Accordingly, implementation of Alternative 2D would not result in a wasteful or inefficient energy use and this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and Environmental Commitments 3, 4, 6–12, 15, and 16 with Plans and Policies

Constructing the water conveyance facilities and implementing the Environmental Commitments under Alternative 2D would generally have the same potential for incompatibilities with one or more plans and policies related to energy resources as described for Alternative 4 in Section 21.3.3.9. See the discussion of Impact ENG-3 under Alternative 4.

NEPA Effects: As described for Alternative 4 in Section 21.3.3.9, the project would be constructed and operated in compliance with regulations related to energy resources enforced by Federal Energy Regulatory Commission (FERC) and other federal agencies. The project would not conflict with the Warren-Alquist Act or State CEQA Guidelines, Appendix F, *Energy Conservation.*

***CEQA Conclusion*:** The potential incompatibilities with plans and policies listed above indicate the potential for a physical consequence to the environment. The physical effects they suggest are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the compatibility of Alternative 2D with relevant plans and policies.

21.3.4.4 Alternative 5A—Dual Conveyance with Modified Pipeline/Tunnel and Intake 2 (3,000 cfs; Operational Scenario C)

Impact ENG-1: Wasteful or Inefficient Energy Use for Temporary Construction Activities

Alternative 5A would include the same physical/structural components as Alternative 4, but would include two fewer intakes, similar to Alternative 5 as described in Section 21.3.3.10. Construction electricity required for Alternative 5A would therefore be slightly less than Alternative 4, as shown in Table 21-10. Diesel and gasoline consumption would also be less than Alternative 4 (see Table 21-11), due to reduced equipment and vehicle activity required to construct two fewer intakes. Based on the analysis presented in Chapter 22, *Air Quality and Greenhouse Gases*, it is estimated that Alternative 5A would result in 9% fewer CO_2 from equipment and vehicles than Alternative 4. Using CO_2 as a proxy for fuel consumption, Alternative 5A would consume approximately 95 million gallons of diesel and gasoline over the entire construction period (see Table 21-11).

NEPA Effects: Total construction electricity for Alternative 5A would be about 2,116 GWh of electricity over the 14-year construction period (see Table 21-10). Alternative 2D would also consume approximately 95 million gallons of diesel and gasoline. While Alternative 5A would require slightly less construction energy than Alternative 4, the potential for Alternative 5A to result in a wasteful, inefficient or unnecessary consumption of construction energy would be similar to Alternative 4 because, under both alternatives, project proponents would implement all feasible control measures to improve equipment efficiency and reduce energy use (refer to Appendix 3B, *Environmental Commitments, AMMs, and CMs*, Section 3B.2.9.1). These and other policies would help reduce construction energy and are consistent with state and local legislation and policies to conserve energy. Construction activities would therefore not result in the wasteful, inefficient or unnecessary consumption of energy. Accordingly, there would be no adverse effect on energy resources

CEQA Conclusion: Energy requirements for construction of the water conveyance facilities associated with Alternative 5A would equate to approximately 2,116 GWh during the construction period. Alternative 5A would also consume approximately 95 million gallons of diesel and gasoline. Construction BMPs would ensure that only high-efficiency equipment is utilized during construction and that construction activity would result in a less-than-significant impact on energy resources. No mitigation is required.

Impact ENG-2: Wasteful or Inefficient Energy Use for Pumping and Conveyance

NEPA Effects: As shown in Table 21-13, energy use for north Delta intake pumping and tunnel conveyance would range be 26 GWh/yr under 2025 conditions, which is greater than the No Action Alternative (requires no pumping at the north Delta). However, operation of the water conveyance facility would be managed to maximize efficient energy use, including off-peak pumping and use of gravity. Accordingly, implementation of Alternative 5A would not result in a wasteful or inefficient energy use and there would be no adverse effect.

CEQA Conclusion: Operation of Alternative 5A would require an additional 26 GWh/yr under 2025 conditions for north Delta pumping, relative to Existing Conditions. Operation of the water conveyance facility under both scenarios would be managed to maximize efficient energy use, including off-peak pumping and use of gravity.

