2 Description of Alternatives

Chapter 2 summarizes the alternatives development process for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Project) and the alternatives analyzed in this Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

2.1 Alternatives Formulation Process

The Lead Agencies used a comprehensive process to develop alternatives that included review of existing material, public input, and comparison and evaluation of initial alternatives using the Federal planning criteria and purpose and need for the Project. Appendix A, *Plan Formulation Report*, includes a more detailed description of this process.

2.1.1 Alternatives Development Process

The alternatives development process involved input and review from resource agencies, local agencies, landowners, non-governmental organizations (NGOs), and stakeholders. Resource agencies and local agencies were involved at a detailed level, including participation in technical teams (such as the Fisheries and Engineering Technical Team).

The alternatives development process included public scoping conducted in March 2013. Public scoping allowed the Lead Agencies to provide preliminary information on the purpose and need for the Project. This step also allowed the Lead Agencies to solicit ideas for achieving the Project's purpose and need and learn of potential impacts.

Alternatives development focused on providing fish passage and juvenile floodplain-rearing habitat. Key considerations for adult and juvenile fish movement included:

- Adult fish passage: Passage must consider both salmonids and green sturgeon, but sturgeon passage requirements are generally more stringent. As benthic swimmers, sturgeon generate speed through body curvature, which can limit passage if a channel has submerged obstacles, orifices, or jumps (California Department of Water Resources [DWR] 2017). Sturgeon avoid turbulent flow conditions, so passage must be provided by non-turbulent, open channel flow structures (DWR 2017). Both salmonids and sturgeon need to pass on their own volition, eliminating trap and haul as a primary means for fish passage (DWR 2017).
- Juvenile migration: Structures must be designed so that fish are not disoriented as they pass through the gates. Juvenile salmonids migrate down the river in the top third of the water column. Functional design concepts must avoid impingement[1] and the creation of eddies[2] that can increase predation. Juvenile fish should enter the Yolo Bypass on their own volition with

[1] Impingement occurs when fish are held against a structure.

[2] Eddies are circular flow patterns that can delay fish.

the redirected flow from the Sacramento River; trapping fish in the Sacramento River and relocating them to the Yolo Bypass would not satisfy the requirement for volitional passage (DWR 2017).

The Lead Agencies developed fish passage criteria to comply with during design of Project structures so that adult salmonids and sturgeon would be able to pass (Table 2-1). More detail about how these criteria were developed is included in Appendix C, *Adult Fish Passage Criteria for Federally Listed Species within the Yolo Bypass and Sacramento River* (DWR 2017), of the *Plan Formulation Report* (in Appendix A of this EIS/EIR).

Table 2-1. Summary of Fish Passage Criteria for Federally Listed Species within the Yolo Bypass and Sacramento River

Species	Adult Migration Time	Minimum Depth of Flow (Short Distance)	Minimum Depth of Flow (Long Distance)	Minimum Channel Width	Maximum Velocity (Short Distance)	Maximum Velocity (Long Distance)
Adult Sturgeon	Jan-May	3 feet	5 feet	10 feet	6 feet/ second*	4 feet/ second
Adult Salmonids	Nov-May	1 feet	3 feet	4 feet		

Source: DWR 2017

* Short distance velocity is for a maximum length of 60 feet

Juvenile salmonids out-migrate past Fremont Weir at different times of year, depending on hydrologic conditions. The majority of juvenile winter-run Chinook salmon migrate through this area from December through January and continue to migrate through mid-April to early May (United States Department of the Interior, Bureau of Reclamation [Reclamation] and DWR 2012). The early pulse of out-migration is strongly correlated with the first flushing flow of over 15,000 cubic feet per second (cfs) in the Sacramento River at the Wilkins Slough gage (Reclamation and DWR 2012). The majority of juvenile Central Valley spring-run Chinook salmon pass through this area in late-November through December, with out-migration continuing through mid-May (but primarily is complete in mid-April) (Reclamation and DWR 2012). Diverting fish into the Yolo Bypass (or “entrainment”) would need to occur at times when fish are present in the river near Fremont Weir.

2.1.2 Initial Component Identification and Screening

After the public scoping process, the Lead Agencies collected initial components of alternatives that could help achieve the purpose and need of the Project. A component is a project or plan that could contribute to meeting the purpose and need but may not be able to fully accomplish it independently. The Bay-Delta Conservation Plan (BDCP) included a planning effort to identify actions that could expand rearing habitat and improve fish passage in the Yolo Bypass (DWR 2011). The materials developed in that effort provided initial components for consideration. These components were augmented with suggestions from the Lead Agencies’ technical experts and comments during the public scoping process. The BDCP also formed a stakeholder group, the Yolo Bypass Fisheries Enhancement Planning Team (YBFEPT), which included resource agencies, landowners, and NGOs, to help develop a plan for the Yolo Bypass. The Lead Agencies solicited additional suggestions from the YBFEPT. The Lead Agencies performed an initial screening of the components that came out of this process. Components were not considered further if they would not contribute toward accomplishing the purpose and need of the project or if they were deemed technically infeasible.

2.1.3 Initial Alternatives Formulation

After screening the initial components for their ability to help accomplish the purpose and need of the project, the remaining components were combined into initial alternatives in 2014. The six initial alternatives included:

- No Action and No Project Alternative – Describes conditions if no actions are taken as part of this project to accomplish the project objectives. This alternative is required under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).
- Fremont Weir Notch – Constructs a new gated notch in Fremont Weir to function as the primary adult fish passage mechanism and allow flow and juvenile fish to enter the Yolo Bypass before the Sacramento River rises above the Fremont Weir crest.
- Westside – Allows additional flow to enter the bypass through the Knights Landing Ridge Cut (west of the Yolo Bypass). Fish rearing would be accomplished through aquaculture, and upstream fish passage would be accomplished through fish rescue.
- Elkhorn Area – Constructs floodplain-rearing habitat within the Elkhorn Area (to the east of the Yolo Bypass) along the Sacramento River.
- Sacramento Weir Notch – Constructs a new gated notch in the Sacramento Weir to function as the primary adult fish passage mechanism and allows flow and juvenile fish to enter the Yolo Bypass through the Sacramento Bypass before the Sacramento River rises above the Sacramento Weir crest.
- Sutter Bypass – Constructs a new gated notch in Tisdale Weir and expands rearing opportunities in the Sutter Bypass. Construction would need to occur in both the Sutter and Yolo bypasses because adult fish passage facilities at Fremont Weir would also be included.

Each of these alternatives also included variations in the size and location of structures. The Lead Agencies completed an initial evaluation of these alternatives based on the Federal planning criteria included in the *Principles, Requirements and Guidelines for Federal Investments in Water Resources* (PR&Gs) (United States Department of the Interior [DOI] 2013, 2014). The evaluation considered:

- Effectiveness: How well an alternative plan would achieve rearing habitat and fish passage objectives.
- Completeness: Whether an alternative plan would provide improvements for all four focus fish (Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the Southern Distinct Population Segment [DPS] of North American green sturgeon).
- Acceptability: Whether an alternative plan would be compatible with other efforts in the bypass and minimize effects to agriculture, waterfowl, education, and biological resources.

- Efficiency: How well an alternative plan would deliver economic benefits relative to project costs.

Applying these criteria, the No Action and No Project Alternative and variations of the Fremont Weir Notch Alternative were considered for further evaluation. These alternatives are described in Sections 2.2 through 2.9. The remaining alternatives were dismissed. Section 2.1.5 describes the reasoning for dismissal.

2.1.4 Value Planning

Value Planning is part of the Federal process in planning projects. The purpose of Value Planning is to take a big-picture look at project alternatives and see if there is a better way to achieve the greatest value. Reclamation conducted a Value Planning session in August 2014. Value Planning can include agency representatives, landowners, NGOs, and other stakeholders, but it is designed to focus on those that have not been key participants in the alternatives formulation process. The Value Planning team concluded that more focus should be placed on integrating flood projects with restoration efforts and recommended including water control structures to help increase inundation on the Yolo Bypass. Reclamation and DWR have worked to coordinate closely with the ongoing flood projects. Water control structures have been incorporated into Alternative 4 in this EIS/EIR.

2.1.5 Alternatives Evaluation Process

After the initial evaluation and feedback from the Value Planning process, the Lead Agencies moved forward with a more detailed analysis of the remaining alternatives, which were further developed and modeled to better characterize each alternative. The Lead Agencies then established evaluation criteria based on the Federal planning criteria (DOI 2013, 2014), as shown in Table 2-2.

Table 2-2. Alternatives Evaluation Criteria

Federal Planning Criterion[1]	Category	Performance Measure	Method to Measure Performance
Effectiveness: How well an alternative would alleviate problems and achieve opportunities	Increase access to floodplain habitat	Entrainment of winter-run Chinook salmon onto floodplain	Entrainment model
		Entrainment of spring-run Chinook salmon onto floodplain	Entrainment model
	Increase seasonal floodplain fisheries rearing habitat	Percent increase in winter-run Chinook salmon escapement	Juvenile floodplain production model
		Percent increase in spring-run Chinook salmon escapement	Juvenile floodplain production model
	Increase area of floodplain habitat	Inundation area (area inundated at least 14 days in 50 percent of years)	TUFLOW model

Federal Planning Criterion[1]	Category	Performance Measure	Method to Measure Performance
	Increase duration of flooded habitat	Wetted acre-days when fish are likely present	TUFLOW model
	Increase food production as part of an ecosystem approach	Increase in food production	Foodweb tool
	Adult fish passage	Days with depth barrier to adult volitional passage	Fish passage tool
		Days with velocity barrier to adult volitional passage	Fish passage tool
		Operational range for adult fish passage	Fish passage tool
		Percent of season that meets adult fish passage criteria	Fish passage tool
		Fish passage facilities incorporate open channel flow	Qualitative assessment of number of fish passage facilities to provide passage and complexity of operations between passage facilities
	Juvenile fish passage	Potential for juvenile stranding or predation risk	Qualitative assessment of need for complex mechanized operation
Completeness: Whether an alternative would account for all investments or other actions necessary to realize the planned efforts	Provide complete fish benefits	Addresses all four focus fish (Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and Southern DPS North American green sturgeon)	Qualitative assessment
		Long-term stability of facilities	Qualitative assessment of maintenance requirements
Acceptability: The viability of an alternative with respect to acceptance by other Federal, State of California (State), and local entities and compatibility with existing laws	Agricultural impacts	Inundation effects on agricultural production	Bypass Production Model
		Inundation effects on winter maintenance activities (increased wetted acre-days)	TUFLOW model

Federal Planning Criterion[1]	**Category**	**Performance Measure**	**Method to Measure Performance**
	Recreation impacts	Inundation of recreational areas that could impact hunting activities	TUFLOW model
	Waterfowl impacts	Available foraging habitat	TUFLOW model
		Inundation of areas that reduce waterfowl food production	TUFLOW model
		Impacts to road access for bird viewing in refuge	TUFLOW model
		Impacts to refuge drainage	Qualitative assessment
	Education impacts	Inundation of areas used for educational outreach	TUFLOW model
	Biological impacts	Impacts from construction (benefits addressed under "effectiveness" criterion)	Qualitative assessment
	Cultural impacts	Relative potential to encounter unexpected resources	Qualitative assessment
	Flood impacts	Relative potential to affect flood management or operations and maintenance	TUFLOW model and qualitative assessment (for operations and maintenance)
	Water supply impacts	Relative potential to affect agricultural or municipal water supplies	Qualitative assessment
		Relative potential to affect groundwater resources	Qualitative assessment of groundwater based on TUFLOW model surface water changes
		Decreased diversions in the Sacramento-San Joaquin Delta (Delta) (at existing or likely future facilities)	CalSim
	Compatibility with other related efforts	Potential to affect future options or costs for other flood and restoration planning efforts	Qualitative assessment
Efficiency: How well an alternative would deliver economic benefits relative to project costs	Cost effectiveness	Relative benefits and costs	Rough cost estimates compared to benefits

Notes:

[1] Federal planning criteria are from the Principles, Requirements, and Guidelines (DOI 2013, DOI 2014)

During alternatives evaluation in 2015, BDCP planners split the BDCP into two separate plans: California WaterFix and EcoRestore. As a result, the YBFEPT no longer gathered for meetings. Instead, the Lead Agencies began working with the Yolo Bypass Working Group, a collection of local agencies, landowners, NGOs, and stakeholders that began meeting after the Value Planning effort. The Lead Agencies worked with this group to refine the alternatives evaluation and add additional alternatives. Additionally, several of the common elements that had previously been considered in the action alternatives have independent utility as restoration projects and were separated from this effort to be a part of the EcoRestore program. These projects include Wallace Weir improvements, modifications to existing fish passage at Fremont Weir, removal and replacement of three agricultural road crossings in the Tule Canal, and modification of Lisbon Weir. These projects are now underway as separate efforts.

After the initial evaluation, the alternatives focused on a smaller, more passively operated gated notch in Fremont Weir that would allow a maximum flow of 6,000 cfs (see Appendix A, *Plan Formulation Report*, for more details). The Yolo Bypass Working Group expanded on the benefits of several other alternatives and included additional alternatives to incorporate smaller and larger flows, water control structures, multiple gates, and increased duration of floodplain habitat in the northern bypass.

2.1.6 Alternatives Considered but Eliminated from Further Evaluation

During the alternatives formulation process, multiple alternatives were considered but eliminated from further consideration. Table 2-3 provides an overview of these alternatives; they are discussed in more detail in Appendix A.

Table 2-3. Alternatives Considered but Eliminated from Further Evaluation

Alternative	Key Components	Reasons Alternative was Not Retained
Westside Alternative	Flows would enter the Yolo Bypass through the Knights Landing Ridge Cut, juvenile fish would be transported onto inundated fields for rearing, and fish rescue at Fremont Weir would provide upstream fish passage.	Lack of volitional fish passage prevents the alternative from meeting the project objectives.
Westside Alternative with Volitional Passage	Knights Landing Ridge Cut would be re-plumbed to allow flow and juvenile fish from the Sacramento River to enter the Yolo Bypass; upstream adult fish passage would be provided at Fremont Weir.	Routing flows and juvenile fish through the Knights Landing Ridge Cut is less effective for fish survival and more costly than other alternatives.
Elkhorn Alternative	Levee setbacks on the Sacramento River into the Elkhorn Area (east of the Yolo Bypass) would provide floodplain-rearing habitat; upstream fish passage would be provided at Fremont Weir.	Creating floodplain-rearing habitat in the Elkhorn Area could have acceptability concerns because it would take agricultural land out of production, and grading costs would be prohibitively high.

Alternative	Key Components	Reasons Alternative was Not Retained
Sacramento Weir Alternative	Flows and juvenile fish would enter the Yolo Bypass through a gated notch in the Sacramento Weir; upstream adult fish passage would be provided at Fremont Weir.	Flows would primarily inundate habitat south of the Sacramento Bypass in the Yolo Bypass, which would have fewer rearing habitat benefits because approximately 1/3 of the Yolo Bypass area would be inaccessible to juvenile fish.
Sutter Bypass Alternatives	Flows and juvenile fish would enter the Sutter Bypass through a gated notch at Tisdale Weir, and a bypass expansion would provide additional habitat. Upstream adult fish passage would be provided at Fremont Weir.	Expanding the Sutter Bypass would have acceptability concerns because it would take agricultural land out of production, and costs would be higher than other alternatives (relative to benefits accomplished) because improvements would need to be constructed in both the Sutter and Yolo Bypasses.

2.1.7 Summary of Alternatives Retained for Further Evaluation

After the alternatives formulation and evaluation effort, six action alternatives were retained for detailed evaluation in the EIS/EIR. Table 2-4 summarizes the key components of each alternative.

Table 2-4. Summary of Alternatives Retained for Detailed Evaluation in this EIS/EIR

Components	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Maximum design flow (cfs)	6,000	6,000	6,000	3,000	3,400	12,000
Gated notch and channel location	East	Central	West	West	Central (Multiple)	West
Supplemental fish passage	West	West	East	East	West	East
Downstream channel improvements	X	X	X	X		X
Agricultural road crossing 1	X	X	X	X	X	X
Tule Canal water control structures				X		
Tule Canal floodplain improvements (program-level)					X	
Closure date for inundation flows	March 15	March 15	March 15	March 15 or March 7	March 15	March 15

Key: cfs = cubic feet per second

2.2 No Action and No Project Alternative

NEPA and CEQA require the evaluation of an alternative that presents the reasonably foreseeable future conditions in the absence of the project. This alternative is called the No Action Alternative under NEPA and the No Project Alternative under CEQA. The No Action or No Project Alternative allows decision makers to compare the impacts of approving the project to the impacts of not approving the project. This alternative is referred to in the remainder of the document as the “No Action Alternative.” Under NEPA, the No Action Alternative also serves as the baseline to which action alternatives are compared to determine potential impacts. This differs from CEQA wherein existing conditions serve as the baseline to determine potential impacts of the alternatives. The No Action Alternative may differ from the existing conditions if other actions that could occur in the Project area in the future do not rely on approval or implementation of the project. The No Action Alternative and the existing conditions will be used as the environmental baseline for identifying project effects (see Section 3.2.1 for more details).