In addition, the additional energy required by Alternative 5A would be provided through increases in renewable energy procurement. Because Alternative 5A would result in additional SWP energy demands in excess of 15 GWh/yr, consultation with DWR's SWP Power and Risk Office would be required, and modifications to the REPP to accommodate Alternative 5A would be identified to ensure it does not conflict with DWR's ability to achieve the GHG reductions outlined in its CAP. These modifications to the REPP would detail the additional gigawatts of renewable electricity that DWR expects to purchase each year during the 40-year period from 2011 to 2050 to meet the GHG emissions reduction goals outlined in the CAP. Consequently, additional energy required by Alternative 5A would include renewable energy so as to meet the goal outlined in DWR's REPP and CAP.

Accordingly, implementation of Alternative 5A would not result in a wasteful or inefficient energy use and this impact would be less than significant. No mitigation is required.

Impact ENG-3: Compatibility of the Proposed Water Conveyance Facilities and Environmental Commitments 3, 4, 6, 7, 9–12, 15, and 16 with Plans and Policies

Constructing the water conveyance facilities and implementing the Environmental Commitments under Alternative 5A would generally have the same potential for incompatibilities with one or more plans and policies related to energy resources as described for Alternative 4. See the discussion of Impact ENG-3 under Alternative 4 in Section 21.3.3.9.

NEPA Effects: As described for Alternative 4, the project would be constructed and operated in compliance with regulations related to energy resources enforced by Federal Energy Regulatory Commission (FERC) and other federal agencies. The project would not conflict with the Warren-Alquist Act or State CEQA Guidelines, Appendix F, *Energy Conservation.* Accordingly, there would be no adverse effect.

CEQA Conclusion: The potential incompatibilities with plans and policies listed above indicate the potential for a physical consequence to the environment. The physical effects they suggest are discussed in impacts ENG-1 and ENG-2, above and no additional CEQA conclusion is required related to the compatibility of Alternative 5A with relevant plans and policies.

21.3.5 Cumulative Analysis

This cumulative analysis considers other past, present, and reasonably foreseeable future projects that could affect the same resources during the same timeframe as the action alternatives, resulting in a cumulative energy effect. Energy use and local communities' demands for energy are expected to increase as a result of reasonably foreseeable future projects related to population growth and energy uses. It is expected that some changes related to energy use will take place although it is assumed that all future projects would include design and construction practices to avoid or minimize potential energy effects.

Cumulative effects of the action alternatives on electrical energy generation and use within the study area are expected to change as a result of past, present, and reasonably foreseeable future projects related to population growth and changes in economic activity in the study area (see Chapter 30, *Growth Inducement and Other Indirect Effects,* Section 30.3.2).

When the effects of the action alternatives on increased energy use are considered in connection with the potential effects of projects listed in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impacts Conditions*, the cumulative effects on energy use are adverse because many of the other projects would also increase energy use in the study area. The specific programs, projects, and policies are identified below, based on the potential to contribute to an energy impact that would be cumulatively considerable. The potential for cumulative impacts on energy generation and use are described for the action alternative's operational effects on energy use within the Delta and energy use in the South of Delta region of CVP and SWP water deliveries related to the water conveyance facilities.

Table 21-14 summarizes foreseeable projects and programs that may affect energy resources. Only those projects included in the cumulative analysis are listed.

Table 21-14. Effects related to Energy from the Plans, Policies, and Programs Considered for Cumulative Analysis

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
California Department of Water Resources	Oroville Facilities Relicensing	DWR. 2008. Oroville Facilities Relicensing FERC Project No. 2100 Final Environmental Impact Report.	The objective of the relicensing process was to continue operation and maintenance of the Oroville Facilities for electric power generation, along with implementation of any terms and conditions to be considered for inclusion in a new Federal Energy Regulatory Commission hydroelectric license	May reduce energy generation or require additional energy
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	FCWA web site. Fact Sheet. Site accessed June 30, 2009. URL = http://www.freeportproject.org/nodes/construction/	Construction of a new water intake facility/pumping plant and 17-mile underground water pipeline within Sacramento County.	Increased energy demand