Under the No Action Alternative, the Yolo Bypass would continue to be inundated from the westside tributaries and overtopping events at Fremont and Sacramento weirs. Juvenile fish would enter the bypass with overtopping flood flows from Fremont and Sacramento weirs, and the fish would benefit from the rearing opportunities in the Yolo Bypass. Additional flow and fish would not pass through Fremont Weir when the Sacramento River elevation is below the crest of Fremont Weir or Sacramento Weir.

Adult fish may move upstream in Tule Canal in response to tidal influence in Cache Slough, flows over Fremont Weir, or when the westside tributaries attract fish. As under existing conditions, fish would either move downstream and migrate back into the Sacramento River, pass over Fremont Weir, pass through the existing fish passage structure at Fremont Weir, become stranded at Fremont Weir, or move to the Wallace Weir Fish Rescue Facility. Other projects in the Yolo Bypass and Sacramento River region would continue to move forward, including California EcoRestore projects, Battle Creek Salmon and Steelhead Restoration project, California WaterFix, Environmental Permitting for Operation and Maintenance of flood facilities, Oroville Facilities Federal Energy Regulatory Commission Relicensing and License Implementation, and Sacramento Regional Wastewater Treatment Plant Upgrade. These efforts are described in more detail in Section 3.2.2.1.

2.3 Components Common to Multiple Action Alternatives

This section describes components included in multiple action alternatives. The construction details (borrow material, construction equipment, schedules) are integrated into the alternative descriptions in the following sections.

2.3.1 Agricultural Road Crossing 1 and Cross-Canal Berms

The northernmost agricultural road crossing in Tule Canal is both a vehicular crossing and water delivery feature (see Figure 1-1 for location). The crossing consists of two earthen berms, with the southern used as the road crossing. Together the berms create a cross canal that conveys water across the Yolo Bypass from Wallace Weir to two 36-inch culverts that pass through the

Yolo Bypass east levee. The culverts deliver water via gravity flow into the Elkhorn area for agricultural use.

The cross-canal berms are flow barriers in Tule Canal and form barriers that maintains water levels in the greater Tule Pond wetland (just upstream). The wetland area north of Agricultural Road Crossing 1 and south of Tule Pond is referred to as the "wooded area" and does not have a defined channel. The top of the berm has an elevation of approximately 21 feet[3] and holds water in the wooded area and Tule Pond (see Figure 2-1) after Fremont Weir overtopping events to cover an area of about 85 acres. During the late winter and early spring, shallow groundwater levels are high enough (HDR, Inc. 2017) that they likely contribute water to the Tule Pond and wooded area. Additionally, the berms leak in some years, which provides water inflow into the wooded area (and allows some outflow when water levels are high during the wet season). The local landowners typically make periodic repairs that decrease the leakage.

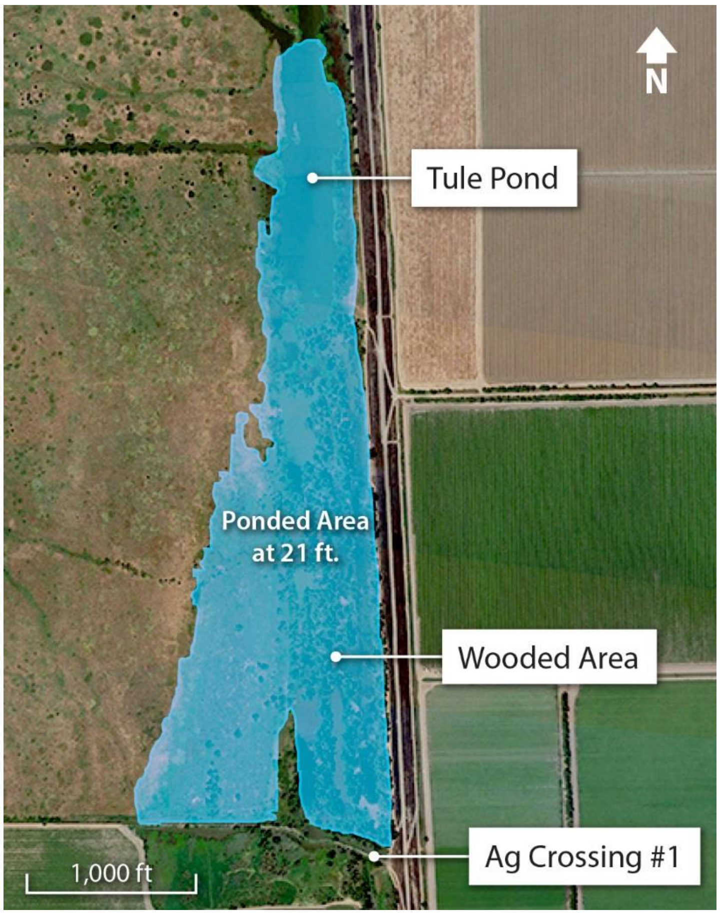

Figure 2-1. Existing Inundation Area North of Agricultural Road Crossing 1

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[3] Elevations in the EIS/EIR are compared to the North American Vertical Datum of 1988 (NAVD 88).

Agricultural Road Crossing 1 improvements would include removal of the cross-canal berms and road crossing that create a fish passage barrier, construction of a bridge for vehicular traffic, and construction of an inverted siphon beneath the new Tule Canal connection to maintain water deliveries to the agricultural water users in the Elkhorn Area. Removing the barriers to fish passage would also remove a flow barrier that retains water in the Tule Pond and wooded area to the north and a source of water for these areas in the cross-canal. The bridge would be 18 feet wide and 80 feet long. It would include concrete abutments on each end to span Tule Canal. Figure 2-2 shows the proposed improvements at Agricultural Road Crossing 1. These improvements are included in all action alternatives.

The cross-canal berm would be removed and the channel regraded to connect proposed upstream channel improvements (described in Section 2.3.2) to Tule Canal. A turnout structure would be constructed on the west side of the new Tule Canal connector channel. Two 36-inch, 270-foot-long pipes would run under the new connection with Tule Canal from the turnout structure and tie into a concrete junction box on the east side of Tule Canal that would feed the supply pipes through the existing levee. An emergency overflow bypass structure would be installed immediately adjacent and northwest of the turnout structure to prevent overtopping the canal embankments into the surrounding fields during non-flood events. Overtopping the embankments could cause erosion, so the overflow bypass would reduce operations and maintenance needs on the canal embankments. The overflow bypass structure would discharge high flows south into existing Tule Canal.

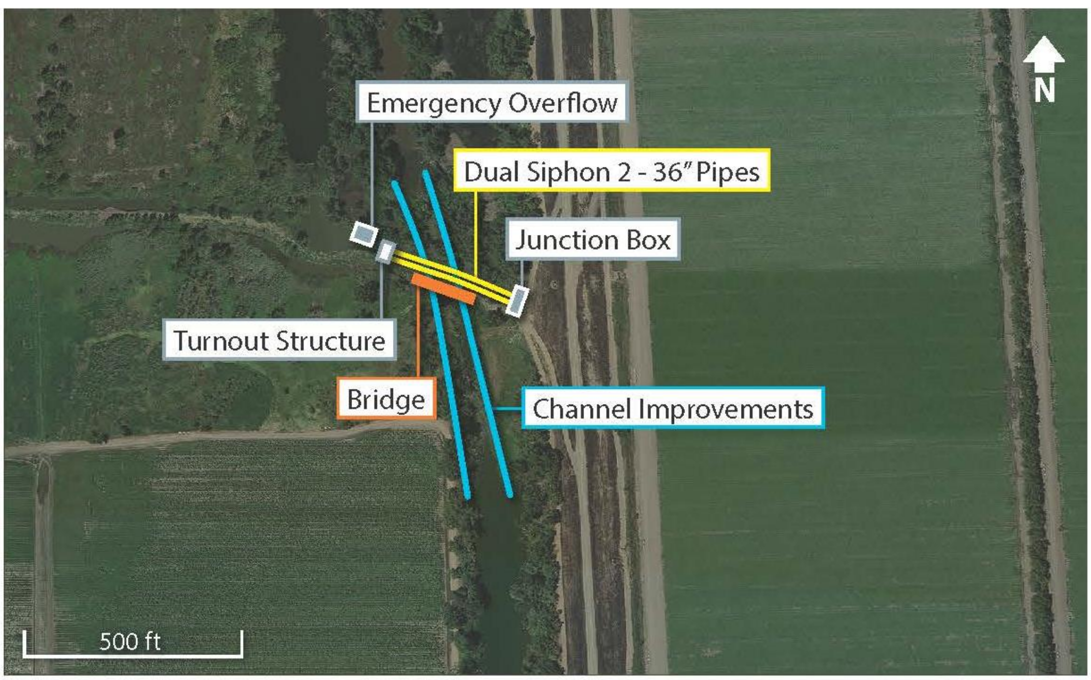


Figure 2-2. Agricultural Road Crossing 1 Improvements

2.3.2 Downstream Channel Improvements

With the exception of Alternative 5, all proposed alternatives include an engineered, trapezoidal channel that connects a new gated notch in Fremont Weir to Tule Pond. Alternative 5 varies from the other alternatives because it includes a multi-channel complex that connects to Tule Canal south of Tule Pond (near Agricultural Road Crossing 1); the conditions and improvements described in this section do not apply to Alternative 5.

The area just south of Tule Pond is referred to as the “wooded area” on Figure 2-1 and does not have a defined channel. Discussed as part of the Agricultural Road Crossing 1 improvements, water is often ponded in this area, allowing vegetation and tree growth. The area is often wet outside of the winter season and is dominated by tule growth.

The lack of a defined channel within the wooded area makes fish passage more difficult during periods when the entire area is not inundated. Fish do not have a clear path to move between Tule Pond and the wooded area just upstream of Agricultural Road Crossing 1.

Under Alternatives 1 through 4 and 6, improvements would be made to connect isolated pools within the wooded area that extends from the Tule Pond outlet downstream to Agricultural Road Crossing 1 where the Tule Canal begins. Improvements include a trapezoidal channel with constant slope. The improvements would facilitate upstream adult fish passage between the existing Tule Canal and Tule Pond. The engineered, trapezoidal channel would begin downstream of Agricultural Road Crossing 1 and extend north to Tule Pond. The channel would have a 20-foot-bottom width and a 3:1 side slope (horizontal to vertical). The top of channel would be 60 to 70 feet wide, with eight feet of revetment and a 12-foot wide maintenance corridor on either side.

To avoid concerns about levee seepage and stability near the channel improvements, Alternatives 1 through 4 and 6 would include a subsurface cutoff wall in the levee parallel to the channel. A subsurface cutoff wall is a structure that uses a slurry or cement mix to create a “wall” along a levee to prevent seepage under the levee or address other levee stability and seepage concerns. This cutoff wall would be included because the channel construction would cut through an existing clay blanket layer that currently prevents levee underseepage. The cutoff wall would be approximately 3,150 feet long and 30 feet deep. The location is at the toe of the levee, and the cutoff wall would be entirely underground. Figure 2-3 presents a preliminary concept for the channel improvements.

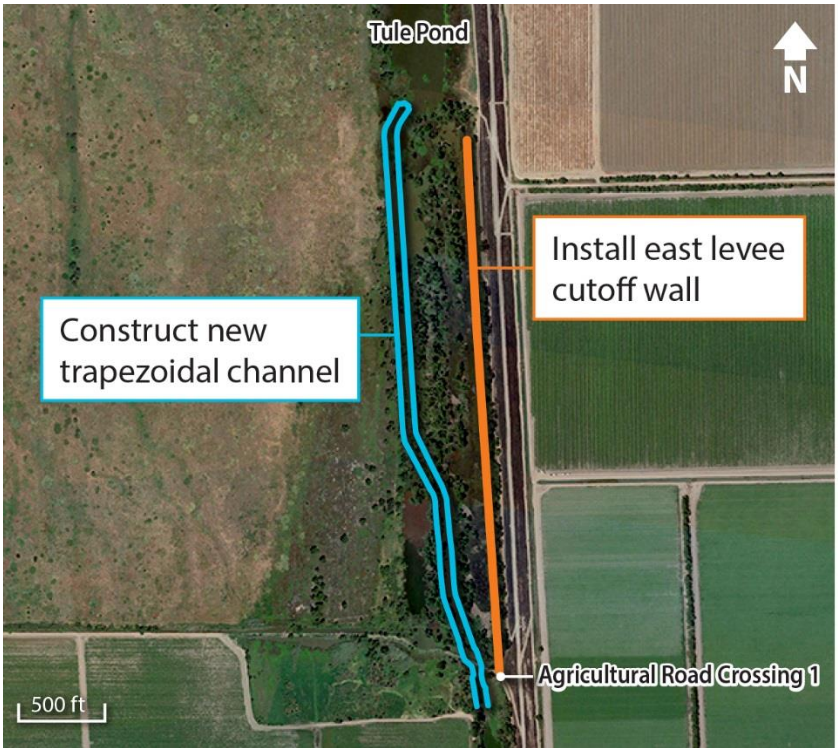


Figure 2-3. Downstream Channel Improvements

2.3.3 Operational Timeframe

All of the new gated notch structures have the potential to begin operations on November 1. As described in Section 2.1.1, juvenile salmonid out-migration typically begins during early storms in November. The gates would open as river elevations rise, which is discussed in more detail in the operations section of each alternative description.

The gated notch structures were originally planned to stay open through April to allow juveniles to enter the Yolo Bypass, but discussions with stakeholders indicated that an earlier inundation end date (originally suggested as March 15) would reduce impacts to agricultural users and wetlands. The Lead Agencies analyzed whether this change would result in a substantive decrease in benefits to the focus fish species and found little change in benefits, so the end date was changed for all alternatives to March 15. Subsequent discussion with landowners identified potential benefits from an earlier closure date of March 7, and this date was incorporated as a variation of Alternative 4.

After March 15 (or March 7 in the Alternative 4 variation), the new gated notch structure could remain partially open to provide fish passage until the end of May. The gated notch would only allow flows up to 1,000 cfs that would not inundate areas outside of Tule Canal. Alternative 6 would not allow operation during this period because the facilities would not provide sufficient depths and velocities for fish passage at flows less than 1,000 cfs.

2.3.4 Best Management Practices

All of the alternatives incorporate typical measures to reduce impacts, typically called Best Management Practices (BMPs). All action alternatives incorporate BMPs and have been designed to avoid and minimize impacts to the maximum extent practicable.

2.3.4.1 BMPs for Construction and Maintenance Activities to Reduce Greenhouse Gas (GHG) Emissions

The following measures are considered BMPs for DWR construction and maintenance activities. Implementation of these practices will reduce GHG emissions from construction projects by minimizing fuel usage by construction equipment, reducing fuel consumption for transportation of construction materials, reducing the amount of landfill material, and reducing emissions from the production of cement.

2.3.4.1.1 Pre-Construction and Final Design BMPs

Pre-construction and Final Design BMPs are designed to ensure that individual projects are evaluated and their unique characteristics taken into consideration when determining if specific equipment, procedures, or material requirements are feasible and efficacious for reducing GHG emissions from the project. While all projects will be evaluated to determine if these BMPs are applicable, not all projects will implement all the BMPs listed below.

- BMP 1. Evaluate project characteristics, including location, project work flow, site conditions, and equipment performance requirements, to determine whether specifications of the use of equipment with repowered engines, electric drive trains, or other high efficiency technologies are appropriate and feasible for the project or specific elements of the project.
- BMP 2. Evaluate the feasibility and efficacy of performing on-site material hauling with trucks equipped with on-road engines.
- BMP 3. Ensure that all feasible avenues have been explored for providing an electrical service drop to the construction site for temporary construction power. When generators must be used, use alternative fuels, such as propane or solar, to power generators to the maximum extent feasible.
- BMP 4. Evaluate the feasibility and efficacy of producing concrete on-site and specify that batch plants be set up on-site or as close to the site as possible.
- BMP 5. Evaluate the performance requirements for concrete used on the project and specify concrete mix designs that minimize GHG emissions from cement production and curing while preserving all required performance characteristics.
- BMP 6. Limit deliveries of materials and equipment to the site to off peak traffic congestion hours.

2.3.4.1.2 Construction BMPs

Construction BMPs apply to all construction and maintenance projects that DWR completes or for which DWR issues contracts. All projects are expected to implement all construction BMPs unless a variance is granted by the Division of Engineering Chief, Division of Operation and

Maintenance Chief, or Division of Flood Management Chief (as applicable) and the variance is approved by the DWR CEQA Climate Change Committee. Variances will be granted when specific project conditions or characteristics make implementation of the BMP infeasible and where omitting the BMP will not be detrimental to the project's consistency with the GHG Emissions Reduction Plan.