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
Cities of Davis and Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	The project is nearing completion and the Cities will begin using surface water in June 2016	Divert up to about 46,100 acre-feet per year of surface water from the Sacramento River and convey it for treatment and subsequent use in Davis and Woodland and on the University of California, Davis campus	May reduce energy generation or require additional energy
Contra Costa Water District, Bureau of Reclamation, and California Department of Water Resources	Contra Costa Water District Alternate Intake Project	Completed in 2011	Locate a new drinking water intake at Victoria Canal, about 2.5 miles east of Contra Costa Water District's existing intake on the Old River, which would allow the district to divert higher quality water when it is available	Increased energy demand
Contra Costa Water District and Bureau of Reclamation	Los Vaqueros Reservoir Expansion Project	U.S. Bureau of Reclamation, Contra Costa Water District, Los Vaqueros Reservoir Expansion Project, Final Environmental Impact Statement/Environmental Impact Report, March, 2010.	Increase the reservoir capacity to 275,000 acre-feet and add a new 470 cfs connection that would allow the Los Vaqueros system to provide water to South Bay water agencies – Alameda County Flood Control and Water Conservation District, Zone 7, Alameda County Water District, and Santa Clara Valley Water District – that otherwise would receive all of their Delta supplies through the existing SWP and CVP export pumps	Increased energy demand
Bureau of Reclamation and California State Water Resources Control Board	Battle Creek Salmon and Steelhead Restoration Project	Reclamation and SWRCB. 2005. Battle Creek Salmon and Steelhead Restoration Project final environmental impact statement/environmental impact report. July 2005.	Restoration of Battle Creek will be accomplished primarily through the modification of the Battle Creek Hydroelectric Project (Federal Energy Regulatory Commission Project No. 1121) facilities and operations, including instream flow releases. Facility changes include the removal of five diversion dams and construction of fish ladders and fish screens at three diversion dams.	May reduce energy generation or require additional energy
Bureau of Reclamation and Tehama Colusa Canal Authority	Red Bluff Diversion Dam Fish Passage Project	Project completed in 2012.	Includes a new pumping plant and fish screen with a pumping capacity of 2,500 cfs. The initial installed pumping capacity will be 2,000 cfs.	May reduce energy generation or require additional energy

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
Bureau of Reclamation	Delta-Mendota Canal Intertie Pumping Plant	Project completed in 2012.	Construction and operation of a pumping plant and pipeline connection between the Delta Mendota Canal (DMC) and the California Aqueduct. The intertie would include a 450-cfs pumping plant at the DMC that would allow up to 400 cfs to be pumped from the DMC to the California Aqueduct via an underground pipeline. The additional 400 cfs would bring the Jones Pumping Plant to its authorized amount of 4,600 cfs.	Increased energy demand
Zone 7 Water Agency and Department of Water Resources	South Bay Aqueduct Improvement and Enlargement Program	Under construction.	Increase the existing capacity of the water conveyance system up to its design capacity of 300 cfs, and expand capacity in a portion of the project to add 130 cfs (total of 430 cfs).	Increased energy demand
California Department of Water Resources	North Bay Aqueduct Alternative Intake	EIR in preparation	Plan to construct and operate an alternative intake on the Sacramento River, generally upstream of the Sacramento Regional Wastewater Treatment Plant, and connect it to the existing North Bay Aqueduct system by a new pipeline.	May increase energy demand
California Department of Water Resources	California Water Action Plan	Water Action Plan. URL = http://resources.ca.gov/california_water_action_plan/. Site accessed April 25, 2016.	This plan lays out a roadmap for the next 5 years for actions that would fulfill 10 key themes. In addition, the plan describes certain specific actions and projects that call for improved water management throughout the state.	Potential effects on energy resources during construction of water supply infrastructure under this program
Delta Conservancy	California EcoRestore	In progress.	This program will accelerate and implement a suite of Delta restoration actions for up to 30,000 acres of fish and wildlife habitat by 2020.	Potential for minor effects on energy resources during construction of restoration actions.
California High Speed Rail Authority and Federal Railroad Administration	Altamont Corridor Rail Project	CHSRA. 2009. California High-Speed Train Program Summary Report, July 2009. CHSRA. 2009. Notice of Preparation (filed October 22, 2009).	The project would incrementally upgrade the Altamont Commuter Express System.	Increased energy demand