- BMP 7. Minimize idling time by requiring that equipment be shut down after five minutes when not in use (as required by the State airborne toxics control measure 13 California Code of Regulations [CCR] 2485). Provide clear signage that posts this requirement for workers at the entrances to the site and provide a plan for the enforcement of this requirement.
- BMP 8. Maintain all construction equipment in proper working condition and perform all preventative maintenance. Required maintenance includes compliance with all manufacturer's recommendations, proper upkeep and replacement of filters and mufflers, and maintenance of all engine and emissions systems in proper operating condition. Maintenance schedules shall be detailed in an Air Quality Control Plan prior to commencement of construction.
- BMP 9. Implement a tire inflation program on the jobsite to ensure that equipment tires are correctly inflated. Check tire inflation when equipment arrives on-site and every two weeks for equipment that remains on-site. Check vehicles used for hauling materials off-site weekly for correct tire inflation. Procedures for the tire inflation program shall be documented in an Air Quality Management Plan prior to commencement of construction.
- BMP 10. Develop a project specific ride share program to encourage carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.
- BMP 11. Reduce electricity use in temporary construction offices by using high efficiency lighting and requiring that heating and cooling units be Energy Star compliant. Require that all contractors develop and implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business.
- BMP 12. For deliveries to project sites where the haul distance exceeds 100 miles and a heavy-duty class 7 or class 8 semi-truck or 53-foot or longer box type trailer is used for hauling, a SmartWay[4] certified truck will be used to the maximum extent feasible.
- BMP 13. Minimize the amount of cement in concrete by specifying higher levels of cementitious material alternatives, larger aggregate, longer final set times, or lower maximum strength where appropriate.
- BMP 14. Develop a project specific construction debris recycling and diversion program to achieve a documented 50 percent diversion of construction waste.

[4] The U.S. Environmental Protection Agency has developed the SmartWay truck and trailer certification program to set voluntary standards for trucks and trailers that exhibit the highest fuel efficiency and emissions reductions. These tractors and trailers are outfitted at point of sale or retrofitted with equipment that significantly reduces fuel use and emissions including idle reduction technologies, improved aerodynamics, automatic tire inflation services, advanced lubricants, advanced powertrain technologies, and low rolling resistance tires.

- BMP 15. Evaluate the feasibility of restricting all material hauling on public roadways to off-peak traffic congestion hours. During construction scheduling and execution minimize, to the extent possible, uses of public roadways that would increase traffic congestion.

2.3.4.2 Air Quality BMPs

Fugitive dust control measures required by the Sacramento Metropolitan Air Quality Management District (AQMD) will be implemented as environmental commitments for all alternatives. The BMPs required by the Sacramento Metropolitan AQMD (2016) to allow non-zero particulate matter significance thresholds are as follows:

1. Water all exposed surfaces two times daily. Exposed surfaces include but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
2. Cover or maintain at least two feet of freeboard space on haul trucks transporting soil, sand, or other loose material on the site. Any haul trucks that would be traveling along freeways or major roadways should be covered.
3. Use wet power vacuum street sweepers to remove any visible track out mud or dirt onto adjacent public roads at least once a day. Use of dry power sweeping is prohibited.
4. Limit vehicle speeds on unpaved roads to 15 mph.
5. All roadways, driveways, sidewalks, and parking lots to be paved should be completed as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used.
6. Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to 5 minutes [required by CCR, Title 13, sections 2449(d)(3) and 2485]. Provide clear signage that posts this requirement for workers at the entrances to the site.
7. Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determine to be running in proper condition before it is operated.

2.4 Alternative 1: East Side Gated Notch

Alternative 1, East Side Gated Notch, would allow increased flow from the Sacramento River to enter the Yolo Bypass through a gated notch on the east side of Fremont Weir. The gated notch would create an opening in Fremont Weir that is deeper than Fremont Weir, with gates to control water going through the facility into the Yolo Bypass. The invert of the new notch would be at an elevation of 14 feet, which is approximately 18 feet below the existing Fremont Weir crest. Water would be able to flow through the notch during periods when the river elevations are not high enough to go over the crest of Fremont Weir (at an elevation of 32 feet).

Alternative 1 would connect the new gated notch to Tule Pond with a channel that parallels the existing east levee of the Yolo Bypass. Alternative 1 would have the shortest and most direct access to the Tule Canal for migrating fish. Alternative 1 would allow flows up to 6,000 cfs, depending on Sacramento River elevation, through the gated notch to provide open channel flow for adult fish passage, juvenile emigration, and floodplain inundation. This alternative would include a supplemental fish passage facility on the west side of Fremont Weir and improvements to allow fish to pass through Agricultural Road Crossing 1 and the channel north of Agricultural Road Crossing 1, as described in Section 2.3. Figure 2-4 shows key components of the alternative and the common elements described in Section 2.3. Alternative 1 is currently the CEQA preferred alternative (as described in more detail in Section 23.6).

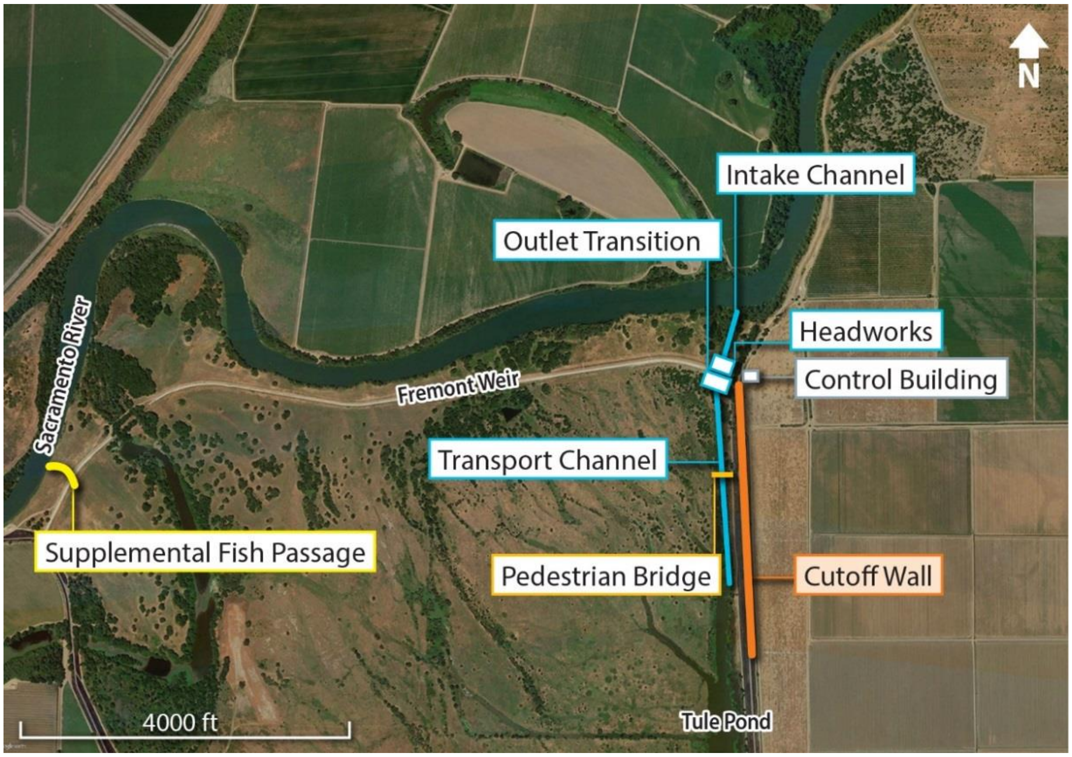


Figure 2-4. Alternative 1 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.4.1 Facilities

2.4.1.1 Intake Channel

The primary purpose of the intake channel is to draw juvenile salmonids and floodplain inundation flows from the Sacramento River to the new headworks structure (described in Section 2.4.1.2) and provide upstream adult fish passage between the headworks structure and the Sacramento River. The intake channel would be constructed with a 98-foot-bottom width with 3:1 side slopes (horizontal to vertical). It would have a gentle slope away from Fremont Weir so that flows would drain toward the river. It would reach the river with an invert elevation of 12 feet (compared to the invert of 14 feet at Fremont Weir). At the downstream end of the intake channel (near the headworks at Fremont Weir), there would be a short transition from the trapezoidal intake channel to the rectangular sides of the headworks structure. To avoid scour, the channel would be lined with angular rock placed along the bank slopes and rounded rock placed along the channel bottom.

2.4.1.2 Headworks Structure

The headworks structure would control the diversion of flow from the Sacramento River to the Yolo Bypass. It would serve as the primary upstream fish passage facility for adult fish and the primary facility for conveying floodplain inundation flows and juvenile salmonids onto the Yolo Bypass.

The headworks structure would be a three-bay, pile-supported, reinforced concrete structure that would bisect the existing Fremont Weir at an eastern location. It was designed to convey 6,000 cfs at a river elevation of 28 feet (14 feet of water depth in the headworks structure) with all gates fully open and to meet the applicable requirements for fish passage and flood control. It would house three operating control gates and include a concrete control structure, an upstream vehicular bridge crossing, and a concrete channel transition, which would transition the rectangular sides of the control structure to the side channel slopes of the outlet channel. It would have a sheet pile cutoff wall on the river side of the structure under the gates and on both sides of the structure to prevent underseepage from the river. The gate structure would be 65 feet (upstream to downstream) by 108 feet, and the sheet piles would add 50 feet on either side of the gate structure.

Stoplogs would be provided at each of the three headworks bays upstream of the control to dewater the gates for maintenance and as a backup closure for the structure. Six stoplogs are required for the larger gate and four for the two smaller gates. Installation of the stoplogs would require a mobile crane capable of lifting approximately 10,000 pounds. Stoplogs would be stored off site and could only be installed or removed when there would be no flow through the headworks structure or when the gates are closed. The stoplogs would be used to prevent groundwater or small amounts of river flow from entering the structure during maintenance activities.

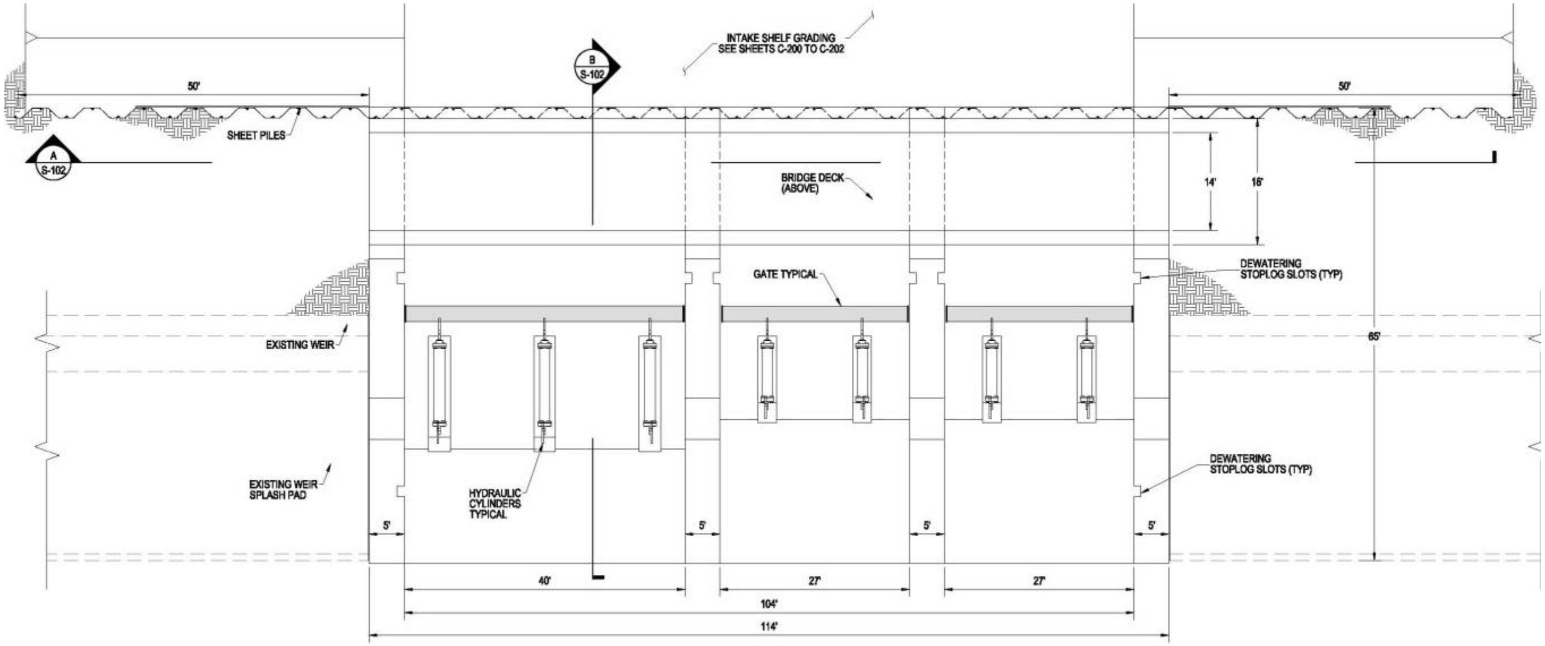
Three hydraulically or pneumatically operated, flush-mounted bottom hinge gates would be used in the headworks structure. These gates would be able to operate under variable river elevations and overtopping events. The top of the gate elevation of 32 feet would be flush with the existing Fremont Weir crest. The upstream face of the control gates would be approximately in-line with the upstream face of the existing Fremont Weir. When open, the gates would be flush with the channel invert. Table 2-5 presents the dimensions, invert elevation, and expected weight of the gates to be installed under Alternative 1.

Table 2-5. Gate Specifications for Alternative 1

Gate	Height x Width (feet)	Invert Elevation (feet)	Expected weight (pounds)
1	18 x 34	14.0	65,000
2 and 3	14 x 27	18.0	40,000 each

The gates would open to allow a maximum flow of 6,000 cfs when the water surface elevation in the river reaches 28 feet. Each gate would be capable of independent operation via submersible hydraulic cylinders or inflatable reinforced bladders located beneath the gate. Mechanical and electrical control components for each gate would be housed in a control building outside of the bypass on the eastern levee. Figure 2-5 and Figure 2-6 show the headworks structure design.

View from top of structure looking down



Cross-section (viewing from bypass side of Fremont Weir)

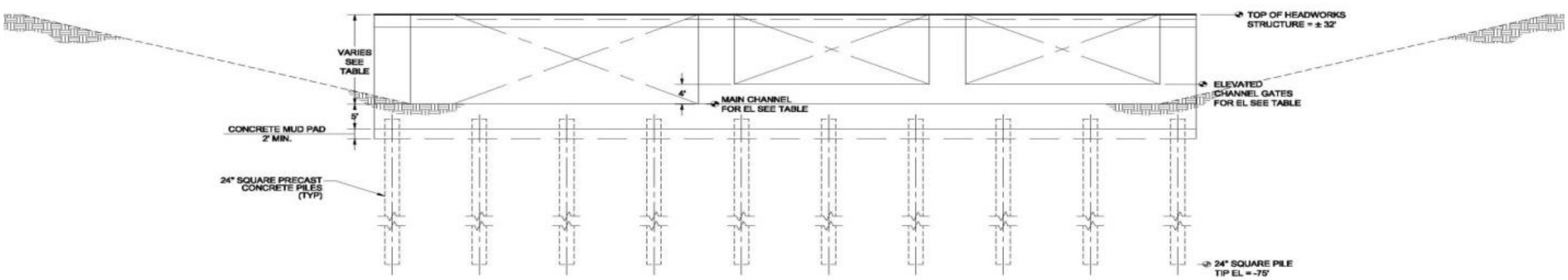


Figure 2-5. Alternative 1 Headworks Cross-Section and Top Views

View from side of structure

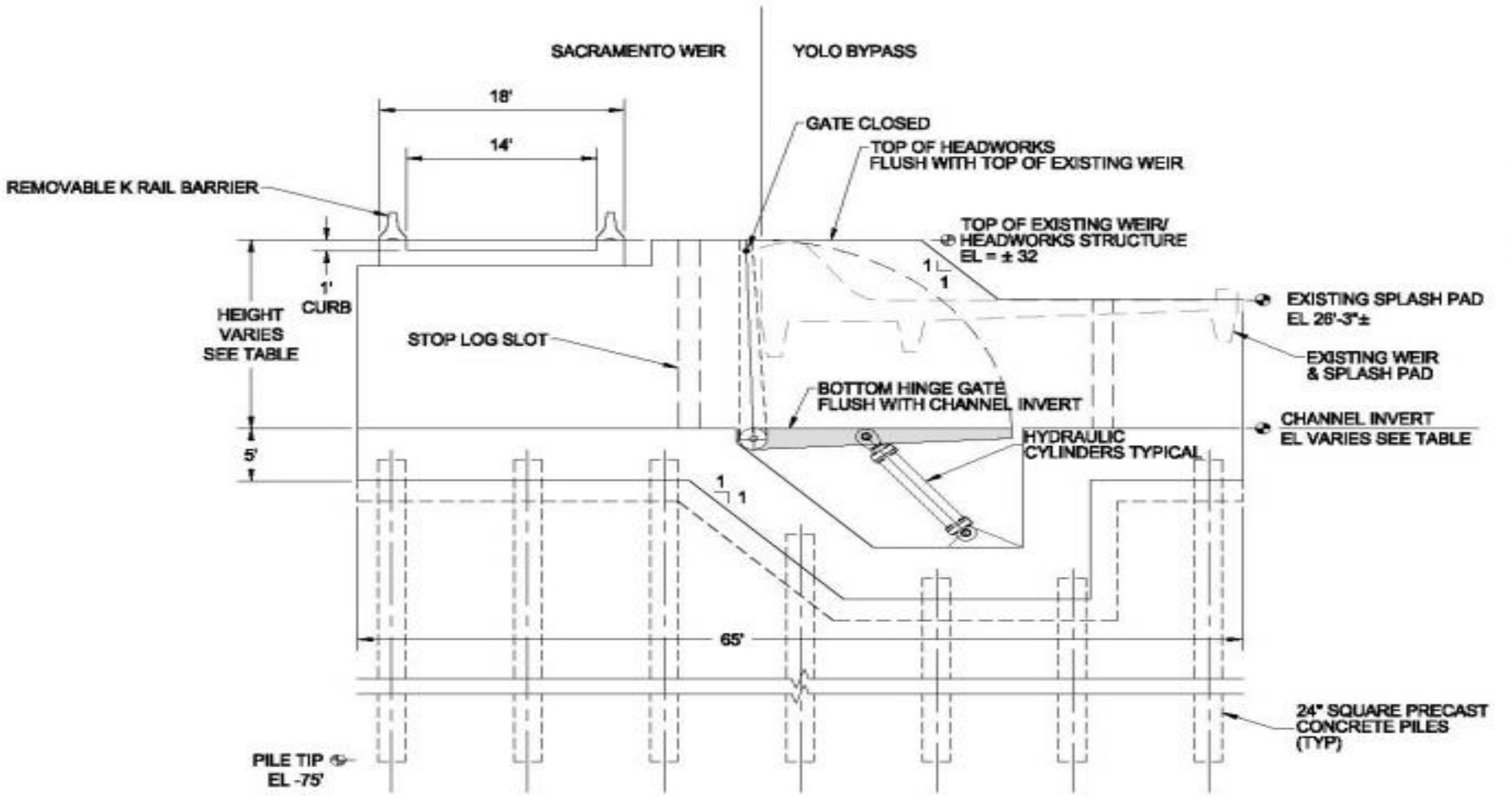


Figure 2-6. Alternative 1 Headworks Side View

Debris is expected within the Sacramento River, and debris accumulation could affect hydraulic performance or fish passage. Debris fins would be installed between gates of the headworks structure (on the river side) to redirect debris to pass through or over the gates rather than become stuck on the gate walls or facilities. Figure 2-7 shows an example of debris fins.