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
California High Speed Rail Authority and Federal Railroad Administration	California High-Speed Rail System Fresno to Merced Section	California High-Speed Train Program Summary Report, July 2009. Available at: http://www.cahighspeedrail.ca.gov/library.asp?p=8200. CHSRA and FRA. 2005. Final Program Environmental Impact Report/ Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System. August. Bay Area to Central Valley Program EIR/EIS, available at: http://www.cahighspeedrail.ca.gov/library/Default.aspx?ItemID=6113.	The project would construct a new rail corridor between Merced and Fresno.	Increased energy demand
East Bay Municipal Utility District	Water Supply Management Program 2040	EBMUD web site. Water Supply Management Plan 2040. Site accessed October 20, 2009. URL = http://www.ebmud.com/water_&_environment/water_supply/water_supply_management_program/default.htm	The plan serves as the basis for water conservation and recycling programs and for development of supplemental supply initiatives through 2040, especially dry-year water needs and future needs with climate change.	May change CVP operations and energy use
Placer County Water Agency	Sacramento River Water Reliability Study	Reclamation web site. Site accessed August 20, 2009. URL = http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=907	Placer County Water Agency, Sacramento Suburban Water District, and the cities of Roseville and Sacramento, are investigating the viability of a joint water supply diversion from the Sacramento River.	May change to pumping and energy demand

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
Semitropic Water Storage District	Delta Wetlands Projects	August 2011. Final Delta Wetlands Project Place of Use Environmental Impact Report.	Under the current proposal, the project would: 1) provide water to Semitropic Water Storage District to augment its water supply, 2) bank water within the Semitropic Groundwater Storage Bank and Antelope Valley Water Bank, and 3) provide water to other places, including the service areas of the Golden State Water Company and Valley Mutual Water Company.	May increase energy demand
Bureau of Reclamation	Upper San Joaquin River Basin Storage Investigation	Reclamation. May 29, 2009. Letter - Plan Formulation Report for the Upper San Joaquin River Basin Storage Investigation.	The Upper San Joaquin Storage would contribute to restoration of the San Joaquin River, improve water quality of the San Joaquin River, and facilitate additional conjunctive management and water exchanges that improve the quality of water deliveries to urban communities. To the extent possible, the Upper San Joaquin River Basin Storage Investigation will explore opportunities to provide other benefits that could include hydropower, flood control, and recreation.	May increase system resiliency and availability of energy resources
Western Municipal Water District and Bureau of Reclamation	Riverside-Corona Feeder Conjunctive Use Project	A Final Supplemental EIR/EIS was completed in February 2012. No "significant new information" was added to the Final SEIR/EIS following distribution of the draft SEIR/EIS.	The project would allow the district to purchase water from SWP and store up to 40,000 acre-feet of water in the San Bernardino Basin Area and Chino Basin and to extract the water from the groundwater basins.	May increase system resiliency and availability of energy resources; water conveyed throughout the region may increase energy demand
Metropolitan Water District of Orange County	Seawater Desalination Project at Huntington Beach	Final Subsequent Environmental Impact Report, August, 2010. Scheduled to be operational by 2019.	Water treatment plant would provide up to 50 million gallons per day of desalinated water.	May increase energy demand
San Diego County Water Authority and other water suppliers	Carlsbad Seawater Desalination Plant	Operational	Water treatment plant would provide up to 50 million gallons per day of desalinated water.	May increase energy demand