Figure 2-7. Debris Fins Incorporated at Headworks Structure (Example)

2.4.1.3 Control Building

The control building would be a single-story, 18- by 18-foot concrete masonry unit. The building would be located on the eastern levee. It would house, among other equipment, a programmable logic controller (PLC) for the gates, three hydraulic power units, and a motor control center. The electrical service required would be three- phase at approximately 100 amperes (A) and 480 volts alternating current (VAC) (80 kilovolt-amps [kVA]). There would be no backup or standby emergency generator; however, the units would include connections for a portable generator. Active ventilation would be required during the operation of the equipment and would be achieved by installing a roof-mounted fan that vents to the outside of the structure.

2.4.1.4 Access Structures

A reinforced concrete, three-span vehicular headworks bridge would be on the upstream side of Fremont Weir to connect to the existing access road. The bridge would span the channels through the new headworks structure. The bridge would be built at nearly the same alignment and elevation as the existing upstream maintenance road and would allow for continued patrolling and maintenance access along the weir. The bridge would have a roadway width of 14 feet and an overall width of 18 feet. Top curb elevation would be equal to the top of the weir elevation.

Temporary barrier rails (“K rails”) would be installed and removed such that no part of the bridge extends above the top of the weir during an overtopping event.

Table 2-6 presents the bridge span corresponding to each control gate.

Table 2-6. Bridge Span Specifications for Alternative 1

Gate	Bridge Span (feet)
1	34
2 and 3	27

The headworks bridge would provide a vehicular and pedestrian crossing on the north side of Fremont Weir. However, when water begins to flow through the new notch in Fremont Weir, the channels south of the weir would fill and create a barrier. If recreational users are in the Fremont Weir Wildlife Area, they may not be able to cross the channel back to where they accessed the area. For this purpose, Alternative 1 includes a 130-foot-long, eight-foot-wide steel-trussed pedestrian bridge just south of Fremont Weir (and north of Tule Pond), as shown in Figure 2-4.

2.4.1.5 Outlet Transition

The outlet transition would be a 100-foot-long reinforced concrete channel that provides gradual hydraulic transition from the headworks into the graded transport channel. The width varies from 108 feet at the headworks to 196 feet at the transport channel. The cross-section of the headworks includes three rectangular gates (one large gate with an invert elevation of 14 feet and two small gates with an invert elevation of 18 feet, shown in Figure 2-5). The outlet transition would be a structure that transitions from the headworks gates to the trapezoidal downstream transport channel. The transition would be accomplished with reinforced retaining walls that flair out from the headworks abutment piers and a reinforced concrete slab-on-grade bottom, which would gradually transition into the slopes of the trapezoidal transport channel. The outlet transition would have a gentle slope consistent with the downstream transport channel.

2.4.1.6 Transport Channel

The transport (outlet) channel would be a graded trapezoidal channel with an interior inline bench. Figure 2-8 shows the transport channels for Alternatives 1 (east), 2 (central), and 3 and 4 (west). The interior bench would help maintain acceptable velocities for fish passage at higher river elevations. The transport channel would serve as the primary facility for upstream adult fish passage between the existing Tule Pond and the headworks structure. It also would serve as the primary channel for conveying juvenile salmonids and rearing habitat flows from the headworks structure to the existing Tule Pond.

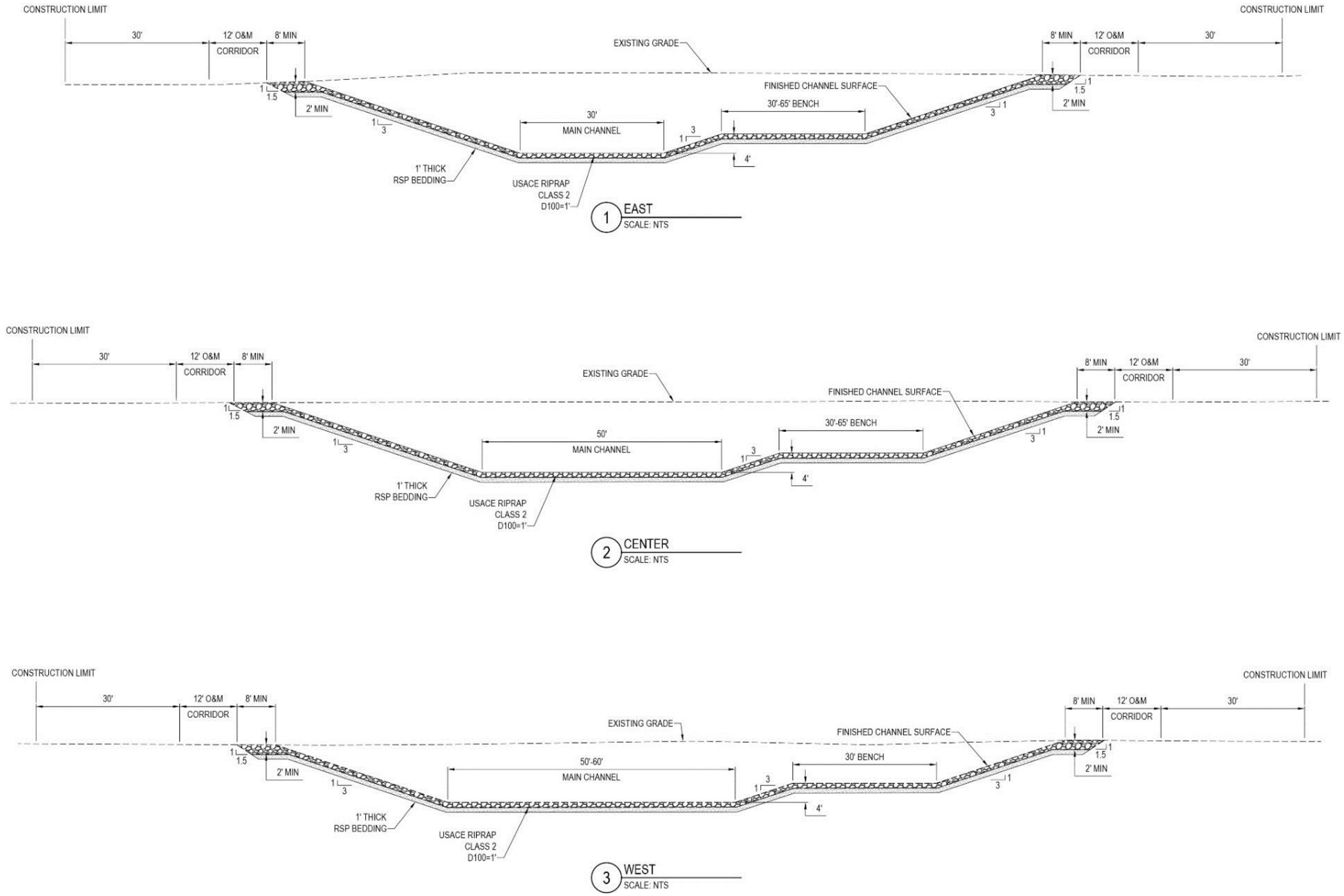


Figure 2-8. Transport Channel Cross-Section

The main channel within the trapezoidal channel would have a bottom width of 30 feet. The bench would be on the east side of the channel and elevated four feet above the main channel. The bench width would vary between 30 and 65 feet. The trapezoidal channel would have 3:1 side slopes (horizontal to vertical). The top of the channel would be approximately 150 feet wide. The channel would be about 2,650 feet long with a gradual downward slope toward Tule Pond (a slope of 0.00075). The entire channel would be lined with rounded rock revetment on the channel bottom and angular rock on the bank slopes. It would be designed to convey up to 6,000 cfs at a river elevation of 28 feet while maintaining velocities that permit fish passage. At the top of each side of the channel, an eight-foot-wide area with rock (a “rock key”) would be added to reduce the potential for the channel to head cut the channel banks. The facility also would have a 12-foot-wide maintenance corridor at the top of each side of the channel.

2.4.1.7 Seepage Measures

The transport channel for the new gated notch would be immediately adjacent to the east levee of the Yolo Bypass and would cut through the clay blanket layer at the toe of the levee, which raises concerns about increased levee underseepage. Levee underseepage could cause levee stability concerns. To reduce seepage, a cutoff wall would be constructed at the levee toe from Fremont Weir to the central part of Tule Pond. The cutoff wall would be approximately 2,850 feet long and 30 feet deep, and the wall would be completely underground.

2.4.1.8 Supplemental Fish Passage Facility

The proposed gated notch in Fremont Weir would serve as the primary fish passage facility in Alternative 1. Another project in the Yolo Bypass, the Fremont Weir Adult Fish Passage Modification Project, is constructing an improved fish passage facility at the location of the existing, smaller fish ladder (near the middle of Fremont Weir on the eastern side of Rattlesnake Island) to provide fish passage after an overtopping event. These two facilities would improve fish passage from the Yolo Bypass into the Sacramento River; the proposed gated notch would provide the main passage route, and the improved fish passage structure would pass additional fish on the eastern side of Fremont Weir after overtopping events. However, after an overtopping event, fish on the western side of Fremont Weir would not be able to pass over to the eastern side to access these two fish passage facilities because Rattlesnake Island prevents movement.

An additional fish passage facility would be constructed at a western location along the existing Fremont Weir (Figure 2-9). This facility would provide another opportunity for adult fish to travel from the Yolo Bypass into the Sacramento River. This structure would allow fish that are trapped in the stilling basin (on the bypass side of Fremont Weir) to move back into the Sacramento River after an overtopping event. The facility would have a gentle slope away from Fremont Weir so that flows would drain toward the river. It would reach the river with an invert elevation at 20 feet (compared to the invert of 22 feet at Fremont Weir). The supplemental fish passage channel would have 10-foot-bottom width and 3:1 side slopes, stretch over 350 feet measured from Fremont Weir to Sacramento River, and connect to the fish passage facility through a channel transition. The transition would be 10-feet-long and connect the 10-foot wide channel to the 15-foot width of the fish passage structure. The concrete fish passage structure would have an elevation of 22 feet at Fremont Weir and house an approximately 15-foot-wide hinge gate, recessed air bladder, and metal grate. Sheet piles would be installed north of Fremont Weir to prevent underseepage. When open, the gate would allow less than approximately 1,000 cfs to enter the Yolo Bypass. At an elevation of 32 feet, the concrete wall of the fish passage structure would be flush with the top of the existing weir. The structure would have a 16-foot-wide traffic-rated deck to allow vehicular passage.

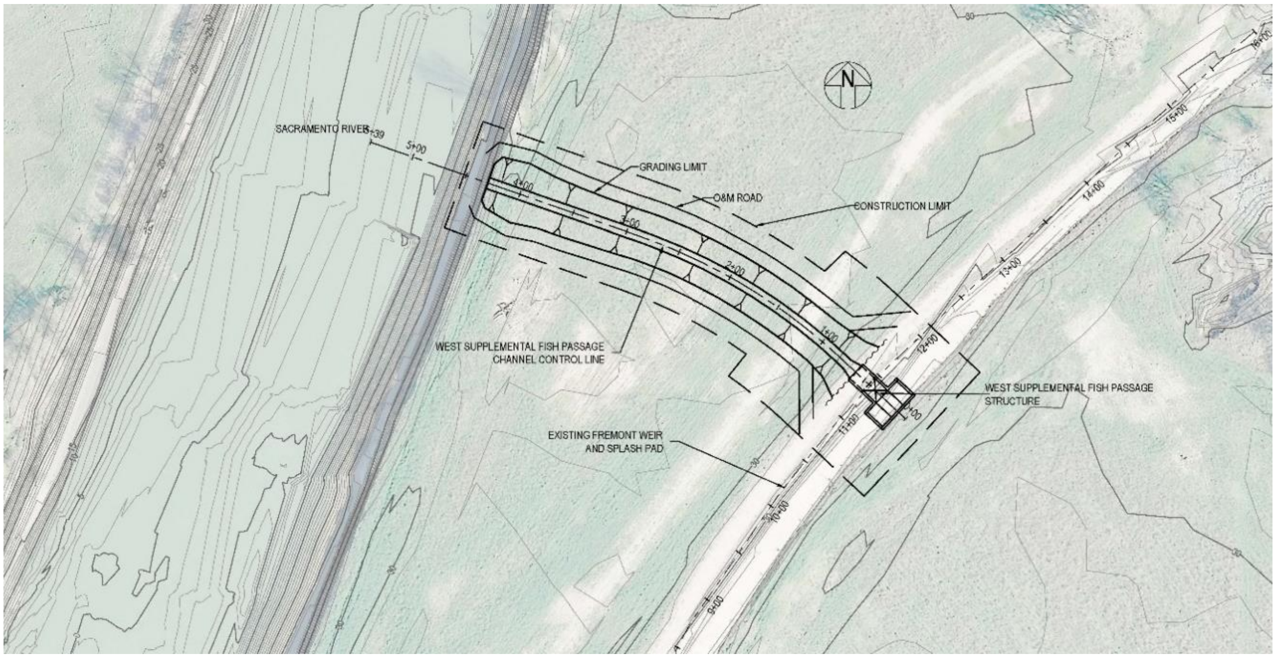


Figure 2-9. Alignment of the Western Supplemental Fish Passage Facility

2.4.2 Construction Methods

Construction of the components of Alternative 1 would begin with the demolition of a portion of the existing concrete Fremont Weir. This step would be completed in about one week. The limits for the weir demolition would extend a minimum of five feet beyond both sides of the headworks footprint to allow for excavation down to an elevation of seven feet and installation of a temporary sheet pile cofferdam.

Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 25 weeks to construct the headworks structure. Installation and testing of the gates and mechanical equipment would take an additional 3 to 5 weeks.

Grading of the transport channel would begin at the downstream outlet (at the northern end of Tule Pond) and progress upstream toward the headworks structure, with grading of the intake channel occurring last. This order would avoid potential interruptions to the headworks construction and allow construction to occur in the less saturated soil first as groundwater levels decrease with increasing distance from the Sacramento River. Groundwater levels are anticipated to be high, especially in the spring months, so dewatering efforts likely would be required to construct the headworks structure, especially where the intake channel meets the Sacramento River. About 60 to 80 percent of the channel excavation could be performed in dry unsaturated soil conditions by scrapers and bulldozers. The remaining portion would be performed in wet, saturated soil conditions by hydraulic excavators and haul trucks.

2.4.2.1 Excavated Material

Alternative 1 would require excavation of the intake channel, transport channel, and downstream facilities. Table 2-7 shows the estimated quantities of excess excavated material that would be generated from each facility and would require removal from the construction area. Depending on the type of material excavated, a portion of the material could be re-used within the project area or for other nearby projects.

Table 2-7. Estimated Excess Excavated Material Quantities for Alternative 1

Component	Estimated Excess Excavated Material (cubic yards)
East Intake Channel	64,150
East Transport Channel	116,600
Headworks	6,150
Downstream Channel	72,520
Supplemental Fish Passage (West)	3,230
Agricultural Road Crossing 1	3,170
TOTAL	*265,820*

Reclamation or DWR would purchase land within two miles of the edge of the Yolo Bypass to receive this excess material. Alternative 1 would require seven to eight acres of land to spoil excess construction-related material. This spoil site would be used for excess excavated soil and green waste. Other construction waste would be hauled to a landfill.