Agency	Program/Project	Status	Description of Program/Project	Energy Effect
San Diego County Water Authority	Emergency Storage Project	Completed	The project will increase the amount of water stored locally through new water storage and pipeline connections.	May increase system resiliency and availability of energy resources; water distributed throughout the region may increase energy demand
Contra Costa Water District and Bureau of Reclamation	Los Vaqueros Reservoir Expansion Project	Project completed in 2012.	Project increases the storage capacity of Los Vaqueros Reservoir.	May increase system resiliency and availability of energy resources
Bureau of Reclamation	Shasta Lake Water Resources Investigation	Reclamation. February 2012. Draft Feasibility Report. Site accessed January 15, 2013. URL = http://www.usbr.gov/mp/slwri/documents.html	The project is a multiple purpose plan to modify Shasta Dam and Reservoir for fisheries and water supply benefits.	May change to pumping and energy demand
Department of Water Resources and Bureau of Reclamation	North-of-the-Delta Offstream Storage Investigation	Reclamation. 2008. North-of-the-Delta Offstream Storage Investigation Plan Formulation Report. September 2008.	The plan will provide offstream storage in the northern Sacramento Valley for improved water supply and water supply reliability, improved water quality, and enhanced survival of anadromous fish and other aquatic species.	May increase system resiliency and availability of energy resources
Bureau of Reclamation	San Luis Reservoir Expansion	U.S. Bureau of Reclamation, Mid-Pacific Region. San Luis Reservoir Expansion, Draft Appraisal Report, Central Valley Project, California, December, 2013.	The plan is to increase the storage capacity of San Luis Reservoir (behind B.F. Sisk Dam) to improve the reliability of CVP and SWP water supplies dependent upon San Luis Reservoir.	May increase system resiliency and availability of energy resources
California Department of Water Resources	South Delta Temporary Barriers Project	Operational	The program was initiated in 1991, and includes four rock barriers across South Delta channels.	May change to pumping and energy demand

21.3.5.1 Cumulative Effects of the No Action Alternative

The No Action Alternative is not anticipated to cumulatively effect energy resources in the study area. The combined energy factor for CVP and SWP pumping would be about 1.5 GWh/TAF. Slight variances would be expected from the potential reoperation of reservoirs and energy generation facilities to accommodate changes in future precipitation and water management. Ongoing and reasonably foreseeable future projects that use more energy may also affect regional energy use. However, the No Action Alternative would not create new demand that would cumulatively effect energy resources or the energy use factor for CVP and SWP south of Delta pumping.

The Delta and vicinity are within a highly active seismic area, with a generally high potential for major future earthquake events along nearby and/or regional faults, and with the probability for such events increasing over time. Based on the location, extent and non-engineered nature of many existing levee structures in the Delta area, the potential for significant damage to, or failure of, these structures during a major local seismic event is generally moderate to high. In the instance of a large seismic event, levees constructed on liquefiable foundations are expected to experience large deformations (in excess of 10 feet) under a moderate to large earthquake in the region. While there are no set thresholds for salinity, bromide, or other contaminants at which the Banks and/or Jones Pumping Plants would cease operations, an event that would alter the hydrology of the Delta such that brackish water or seawater is drawn into the southwest portion of the Delta would likely result in these pumps shutting down until freshwater flows can be reestablished and flush the brackish water/seawater from the vicinity of these pumping plants' intakes. (See Appendix 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water Supplies*, for more detailed discussion.) Depending on the duration of the interruption, this could result in a substantial decrease in energy use at the SWP and CVP Delta pumping plants. This decrease in energy use could be offset if south of Delta water uses switch to alternative water supplies. To reclaim land or rebuild levees after a catastrophic event due to climate change or a seismic event would create an increase in energy use during construction. While similar risks would occur under implementation of the action alternatives, these risks may be reduced by project-related levee improvements along with those projects identified for the purposes of flood protection in Table 12-14.