2.4.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project site. The haul routes for these materials would be along public streets, including Interstate (I) 5; State Route 99; and County Roads (CRs) 105, 16, 116A, and 117. Table 2-8 provides potential locations and haul routes for offsite import of materials. The exact source of the materials would be determined by the construction contractor, but these potential sources provide reasonable estimates for distances and haul routes.

Table 2-8. Construction Material Quantities, Sources, and Haul Routes

Material	Quantity	Potential Location	Haul Route	Distance
Aggregate base for road maintenance		Teichert Aggregates	Interstate 5; County Roads 16, 117, and 17; Old River Road	26 miles
Riprap material	66,860 tons	Parks Bar Quarry	County Roads 16 and 117, Old River Road, Interstate 5, State Route 99	66 miles
Rock slope protection bedding	68,618 tons	Parks Bar Quarry	County Roads 16 and 117, Old River Road, Interstate 5, State Route 99	66 miles
Equipment		Construction Contractor Office (likely access from Interstate 5)	County Roads 16 and 117, Old River Road, Interstate 5, Elkhorn Boulevard	20 miles (estimate, varies depending on contractor)

2.4.2.3 Staging Areas and Access

The construction easements for Alternative 1 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Construction sites would be accessed by the use of I-5 to CR 117 (paved rural road), north to CR 16 (paved and dirt road), west to the Yolo Bypass east levee, and then north on the east levee crown road to access the site. The use of CR 16 for equipment and offsite haul would substantially degrade the quality of the road and require re-grading and gravelling (and potentially repaving) to restore it to pre-project conditions. In addition, portions of the existing levee crown roads would be used for hauling. The levee crown consists of only aggregate surfacing in marginal conditions. It is anticipated that use of the levee crown for hauling would trigger the need to resurface the levee crown to pre-project conditions with six inches of aggregate base material.

The county roads and levee crown roads utilized for site access and haul would be inspected periodically during construction operations. As areas of damage are identified, they would be temporarily repaired to accommodate ongoing operations. At the completion of project construction, all roads that have been temporarily repaired would be repaved as specified by the governing local, county, or State standards.

2.4.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided in Table 2-9. Equipment specifics may vary based on the contractor's capabilities and the availability of equipment. Appendix B, *Constructability and Construction Considerations*, includes information on how many of each type of equipment would be used.

Table 2-9. List of Major Equipment Needed for Construction of Alternative 1

List of Major Equipment	
• 0.8-CY backhoe loaders • 1.5-CY front end loader crawler • 10-TN smooth roller • 100-TN off highway trucks • 100-foot auger track-mounted drill rig • 12-foot blade grader • 165-HP dozer • 2.5-CY hydraulic excavator • 2.5-inch diameter concrete vibrator • 24-TN truck end dump • 3.5-CY hydraulic excavator • 3-axle haul trucks • 30-CY scrapers • 300-kW generator	• 4.5-CY hydraulic excavator • 40-TN truck-mounted hydraulic crane • 4,000-gallon water truck • 450-HP dozer crawler • 6-inch diameter pump engine drive • 75-TN crane crawler pile hammer • Concrete mixer truck • Concrete pump boom, truck-mounted • Extended boom pallet loader • Flatbed truck • Haul truck oversize transport • Hydroseeding truck • Pickup trucks, conventional

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.4.2.5 Construction Schedule and Workers

Alternative 1 construction likely would begin in late 2020 or early 2021 and is estimated to last 28 weeks. All project components are expected to be completed in one construction season during times that are outside the flood period (construction from April 15 through November 1). The headworks structure would have the longest construction duration and would start at the beginning of the construction period. Construction of channel improvements would commence the same week as the headworks structure construction activities.

Construction would occur 6 days per week, 10 hours per day between 7 a.m. and 6 p.m. Construction workers would be divided into multiple crews and would work one shift per day. Maintenance and equipment upkeep crews would work on equipment at night when it is not in use. The peak number of construction workers, which would be needed for one week in July, is estimated to be 202.

2.4.3 Operations

The goal of Alternative 1 operations is to maximize the number of out-migrating juvenile winter-run Chinook salmon that enter the Yolo Bypass. Downstream out-migration is triggered during the first wet season event. Gate operations could begin each year on November 1 and would first open based on river conditions. All gates would be opened when the river elevation reaches 15 feet, which is one foot above the lowest gate invert. At this river elevation, about 130 cfs would enter the gated notch. If the river continues to rise, the gates would stay open until the flow through the gates reaches 6,000 cfs. The flow through the gates would reach 6,000 cfs when the river elevation is about 27.5 feet; at this point, the two smaller gates would be programmed to start closing such that 6,000 cfs would not be exceeded. Gate closures would be controlled so that there is not a sudden reduction in flow. Gate 1, the larger gate, would remain fully open throughout operations.

Once Fremont Weir begins to overtop, the smaller gates would remain in their last position prior to the weir overtopping (generally both would be closed at this point). After the overtopping event is over, the smaller gates would open and close as needed to keep the flow through the gate below, but as close as possible to, 6,000 cfs. All gates would close when the river elevation falls below 14 feet. Gate operations to increase inundation could continue through March 15 of each year, based on hydraulic conditions. The gates may remain partially open after March 15 to provide fish passage. However, flows through the gates after March 15 could not exceed 1,000 cfs (the capacity of Tule Canal) so that these flows do not inundate areas outside of the canal and affect landowners.

The headworks structure would house three operating control gates and include a “dogging” device on each gate to be used when the gates are raised (closed) for long periods of time. The dogging device, when manually engaged, would relieve the hydraulic operating equipment of the need to maintain pressure to keep the gates from lowering.

Each control gate would be capable of independent operation via submersible hydraulic cylinders located beneath the gate. Operation of the gates would occur from an operating control building that would house the service panel board and electrical controls for the gates, including a PLC panel.

2.4.4 Inspection and Maintenance

Maintenance activities would include debris removal, sediment removal, and facility inspections. To prevent corrosion, the gates would be rinsed at the end of the flood season as part of the facility inspections. As the Sacramento River rises, some components would no longer be accessible for maintenance. Bridge guardrails would be removed before the river rises to 28 feet. The installation of dewatering stoplogs could not be performed under any flow conditions but rather could only be installed below a river elevation of 14 feet or when the river elevation is between 14 and 28 feet and the gates are raised. When the river elevation is greater than 28 feet, with the gates open or partially open, there would be no safe access to the headworks or bridges. Table 2-10 provides a list of accessible components at varying river stages.

Table 2-10. Maintenance Accessibility by River Elevation

River Elevation	Areas Accessible for Maintenance
Below 14 feet	All components of the headworks structure, bridges, gates (upstream and downstream), and operating components. Stoplogs could be installed for all gates.
14 to 28 feet (gate closed)	Upstream sides of Gates 2 and 3 (from 14 to 18 feet), downstream components of the headworks structure, bridges, gates, and operating components. Stoplogs could be installed for Gates 2 and 3.
14 to 28 feet (gate open)	Upstream bridge deck.
Above 28 feet (gate open)	All components inaccessible.

2.4.4.1 Sediment Deposition

Estimates indicate that approximately 659,000 cubic yards of sediment enter the bypass annually under existing conditions. A portion of this sediment settles in the Yolo Bypass and must be removed through current maintenance efforts. Alternative 1 would increase sediment entering the bypass to about 743,000 cubic yards annually. Most of the additional sediment (about 45 percent) would settle out in the Fremont Weir Wildlife Area, about 25 percent would settle downstream of Agricultural Road Crossing 1, and the remaining 30 percent of sediment would remain in suspension and flow out of the bypass. Most of the sediment that settles out would be removed through flood maintenance in the Fremont Weir Wildlife Area, as under existing conditions. The additional deposition would be in areas inundated regularly under Alternative 1 (in and around channels), and sediment removal efforts associated with Alternative 1 would focus on the channel system. Alternative 1 would accumulate an additional 37,800 cubic yards of sediment annually that would be removed every five years.

Reclamation or DWR would purchase land outside the bypass for the sediment removed during maintenance actions. This acquisition would be part of the land acquired for the construction effort, but the acquisition could be phased over time. The maintenance-related sediment removal operation would require 38 to 43 acres for 50 years of operation.

New channel areas that are constructed perpendicular to the direction of flow in the bypass would incur greater sedimentation. The eastern channel alignment included in Alternative 1 likely would have less sedimentation and debris accumulation than the other action alternatives because it is the shortest and most aligned with the direction of flood flows.

2.4.4.2 Headworks Inspection and Debris Removal

The serviceability and proper function of gates, their actuators, controls, hydraulic cylinders, and the recessed areas for stoplogs and gates would be inspected at the beginning and end of the flood season and after overtopping events. Concrete spalling or severe cracking, material corrosion, or identified weakness would be noted and evaluated to determine whether repair or replacement is necessary. Any sediment deposits or accumulated debris would be removed. Debris removal in and around the headworks would be accomplished using an excavator or a crane.

2.4.4.3 Vegetation Removal

Maintenance activities would include removing vegetation and debris from the project channels annually. Grasses and woody vegetation would be allowed to remain in the channels unless it becomes an obstruction to flow within the passage channel.

2.4.5 Monitoring and Adaptive Management

During project implementation, DWR and Reclamation would monitor fish activity to identify if the project objectives are being met. Specifically, the agencies would monitor:

- Fremont Weir splash pad after overtopping events to identify if fish pass into the Sacramento River (through visual inspection)

- Structures within the Tule Canal/Toe Drain to identify fish passage concerns (through visual inspection)
- Stranding within the floodplain areas (through visual inspection and reports from landowners or visitors)
- Juvenile fish entrainment at the Fremont Weir gated notch (through camera footage at the structure)

If DWR and Reclamation identify concerns or areas where performance could improve, they would consider taking an adaptive management action. Appendix C describes the Adaptive Management Framework that would be implemented.

In addition to monitoring for fish, DWR and Reclamation would monitor groundwater levels in the area surrounding the Yolo Bypass during and after periods when the gated notch would be operating. DWR has a groundwater monitoring network in this area and the wells are checked regularly. DWR and Reclamation would consider groundwater levels each operating season to identify if the gated notch operations could be elevating shallow groundwater levels such that they could affect surrounding lands. If the agencies identify potential effects to surrounding landowners, they would work with landowners to consider a physical solution to the high groundwater elevation, property easements, or consideration of damages.

2.5 Alternative 2: Central Gated Notch

Alternative 2, Central Gated Notch, would provide a new gated notch through Fremont Weir similar to the notch described for Alternative 1. The primary difference between Alternatives 1 and 2 is the location of the notch; Alternative 2 would site the notch near the center of Fremont Weir. This gated notch would be similar in size to Alternative 1 but would have an invert elevation that is higher (14.8 feet) because the river is higher at this upstream location. This location is on an outside bend of the river. Studies have indicated that juvenile fish may be found in greater numbers on the outside edge of river bends (DWR 2017). The new gated notch would allow flow to pass into the Yolo Bypass at lower river elevations than under existing conditions, where flows only enter the Yolo Bypass when Fremont Weir overtops.

Alternative 2 would include facilities to connect the gated notch to the existing Tule Pond. Alternative 2 would allow flows up to 6,000 cfs, depending on Sacramento River elevation, through the gated notch to provide open channel flow for adult fish passage, juvenile emigration, and floodplain inundation. This alternative would also include a supplemental fish passage facility on the western end of Fremont Weir and improvements downstream of Tule Pond as described in Section 2.3. Figure 2-10 shows the key components of this alternative and the common elements described in Section 2.3.

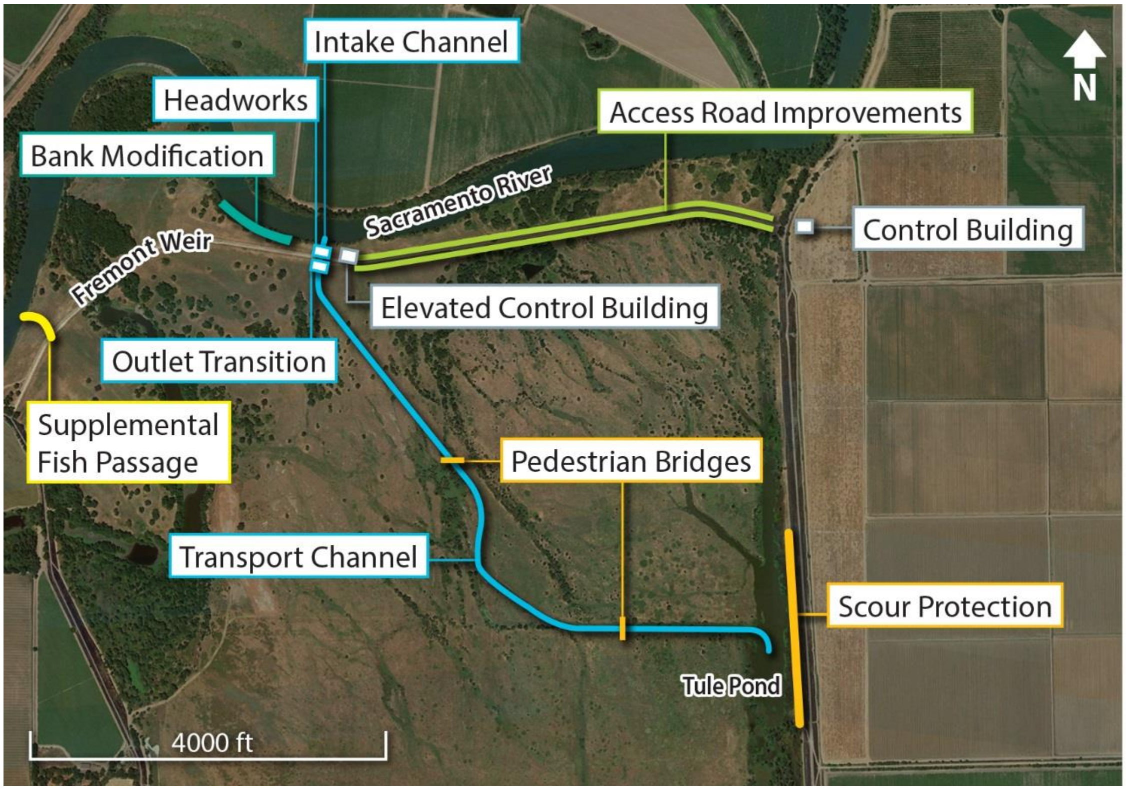


Figure 2-10. Alternative 2 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.5.1 Facilities

2.5.1.1 Intake Channel

Similar to Alternative 1, the primary purpose of the intake channel is to draw juvenile salmonids and floodplain inundation flows from the Sacramento River to the new headworks structure (described in Section 2.5.1.2) and provide upstream adult fish passage between the headworks structure and the Sacramento River. The dimensions and design details would be the same as described for Alternative 1, but the channel would be located in a central location. The Sacramento River bank just upstream and along the intake channel would be modified by removing roughage (existing rock revetment, piles and large wood) in the wetted channel, resloping the bed and embankment contours, and smoothing channel edges along the intake channel.

2.5.1.2 Headworks Structure

Because of the different location, the headworks structure in Alternative 2 would have a slightly different gate configuration than described for Alternative 1. The overall structure and foundation would be the same as described for Alternative 1, but the structure would be a little longer (the gate structure would be 114 feet compared to 108 feet for Alternative 1).

Three hydraulically operated, flush-mounted bottom hinge gates would be used in the headworks structure. These gates would be capable of operating under variable river elevations and overtopping events. The top of the gate elevation would be flush with the existing Fremont Weir crest (32 feet). The upstream face of the control gates would be approximately in-line with the upstream face of the existing Fremont Weir. When open, the gates would be flush with the channel invert. Table 2-11 presents the dimensions, invert elevation, and expected weight of the gates to be installed under this alternative. The layout of the facilities would be the same as described for Alternative 1, shown in Figures 2-5 and 2-6, including debris fins.

Table 2-11. Gate Specifications for Alternative 2

Gate	Height x Width (feet)	Invert Elevation (feet)	Expected weight (pounds)
1	17 x 40	14.8	65,000
2 and 3	13 x 27	18.8	40,000 each

2.5.1.3 Control Buildings

Due to the maximum distance over which hydraulic lines can function, two separate control buildings would be required: an operating control building and an elevated control building for hydraulics. The operating control building would be a concrete masonry unit, measuring approximately 12 by 12 feet, located on the eastern levee. The building would house a PLC for the gates and would require three-phase electrical service at approximately 100 A and 480-VAC (80kVA). There would be no backup or standby emergency generator; however, the units would include connections for a portable generator. Active ventilation would be required during the operation of the equipment and would be achieved by installing a roof-mounted fan that vents to the outside of the structure.

The elevated control building would be located on the river side of the weir near the headworks structure. The building would be of similar size and construction as the operating control structure but would be raised above the probable maximum flood elevation. The foundation of the raised building would consist of H-piles, a reinforced concrete pile cap, and a pair of streamlined reinforced concrete columns on which the building slab would rest.

2.5.1.4 Access Structures

A reinforced concrete, three-span vehicular headworks bridge would be on the upstream side of Fremont Weir to connect to the existing access road. The bridge would span the channels through the new headworks structure. Table 2-12 presents the bridge span corresponding to each control gate. The details of the headworks bridge, other than the span specifications, would be the same as discussed for Alternative 1.

Table 2-12. Bridge Span Specifications for Alternative 2

Gate	Bridge Span (feet)
1	40
2 and 3	27

The headworks bridge would provide a vehicular and pedestrian crossing on the north side of Fremont Weir. As discussed in Alternative 1, the channels south of Fremont Weir could be a barrier to access for recreational users in the Fremont Weir Wildlife Area. For this purpose, Alternative 2 includes two 170-foot-long, eight-foot-wide steel-trussed pedestrian bridges south of Fremont Weir (and north of Tule Pond), as shown in Figure 2-10. Alternative 2 includes two bridges (instead of the one bridge in Alternative 1) because of the longer length of the transport channel.

The Sacramento River carries a large amount of debris during high flow events that could accumulate in the new headworks gates. Access immediately after an overtopping event may be necessary to remove debris before a subsequent event, but the existing access roads near Fremont Weir are unpaved and too muddy to travel on for several weeks after overtopping. Alternative 2 would include stabilized access on the north and south sides of Fremont Weir to provide access following overtopping events earlier than under existing conditions. On the north side (closer to the Sacramento River), the 14-foot-wide existing access road would be excavated by two feet. The excavation would be filled with two feet of riprap with rocks less than 12 inches in diameter flush to existing grade. On the south side, the 14-foot-wide access road would be stabilized by placing two feet of riprap on top of the existing access road.

2.5.1.5 Outlet Transition

The outlet transition from the headworks to the transport channel would be the same as described for Alternative 1.

2.5.1.6 Transport Channel

The transport (outlet) channel would be a graded trapezoidal channel with an interior bench. The channel would serve the same function as described for Alternative 1. Figure 2-8 shows the cross-section of the transport channel for Alternative 2 (the central location).

The main channel within the trapezoidal channel would have a bottom width of 50 feet. The bench would be on the east side of the channel and elevated four feet above the main channel. The bench width would vary between 30 and 65 feet. The trapezoidal side slopes would have 3:1 slopes (horizontal to vertical). The top of the channel would be approximately 170 feet wide. The channel would be about 7,570 feet long with a gradual downward slope toward Tule Pond (a slope of 0.00037). The entire channel would be lined with rounded rock revetment on the channel bottom and angular rock revetment on the bank slopes. At the top of each side of the channel, an eight-foot-wide area of rock (a rock key) would be added to reduce the potential for the channel to head cut the channel banks. The facility also would have a 12-foot-wide maintenance corridor at the top of each side of the channel.

2.5.1.7 Scour Protection

The transport channel would enter Tule Pond at an angle, which could cause erosion concerns on the eastern Yolo Bypass levee. Rock revetment would be incorporated on the eastern edge of Tule Pond that is 50 feet wide, 2,500 feet long, and 2.5 feet thick, with 1.5:1 side slopes (horizontal to vertical). Additionally, there are several locations along the proposed transport channel where the channel could interact with existing scour channels. These five areas could experience head cutting as a result of the new facilities. Additional channel revetment would be incorporated at these locations; these improvements are included in the construction quantities.

2.5.1.8 Supplemental Fish Passage Facility

As discussed for Alternative 1, additional fish passage would be needed for the western side of Fremont Weir. Alternative 2 includes a supplemental fish passage facility with the same location and dimensions as described for Alternative 1.

2.5.2 Construction Methods

The construction methods and process would be similar to those described for Alternative 1. Construction would start with demolition of a portion of Fremont Weir and continue with the headworks and channel construction. In addition to the construction activities described for Alternative 1, dewatering would be required for the material removal and regrading at the bank of the Sacramento River near the intake channel.

2.5.2.1 Excavated Material

Alternative 2 would require excavation of the intake channel, transport channel, and downstream facilities. Table 2-13 shows the estimated quantities of excess excavated material that would be generated from each facility and would require removal from the construction area.

Table 2-13. Estimated Excess Excavated Material Quantities for Alternative 2

Component	Estimated Excess Excavated Material (cubic yards)
Central Intake Channel	3,360
Central Transport Channel	457,120
Headworks	6,460
Downstream Channel	72,520
Supplemental Fish Passage (West)	3,230
Agricultural Road Crossing 1	3,170
Sacramento River Bank Modification	44,523
Fremont Weir Access Road Improvements	4,961
TOTAL	*595,336*

Reclamation or DWR would purchase land outside of the Bypass within two miles of the edge of the Yolo Bypass to receive this excess material. Alternative 2 would require 12 to 14 acres of land to spoil excess construction-related materials. This spoil site would be used for excess excavated soil and green waste. Other construction waste would be hauled to a landfill.

2.5.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project site. These sites and the associated haul routes would be the same as described for Alternative 1.

2.5.2.3 Staging Areas and Access

The construction easements for Alternative 2 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Access roads would be the same as described for Alternative 1.

2.5.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided in Table 2-14. Equipment specifics may vary based on the contractor's capabilities and the availability of equipment. Appendix B, *Constructability and Construction Considerations*, includes information on how many of each type of equipment would be used.

2.5.2.5 Construction Schedule and Workers

Construction of Alternative 2 likely would begin in 2020 or 2021 and is estimated to last 28 weeks. The construction schedule is the same as Alternative 1. The peak number of construction workers, which would be needed during one week in early August, is estimated to be would be 223.

Table 2-14. List of Major Equipment Needed for Construction of Alternative 2

List of Major Equipment	
• 0.8-CY backhoe loaders	• 4.5-CY hydraulic excavator
• 1.5-CY front end loader crawler	• 40-TN truck-mounted hydraulic crane
• 10-TN smooth roller	• 4,000-gallon water truck
• 100-TN off highway trucks	• 450-HP dozer
• 100-foot auger track-mounted drill rig	• 450-HP dozer crawler
• 12-foot blade grader	• 6-inch diameter pump engine drive
• 165-HP dozer	• 75-TN crane crawler pile hammer
• 2.5-CY hydraulic excavator	• Concrete mixer truck
• 2.5-inch diameter concrete vibrator	• Concrete pump boom, truck mounted
• 24-TN truck end dumps	• Extended boom pallet loader
• 3.5-CY hydraulic excavator	• Flatbed truck
• 3-axle haul trucks	• Haul truck oversize transport
• 30-CY scrapers	• Hydroseeding truck
• 300-kW generator	• Pickup trucks conventional

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.5.3 Operations

Alternative 2 operations would be the same as those described for Alternative 1, but the gates would open when the river elevation rises above 15.8 feet (one foot above the gate invert elevation of 14.8 feet).

The headworks operations would be the same as described for Alternative 1. Each gate would have a dogging device to relieve the hydraulic operating equipment of the need to maintain pressure in order to keep the gates from lowering. Each control gate would be capable of independent operation via submersible hydraulic cylinders located beneath the gate.

2.5.4 Inspection and Maintenance

Maintenance activities associated with Alternative 2 mainly would include debris removal, sediment removal, and facility inspections. Inspection and maintenance would be the same as described for Alternative 1.

2.5.4.1 Sediment Deposition

The amount of sediment entering the Yolo Bypass under Alternative 2 would be the same as described for Alternative 1. The removal frequency, methods, and quantities would be the same as described for Alternative 1.

New areas that are constructed perpendicular to the direction of flow in the bypass would incur greater sedimentation deposition. The central gated notch location, based on its location along the weir and observations of existing debris stranding, likely would experience a higher occurrence of debris accumulation as compared to the west and east alignments. Therefore, debris removal in this area would be required and accomplished using an excavator or a crane.

2.5.4.2 Headworks Inspection and Debris Removal

The serviceability and proper function of gates, their actuators, controls, hydraulic cylinders, and the recessed areas for stoplogs and gates would be inspected at the beginning and end of the flood season and after overtopping events. Concrete spalling or severe cracking, material corrosion, or identified weakness would be noted and evaluated to determine whether repair or replacement is necessary. Sediment deposits or accumulated debris would be removed. Debris removal in and around the headworks would be accomplished using an excavator or a crane.

2.5.4.3 Vegetation Removal

Periodic vegetation and debris removal from project channels would be the same as described for Alternative 1.

2.5.5 Monitoring and Adaptive Management

Monitoring activities and the adaptive management framework would be the same as described for Alternative 1.

2.6 Alternative 3: West Side Gated Notch

Alternative 3, West Side Gated Notch, would provide a new gated notch through Fremont Weir similar to the notch described for Alternative 1. The primary difference between Alternatives 1 and 3 is the location of the notch; Alternative 3 would site the notch on the western side of Fremont Weir. This gated notch would be similar in size to Alternative 1 but would have an invert elevation that is higher (16.1 feet) because the river is higher at this location. The western location is on the outside of a river bend, similar to Alternative 2, but would be easier to access for operations and maintenance than a central location. The new gated notch would allow flow to pass into the Yolo Bypass at lower river elevations than under existing conditions where flows only enter the Yolo Bypass when Fremont Weir overtops.

Alternative 3 would include facilities to connect the gated notch to the existing Tule Pond. Alternative 3 would allow flows up to 6,000 cfs, depending on Sacramento River elevation, through the gated notch to provide open channel flow for adult fish passage, juvenile emigration, and floodplain inundation. This alternative would also include a supplemental fish passage facility on the eastern side of Fremont Weir and improvements downstream of Tule Pond as described in Section 2.3. Figure 2-11 shows the key components of Alternative 3 and the common elements described in Section 2.3.

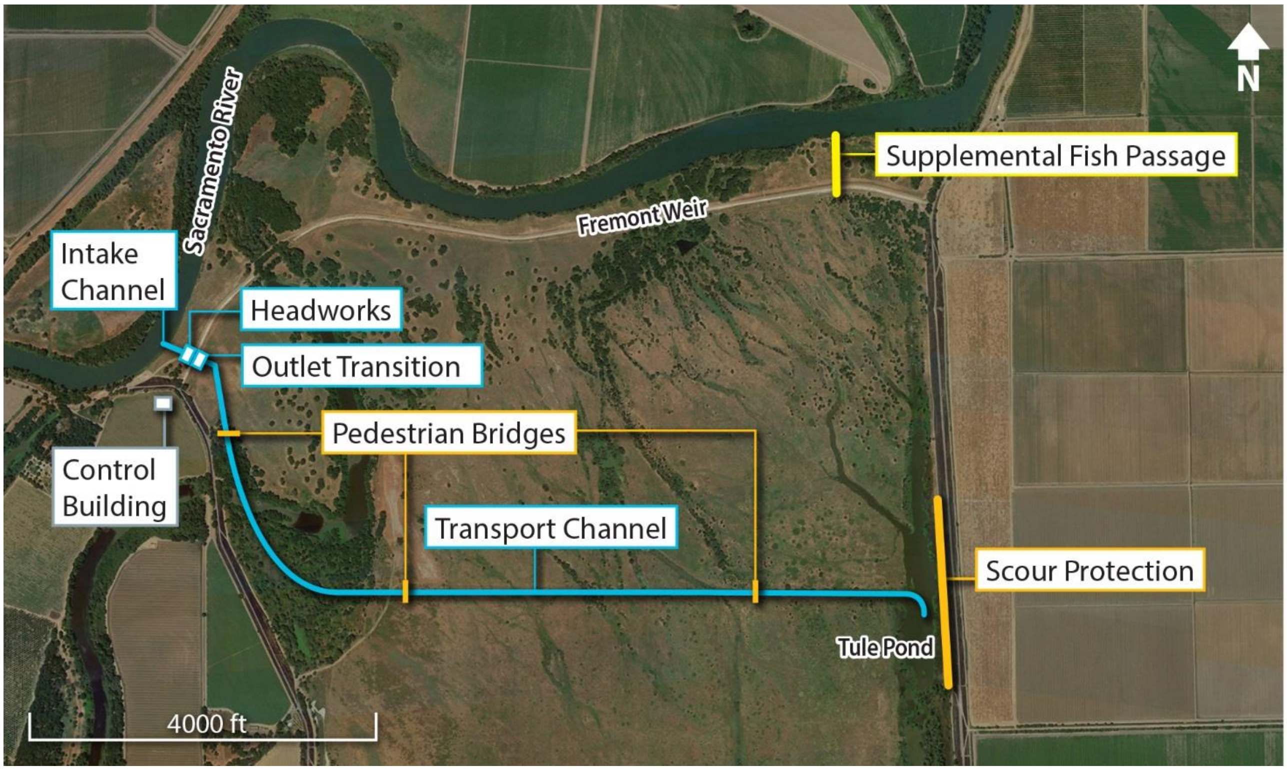


Figure 2-11. Alternative 3 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.6.1 Facilities

2.6.1.1 Intake Channel

Similar to Alternative 1, the primary purpose of the intake channel is to draw juvenile salmonids and floodplain inundation flows from the Sacramento River to the new headworks structure (described in Section 2.6.1.2) and provide upstream adult fish passage between the headworks structure and the Sacramento River. The dimensions and design details would be the same as described for Alternative 1, but the channel would be located in a western location.

2.6.1.2 Headworks Structure

Because of the different location, the headworks structure in Alternative 3 would have a slightly different gate configuration than described for Alternative 1. The overall structure and foundation would be the same as described for Alternative 1, but the structure would be a little longer (the gate structure would be 114 feet compared to 108 feet for Alternative 1).

Three hydraulically operated, flush-mounted bottom hinge gates would be used in the headworks structure. These gates would be capable of operating under variable river elevations and overtopping events. The top of the gate elevation would be flush with the existing Fremont Weir (32 feet). The upstream face of the control gates would be approximately in-line with the upstream face of the existing Fremont Weir. When open, the gates would be flush with the channel invert. Table 2-15 presents the dimensions, invert elevation, and expected weight of the gates to be installed under this alternative. The layout of the facilities would be the same as described for Alternative 1 (Figures 2-5 and 2-6), including debris fins.

Table 2-15. Gate Specifications for Alternative 3

Gate	Height x Width (feet)	Invert Elevation (feet)	Expected weight (pounds)
1	16 x 40	16.1	65,000
2 and 3	12 x 27	20.1	40,000 each

2.6.1.3 Control Building

The control building would be a single-story concrete masonry unit, measuring 18 by 18 feet, located on the western levee. The building would house the same equipment as described for Alternative 1.

2.6.1.4 Access Structures

A reinforced concrete, three-span vehicular headworks bridge would be on the upstream side of Fremont Weir to connect to the existing access road. The bridge would span the channels through the new headworks structure.

Table 2-16 presents the bridge span corresponding to each control gate. The details of the headworks bridge, other than the span specifications, would be the same as discussed for Alternative 1.

Table 2-16. Bridge Span Specifications for Alternative 3

Gate	Bridge Span (feet)
1	40
2 and 3	27

The headworks bridge would provide a vehicular and pedestrian crossing on the north side of Fremont Weir. As discussed in Alternative 1, the channels south of Fremont Weir could be a barrier to access for recreational users in the Fremont Weir Wildlife Area. For this purpose, Alternative 3 includes three 185-foot-long, eight-foot-wide steel-trussed pedestrian bridges south of Fremont Weir (and north of Tule Pond), as shown in Figure 2-11.

2.6.1.5 Outlet Transition

The outlet transition from the headworks to the transport channel would be the same as described for Alternative 1.

2.6.1.6 Transport Channel

The transport (outlet) channel would be a graded trapezoidal channel with an interior bench. The channel would serve the same function as described for Alternative 1. Figure 2-8 shows the cross-section of the transport channel for Alternative 3 (the western location). The transport channel would cross the “oxbow” wetland area on the western side of the Yolo Bypass, but the channel would not have a hydraulic connection to the oxbow. A portion of the oxbow near the western Yolo Bypass levee would be filled to approximately existing grade, then the transport channel would be excavated through the filled section.

The main channel within the trapezoidal channel would have a bottom width of 50 to 60 feet. The bench would be on one side of the channel and elevated four feet above the main channel. The bench width would be approximately 30 feet. The trapezoidal side slopes would have 3:1 slopes (horizontal to vertical). The top of the channel would be approximately 180 feet wide. The channel would be about 10,180 feet long with a gradual downward slope toward Tule Pond (a slope of 0.0004). The entire channel would be lined with rounded rock revetment on the channel bottom and angular rock revetment on the bank slopes. At the top of each side of the channel, an eight-foot-wide area of rock (a rock key) would be added to reduce the potential for the channel to head cut the channel banks. The facility also would have a 12-foot-wide maintenance corridor at the top of each side of the channel.