21.3.5.2 Concurrent Project Effects

Construction and operation of the water conveyance facility would increase energy consumption, relative to the No Action Alternative. Construction activities would consume diesel and gasoline to power heavy-duty vehicles, as well as electricity to power tunnel boring machines (TBM) and equipment. Gasoline and diesel fuel consumption would range between 81 and 154 million gallons, depending on the alternative, over the entire construction period. Operation of the north Delta intakes under Alternatives 1A through 8 would increase annual energy use for pumping and water conveyance through the Delta by between 18 GWh and 421 GWh, relative to the No Action Alternative. Alternative 9 would rely on the existing Delta channels and would not consume a substantial amount of new energy. Delta exports under Alternatives 1A through 5A would require less than the maximum monthly energy requirement planned and previously operated for CVP and SWP water supply deliveries, whereas exports under Alternatives 6A through 9 would reduce energy used to pump water from the Delta to CVP and SWP contractors (refer to Table 21-13).

With the exception of CM5, CM2–CM11 (Environmental Commitments 3, 4, and 6–11 under Alternatives 2D, 4A, and 5A) have been identified as actions that will involve some element of construction within the first 5 years of implementation. Concurrent implementation of CM2–11/Environmental Commitments 3, 4, 6–11 and construction and operation of the water conveyance facility would increase cumulative demand for diesel, gasoline, and electricity. Although energy would be consumed during construction of the water conveyance facility, BMPs would ensure that only high-efficiency equipment is used during construction. Similarly, Mitigation Measure AQ-24 requires equipment utilized during implementation of CM2–CM11/Environmental Commitments 3, 4, 6–11 be properly maintained according to manufactures specifications. Construction activities would therefore not result in the wasteful, inefficient, or unnecessary consumption of energy. With respect to energy use for operation of water pumping and conveyance facilities in the Delta, Alternatives 1A through 8 would be managed to maximize efficient energy use, including off-peak pumping and use of gravity, as applicable. However, the increase in electricity attributable to these alternatives compared to statewide use (300,000 GWh) would not be cumulatively considerable when considered with these other projects.

21.3.5.3 Cumulative Effects of the Action Alternatives

Impact ENG-4: Cumulative Impact on Energy Use for Operation of Water Pumping and Conveyance Facilities in the Delta

Alternatives 1A through 8

NEPA Effects: For Alternatives 1A through 8, the construction and operation of north Delta intakes and a new Delta conveyance facility from the north Delta to the existing CVP and SWP pumping plants in the south Delta would not result in adverse effects on energy use within the Delta region. As indicated in Table 21-13, the amount of energy use each year will depend on the hydrological conditions as well as the specific features of the alternative (i.e., pumping capacity and energy factor). Each of these action alternatives would require an average annual increased energy use of between 18 GWh and 421 GWh, relative to the No Action Alternative (2060), for pumping and conveyance through the Delta. Because all of this electrical energy would be transmitted from existing generation facilities to the new pumping plants on the existing transmission grid, other projects that use more energy would contribute cumulatively to this effect on regional energy use (Table 21-14). However, the increase attributable to any alternative compared to statewide use (300,000 GWh) is not cumulatively considerable.

CEQA Conclusion: Each of these action alternatives would require an annual increase energy use, relative to existing conditions. When combined with ongoing and reasonably foreseeable future projects, cumulative energy demand may affect regional resources. However, the increase attributable to any alternative compared to statewide use (300,000 GWh) is not cumulatively considerable. Accordingly, there is no cumulative effect on energy use from Alternatives 1A through 8. This impact would be less-than-significant. No mitigation is required.

Alternative 9

NEPA Effects: Alternative 9 would rely on the existing Delta channels (with some dredging) and tidal energy to transport water from the Sacramento River to the existing south Delta channels. Dredging for Alternative 9 would require considerable amounts of diesel fuel during the dredging period (2–3 years), but not much electrical energy would be used. Although some new circulation pumps would be needed as part of the separation of the San Joaquin River corridor from the south Delta pumping plants to reduce fish entrainment, no substantial new energy use would be required. There would be no cumulative effect on energy use from Alternative 9.