2.6.1.7 Supplemental Fish Passage Facility

Alternative 3 would provide primary fish passage through the new gated notch on the western side of Fremont Weir. The improved fish passage facility at the existing fish ladder would provide passage immediately after an overtopping event near the center of Fremont Weir, but the eastern section of Fremont Weir is very long. To further improve fish passage from the Yolo Bypass into the Sacramento River after an overtopping event, Alternative 3 would include an additional fish passage facility at an eastern location along the existing Fremont Weir (see Figure 2-12). The supplemental fish passage channel would stretch over 500 feet and connect to the fish passage facility through a channel transition. The 10-foot-long channel transition facilitates the transition from the 10-foot width of the channel to the 15-foot width of the fish passage structure. The concrete fish passage structure would house an approximately 12-foot-wide hinge gate, a recessed air buffer, and a metal grate. The concrete wall of the fish passage structure would be flush with the top of the existing weir (elevation 32 feet).

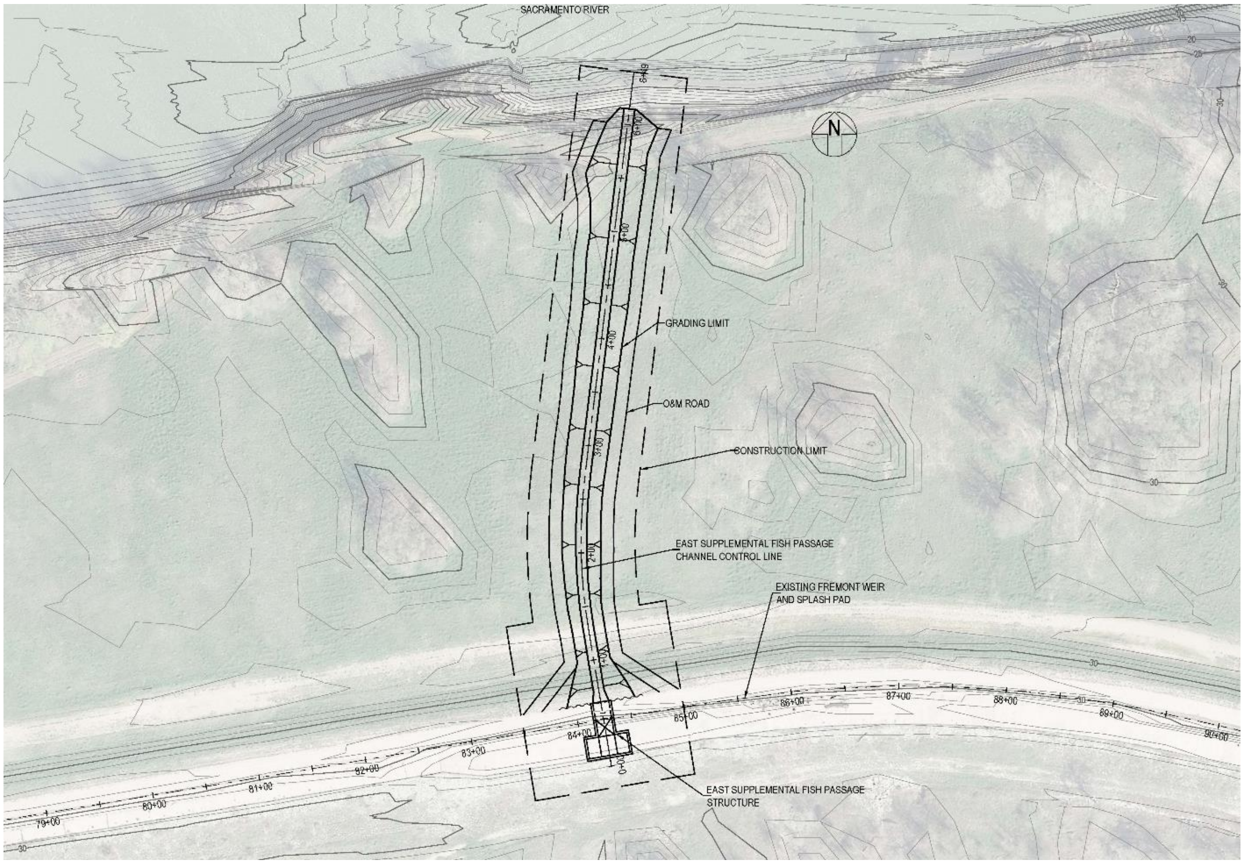


Figure 2-12. Eastern Supplemental Fish Passage

2.6.1.8 Scour Protection

The transport channel would enter Tule Canal at an angle, which could cause erosion on the eastern Yolo Bypass levee. Rock revetment would be placed on the eastern edge of Tule Pond that is 50 feet wide, 2,500 feet long, and 2.5 feet thick, with 1.5:1 side slopes (horizontal to vertical). Additionally, there are several locations along the proposed transport channel where the channel could interact with existing scour channels. These areas could experience head cutting as a result of the new facilities. Additional channel revetment would be incorporated at these locations; these improvements are included in the construction quantities.

2.6.2 Construction Methods

The construction methods and process would be very similar to those described for Alternative 1. Construction would start with demolition of Fremont Weir and continue with the headworks and channel construction.

2.6.2.1 Excavated Material

Alternative 3 would require excavation of the intake channel, transport channel, and downstream facilities. Table 2-17 shows the estimated quantities of excess excavated material that would be generated from each facility and would require removal from the construction area.

Table 2-17. Estimated Excess Excavated Material Quantities for Alternative 3

Component	Estimated Excess Excavated Material (cubic yards)
West Intake Channel	32,720
West Transport Channel	687,640
Headworks	6,460
Downstream Channel	72,520
Supplemental Fish Passage (East)	3,540
Agricultural Road Crossing 1	3,170
TOTAL	*806,050*

Reclamation or DWR would purchase land outside of the bypass within two miles of the edge of the Yolo Bypass to receive this excess material. Alternative 3 would require 17 to 20 acres of land to spoil excess construction-related materials.

2.6.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project sites. These sites and the associated haul routes would be the same as described for Alternative 1.

2.6.2.3 Staging Areas and Access

The construction easements for Alternative 3 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Access roads would be the same as described for Alternative 1.

2.6.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided (Table 2-18). Equipment specifics may vary based on the contractor’s capabilities and the availability of equipment. Appendix B, *Constructability and Construction Considerations,* includes information on how many of each type of equipment would be used.

Table 2-18. List of Major Equipment Needed for Construction of Alternative 3

List of Major Equipment	
• 0.8-CY backhoe loaders	• 4.5-CY hydraulic excavator
• 1.5-CY front end loader crawler	• 40-TN truck-mounted hydraulic crane
• 10-TN smooth roller	• 4,000-gallon water truck
• 100-TN off highway trucks	• 450-HP dozer crawler
• 100-foot auger track-mounted drill rig	• 6-inch diameter pump engine drive
• 12-foot blade grader	• 75-TN crane crawler pile hammer
• 165-HP dozer	• Concrete mixer truck
• 2.5-CY hydraulic excavator	• Concrete pump boom, truck mounted
• 2.5-inch diameter concrete vibrator	• Extended boom pallet loader
• 24-TN truck end dump	• Flatbed truck
• 3.5-CY hydraulic excavator	• Haul truck oversize transport
• 3-axle haul trucks	• Hydroseeding truck
• 30-CY scrapers	• Pickup trucks, conventional
• 300-kW generator	

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.6.2.5 Construction Schedule and Workers

Construction of Alternative 3 likely would begin in 2020 or 2021 and is estimated to last 28 weeks. The construction schedule is the same as Alternative 1. The peak number of construction workers, which would be needed during one week in the middle of July, is estimated to be 277.

2.6.3 Operations

Alternative 3 operations would be the same as those described for Alternative 1, but the gates would open when the river elevation rises above 17.1 feet (one foot above the gate invert elevation of 16.1 feet).

The headworks operations would be the same as described for Alternative 1. Each gate would have a dogging device to relieve the hydraulic operating equipment of the need to maintain pressure in order to keep the gates from lowering. Each control gate would be capable of independent operation via submersible hydraulic cylinders located beneath the gate.

2.6.4 Inspection and Maintenance

Maintenance activities associated with Alternative 3 would mainly include debris removal, sediment removal, and facility inspections. Inspection and maintenance would be the same as described for Alternative 1.

2.6.4.1 Sediment Deposition

The amount of sediment entering the Yolo Bypass under Alternative 3 would be the same as described for Alternative 1. The removal frequency, methods, and quantities would be the same as described for Alternative 1.

New areas that are constructed perpendicular to the direction of flow in the bypass would incur greater sedimentation deposition. This alignment (the western alignment) likely would have the highest amount of sedimentation and debris accumulation because it is the longest and has more changes in direction than the eastern or central alignments. Therefore, debris removal in this area would be required and accomplished using an excavator or a crane.

2.6.4.2 Headworks Inspection and Debris Removal

The serviceability and proper function of gates, their actuators, controls, hydraulic cylinders, and the recessed areas for stoplogs and gates would be inspected at the beginning and end of the flood season and after overtopping events. Concrete spalling or severe cracking, material corrosion, or identified weakness would be noted and evaluated to determine if repair or replacement is necessary. Sediment deposits or accumulated debris would be removed. Debris removal in and around the headworks would be accomplished by excavator or crane.

2.6.4.3 Vegetation Removal

Periodic vegetation and debris removal from project channels would be the same as described for Alternative 1.

2.6.5 Monitoring and Adaptive Management

Monitoring activities and the adaptive management framework would be the same as described for Alternative 1.

2.7 Alternative 4: West Side Gated Notch – Managed Flow

Alternative 4, West Side Gated Notch – Managed Flow, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than the other alternatives, but it would incorporate water control structures to maintain inundation in defined areas for longer periods of time within the northern Yolo Bypass. Alternative 4 would include the same gated notch and associated facilities as described for Alternative 3. However, it would be operated to limit the maximum inflow to approximately 3,000 cfs.

Alternative 4 includes two water control structures on Tule Canal to extend periods of inundation locally. A bypass channel would be constructed around each water control structure to provide adult fish passage when the water control structures are controlling flow. This alternative would also provide means for fish passage on the eastern side of Fremont Weir through a supplemental fish passage facility. In addition, improvements to Agricultural Road Crossing 1 and the downstream channel would be implemented under this alternative (see Section 2.3). Figure 2-13 shows the key components of Alternative 4 and the common elements described in Section 2.3.

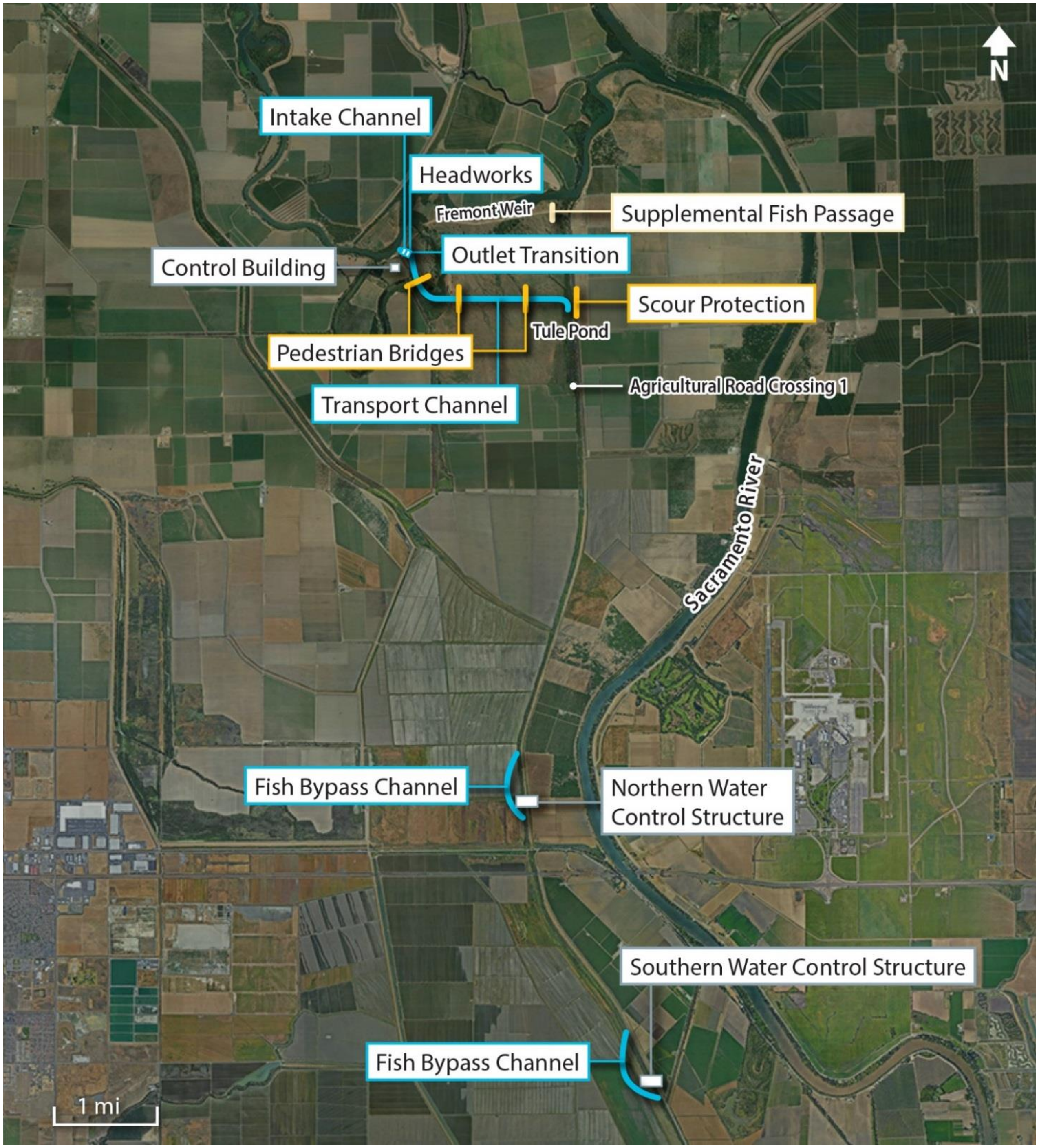


Figure 2-13. Alternative 4 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.7.1 Facilities

The gated notch and associated facilities (intake channel, headworks, outlet transition, transport channel, control building, access structures, and supplemental fish passage) are identical to those described for Alternative 3. The decrease in flows through the gated notch would be accomplished through operations described in Section 2.7.3. This section focuses on the features that are unique to Alternative 4, including the water control structures and bypass channels.

Two bypass channels would be constructed, each as an open channel sized for 300 cfs with a 10-foot-bottom width and 3:1 side slopes. The channel near the northern water control structure would be approximately 2,500 feet long, whereas the channel near the southern water control structure would be 3,000 feet long. The channels would have no operable weir features.

2.7.1.1 Northern Water Control Structure

The northern water control structure would be just north of CR 22, as shown in Figure 2-14. The water control structure would be used to manage water levels upstream from this facility and pond water to increase duration of flooded fish-rearing habitat above this location. The concrete water control structure would include three 16-foot-wide “Obermeyer”-style inflatable gates, or bladder-type dams, that would raise to maintain water levels at an elevation of 21.5 feet. Figure 2-15 shows a picture of an Obermeyer gate with inflatable bladders that raise the gate. The structure would have a concrete bridge on top of the structure for access. It would have sheet pile walls that tie into the Tule Canal banks.

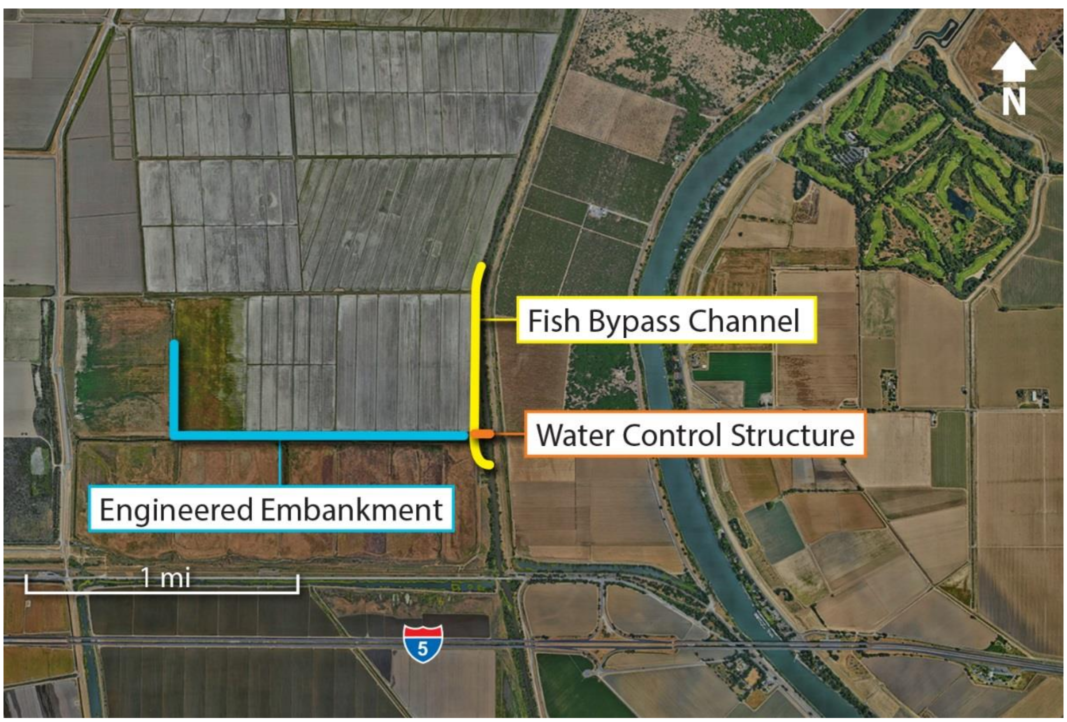


Figure 2-14. Northern Water Control Structure and Bypass Channel

Figure 2-15. Example of Obermeyer-Style Inflatable Gates

When the gates are raised, they would block fish passage through Tule Canal. To reduce fish passage delays, a bypass channel would go around the water control structure, as shown in Figure 2-14. The bypass channel would be an open, trapezoidal channel with a 10-foot-bottom width and 3:1 side slopes. Berms (two to five feet in height) would be constructed on each side of the channel to maintain water levels in the bypass channel. The channel would include two areas where it would be constricted down to a five-foot-bottom width for 60 feet. This constriction would help slow the water and meet fish passage criteria. Figure 2-16 shows a cross-section schematic of the bypass channel next to Tule Canal. The channel would be approximately 2,500 feet long with no operable features in the bypass channel. It would convey up to 300 cfs. The bypass channel would include a box culvert adjacent to the water control structure to allow vehicular access across both facilities.