CEQA Conclusion: Alternative 9 would rely on the existing Delta channels (with some dredging) and tidal energy to transport water from the Sacramento River to the existing south Delta channels. Although some new circulation pumps would be needed as part of the separation of the San Joaquin River corridor from the south Delta pumping plants to reduce fish entrainment, no substantial new energy use would be required. Accordingly, there is no cumulative effect on energy use within the Delta from Alternative 9. This impact would be less-than-significant. No mitigation is required.

Impact ENG-5: Cumulative Impact on Energy Use at Existing CVP and SWP Pumping Plants to Deliver Additional Water Supplies

Alternatives 1A through 5A

NEPA Effects: For Alternatives 1A through 5A, the water conveyance facilities operations would allow increased Delta exports and water supply delivery compared to the No Action Alternative (2060). Table 21-13 provides a comparative summary of the annual average energy use for additional pumping for increased water supply deliveries to CVP and SWP contractors. This increased pumping is less than the maximum monthly energy requirement planned and previously operated for CVP and SWP water supply deliveries. This increased energy use contributes to the cumulative effects on increased energy use in the South of Delta water supply region. Although this increased energy use at the existing CVP and SWP pumping plants was not considered a project impact on energy resources (the energy sources were planned and constructed as part of the CVP and SWP and therefore do not represent a *new* energy demand), this increased energy use would contribute to the cumulative energy use in this large portion of California. The high energy requirements of the SWP are well described and understood (California Energy Commission 2005; Natural Resources Defense Council 2004) and are a significant factor in the cumulative energy use of the south of Delta water supply region. However, the increase attributable to any alternative compared to statewide use (300,000 GWh) would not be cumulatively considerable.

***CEQA Conclusion*:** Increased energy use for pumping of increased water deliveries to the South of Delta CVP and SWP water supply region could result in cumulative impacts on energy use within the water supply region. This cumulative impact is considered significant but the contribution from Alternatives 1A through 5A would not be cumulatively considerable because this energy use is within the planned maximum capacity and historical use for the CVP and SWP. Because this energy use is part of the energy uses for existing facilities, the incremental impact from these action alternatives on cumulative energy use in the South of Delta region would be less-than-significant. No mitigation is required.

Alternatives 6A through 9

NEPA Effects: Alternatives 6A through 9 each would reduce somewhat the energy used to pump water from the Delta to CVP and SWP contractors because these alternatives would reduce the annual average CVP and SWP south of Delta water deliveries and reduce the average annual energy use, relative to the No Action Alternative (2060), by about 100 GWh/yr to 1,800 GWh/yr, depending on the alternative, (Table 21-13). These alternatives would reduce the cumulative effect on energy use in the CVP and SWP South of Delta water supply region and would not be cumulatively considerable.

CEQA Conclusion: Alternatives 6A through 9 would provide somewhat less CVP and SWP water supply deliveries and would reduce the cumulative energy use for pumping from existing conditions. There would be no cumulative energy impact in the South of Delta water supply region. Accordingly, this impact would be less-than-significant. No mitigation is required.

Impact ENG-6: Cumulative Impact on Energy Use from Diesel and Gasoline Consumption during Construction

NEPA Effects: Project construction would consume gasoline and diesel through operation of heavy-duty construction equipment and vehicles. The action alternatives and the cumulative projects listed in Table 21-14 would all incorporate energy-saving measures required by a myriad of state and local energy policies to improve energy efficiency and reduce waste. Measures pursued by the project are summarized in Appendix 3B, *Environmental Commitments, AMMs, and CMs*. With all projects, including the proposed project, implementing similar measures, a cumulative effect related to the inefficient use of energy would not occur.

***CEQA Conclusion*:** Project construction would consume gasoline and diesel through operation of heavy-duty construction equipment and vehicles. The action alternatives and the cumulative projects listed in Table 21-14 would all incorporate energy-saving measures required by a myriad of state and local energy policies to improve energy efficiency and reduce waste. Measures pursued by the project are summarized in Appendix 3B, *Environmental Commitments, AMMs, and CMs*. With all projects, including the proposed project, implementing similar measures, a cumulative impact related to the inefficient use of energy would not occur. No mitigation is required.

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