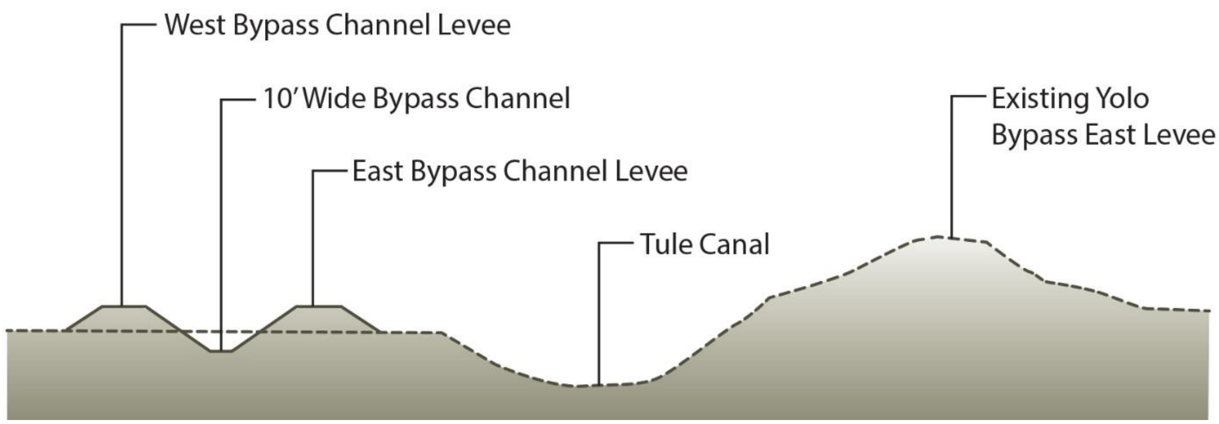


Figure 2-16. Cross-Section of Bypass Channel

An engineered, armored embankment would be added in the area of existing roads or berms west and north of the water control structure to maintain water levels north of the water control structure. This embankment would add two to six feet above the surrounding ground. The improvements would be about 12,000 linear feet, as shown in Figure 2-14. The embankment would be designed to have a top elevation of 23 feet inside the Yolo Bypass.

2.7.1.2 Southern Water Control Structure

The southern water control structure would be south of CR 22 and north of the Sacramento Weir, as shown in Figure 2-17. The water control structure would be used to manage water levels upstream from this facility and pond water to increase rearing habitat. The concrete water control structure would include three 16-foot-wide Obermeyer-style inflatable gates or bladder-type dams that would raise to maintain water levels at an elevation of 17.5 feet. The structure would include a concrete bridge on top of the structure for access. It would have sheet pile walls that tie into the Tule Canal banks.

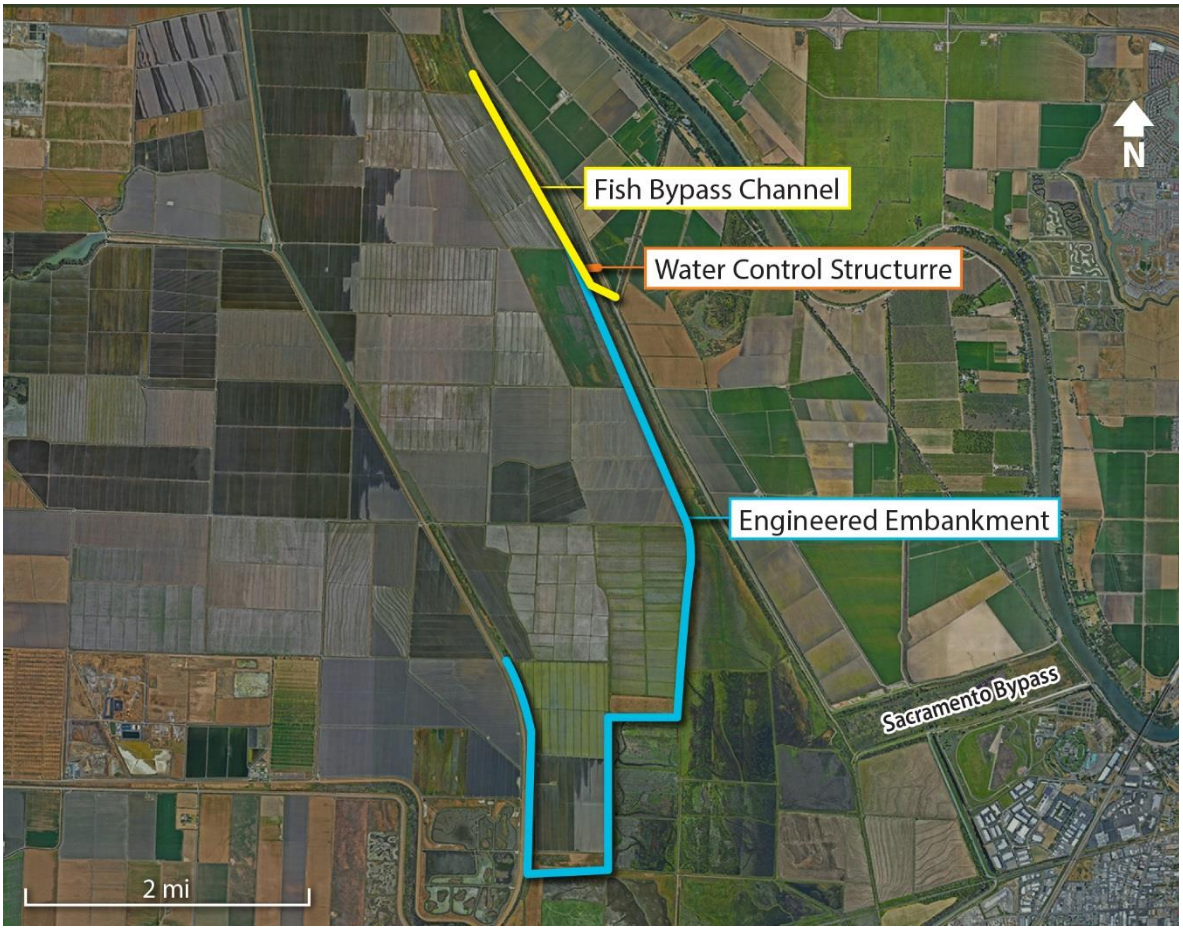


Figure 2-17. Southern Water Control Structure and Bypass Channel

When the gates are raised, they would block fish passage through Tule Canal. To reduce fish passage delays, a bypass channel would go around the water control structure, as shown in Figure 2-17. The bypass channel would be an open, trapezoidal channel with a 10-foot-bottom width and 3:1 side slopes. Berms would be constructed on each side of the channel to maintain water levels in the bypass channel. The cross-section would be similar to the northern channel, as shown in Figure 2-16. The channel would be roughly 4,000 feet long with no operable features in the bypass channel (but existing agricultural facilities would be maintained). The channel would convey up to 300 cfs. The bypass channel would include a box culvert adjacent to the water control structure to allow vehicular access across both facilities.

An engineered embankment (armored with rock) would be constructed along the alignments of existing roads or berms south then west of the water control structure to maintain water levels north of the water control structure. The existing berms would be degraded and rebuilt to meet the stability requirements to hold back water. The rebuilt embankments would be two to six feet above the existing grade on the surrounding property. The improvements would be about 42,500 linear feet, as shown in Figure 2-17. The embankment would be designed to have a top elevation of 19 feet inside the Yolo Bypass.

2.7.2 Construction Methods

Construction of the intake channel, headworks, transport channel, Agricultural Road Crossing 1, and the downstream channel improvements would follow the same construction methods as discussed for Alternative 3.

The water control structures would be constructed in Tule Canal, which has a non-flood flow of approximately 1,000 cfs that would need to be maintained during the construction period. Construction would begin by creating a temporary bypass channel around the construction site to convey these flows, and then cofferdams would be installed upstream and downstream of the site with dewatering pumps to dry out the construction site. The bypass channel construction would mostly be in dry areas except for the transitions to Tule Canal.

2.7.2.1 Excavated Material

The intake channel, headworks, transport channel, downstream channel, and Agricultural Road Crossing 1 improvements under Alternative 4 would be the same as described for Alternative 3, so the excess excavated material would be the same as shown in Table 2-17. Additionally, construction activities would occur at the two water control structures and bypass channels. The excavated materials from these facilities would be re-used to construct the berms on the bypass channel and the engineered embankments. Table 2-19 shows the estimated quantities of material that would be excavated or required for fill during construction of the water control structures and bypass channels.

Table 2-19. Estimated Material Quantities for Water Control Structures in Alternative 4

Component	Net Fill (cubic yards)	Net Excavation (cubic yards)	Net Material (cubic yards)
Northern Water Control Structure and Bypass Channel	75,000	65,000	10,000 Borrow Need
Southern Water Control Structure and Bypass Channel	178,000	134,000	44,000 Borrow Need

The borrow need would be met from excess material generated during construction of the gated notch and channel at Fremont Weir. Reclamation or DWR would purchase land within two miles of the edge of the Yolo Bypass to receive excess material. Alternative 4 would require 16 to 19 acres of land to spoil excess construction-related materials.

2.7.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project sites. These sites and the haul routes would be the same as described for Alternative 1.

2.7.2.3 Staging Areas and Access

The construction easements for Alternative 4 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Site access for work at Fremont Weir and in the Fremont Weir Wildlife Area would be the same as described for Alternative 1.

Construction access for the northern water control structure would be via I-5 to CR 117. The route would then follow CR 22 north onto existing agricultural roads in the bypass. CRs 22 and 117 are paved rural two-lane roads that, based on preliminary site assessment visits, are anticipated to sufficiently accommodate minor construction traffic associated with equipment and material haul for site mobilization. The agricultural roads are basic dirt roads that would need to be maintained during construction to accommodate construction traffic equipment.

Construction access for the southern water control structure would be via I-5 to CR 117 to CR 22, then south onto existing agricultural roads for the northern end of the project. The southern end of the project would be accessed via I-5 to CR 102 to CR 28H, then onto the west bypass levee down to existing agricultural roads. CRs 22, 117, 102, and 28H are paved rural two-lane roads that, based on preliminary site assessment visits, are anticipated to sufficiently accommodate minor construction traffic associated with equipment and material haul for site mobilization. The levee and agricultural roads are basic dirt roads that would need to be maintained during construction to accommodate construction traffic equipment.

2.7.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided (Table 2-20). Equipment specifics may vary based on the contractor's capabilities and the availability of equipment. Appendix B, *Constructability and Construction Considerations,* includes information on how many of each type of equipment would be used.

Table 2-20. List of Major Equipment Needed for Construction of Alternative 4

List of Major Equipment	
• 0.8-CY backhoe loaders	• 4.5-CY hydraulic excavator
• 1.5-CY front end loader crawler	• 40-TN truck-mounted hydraulic crane
• 10-TN smooth roller	• 4,000-gallon water truck
• 100-TN off highway trucks	• 450-HP dozer crawler
• 100-foot auger track-mounted drill rig	• 6-inch diameter pump engine drive
• 12-foot blade grader	• 75-TN crane crawler pile hammer
• 165-HP dozer	• Concrete mixer truck
• 2.5-CY hydraulic excavator	• Concrete pump boom, truck mounted
• 2.5-inch diameter concrete vibrator	• Extended boom pallet loader
• 24-TN truck end dump	• Flatbed truck
• 3.5-CY hydraulic excavator	• Haul truck oversize transport
• 3-axle haul trucks	• Hydroseeding truck
• 30-CY scrapers	• Pickup trucks, conventional
• 300-kW generator	

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.7.2.5 Construction Schedule and Workers

Construction of Alternative 4 likely would begin in 2020 or 2021 and is estimated to last 28 weeks. The construction schedule for the gated notch and associated facilities in Fremont Weir Wildlife Area is the same as Alternative 1. Construction of channel improvements, including water control structures and bypass channels, would be completed concurrently with construction on the headworks facility.

Construction would occur 6 days per week for 10 hours per day between 7 a.m. and 6 p.m. Construction workers would be divided into multiple crews and would work one shift a day. Maintenance and equipment upkeep crews would work on equipment at night when it is not in use. The peak number of construction workers, which would be needed for one week in the middle of July, is estimated to be 363.

2.7.3 Operations

The goal of Alternative 4 operations is to increase rearing time and food production in the bypass while managing flows. Under Alternative 4, the Fremont Weir gates would be operated to limit flows to 3,000 cfs. Gate operations could begin each year on November 1 and would first open based on river conditions. All gates would be opened when the river elevation at this location reaches 17.1 feet, which is one foot above the lowest gate invert. If the river continues to rise, the gates would stay open until the flow through the gates reaches 3,000 cfs. The flow through the gates would reach 3,000 cfs when the river elevation is about 26.6 feet; at this point, the two smaller gates would be programmed to start closing such that 3,000 cfs would not be exceeded. Gate closures would be controlled so that there is not a sudden reduction in flow. Gate 1, the larger gate, would remain fully open throughout operations.

Once Fremont Weir begins to overtop, the smaller gates would remain in their last position prior to the weir overtopping (generally both would be closed at this point). After the overtopping event is over, the smaller gates would open and close as needed to keep the flow through the gate below, but as close as possible to, 3,000 cfs. The notch would close when the river falls below an elevation of 16.1 feet. Gate operations to increase inundation could continue through March 7 or March 15 of each year, based on hydraulic conditions. The gates may remain partially open after March 7 or March 15 to provide fish passage. However, flows through the gates after March 7 or March 15 could not exceed 1,000 cfs (the capacity of Tule Canal) so that these flows do not inundate areas outside of the canal and affect landowners.

Under Alternative 4, Reclamation and DWR would not select a different inundation end date (March 7 or March 15) each year. This EIS/EIR analyzes the potential impacts and benefits from each end date, and if this alternative is selected, Reclamation and DWR would use this analysis as a basis to select one end date in their decision documents.

Water control structures in Tule Canal would be raised when the notch is open. The northern water control structure would be managed to achieve a target water surface elevation of 21.5 feet. The southern water control structure would be managed to achieve a target water surface elevation of 17.5 feet. As canal stage rises above the target elevation, the water control structure gates would begin to lower so that the elevation is held constant. The gates would remain lowered after March 15.

2.7.4 Inspection and Maintenance

Maintenance activities associated with Alternative 4 would mainly include debris removal, sediment removal, and facility inspections. Inspection and maintenance for the headworks, channels, and associated facilities would be the same as described for Alternative 3.

2.7.4.1 Sediment Deposition

Estimates indicate that approximately 659,000 cubic yards of sediment enter the bypass annually under existing conditions. A portion of this sediment settles in the Yolo Bypass and must be removed through current maintenance efforts. Alternative 4 would increase sediment entering the bypass to an estimated 701,000 cubic yards annually. About 25 percent would settle downstream of Agricultural Road Crossing 1, and the remaining 30 percent of sediment would remain in suspension and flow out of the bypass. Most of the sediment that settles out would be removed through flood maintenance in the Fremont Weir Wildlife Area, as under existing conditions. Alternative 4 would accumulate an additional 18,900 cubic yards of sediment annually that would be removed every five years.

Reclamation or DWR would purchase land outside the bypass for the sediment removed during maintenance actions. This acquisition would be part of the land acquired for the construction effort, but the acquisition could be phased over time. The maintenance-related sediment removal would require 20 to 23 acres for 50 years of operation.

2.7.4.2 Water Control Structures

The areas around the water control structures and the bypass channels would need to be inspected periodically to identify areas where sedimentation may be reducing the size of the bypass channel and affecting fish passage at the facilities. If inspections find that sedimentation is causing fish passage concerns, Reclamation or DWR would remove sediment to restore fish passage capability.

2.7.5 Monitoring and Adaptive Management

Monitoring activities and the adaptive management framework would be the same as described for Alternative 1.

2.8 Alternative 5: Central Multiple Gated Notches

Through the strategy of using multiple gates and intake channels at Fremont Weir, Alternative 5, Central Multiple Gated Notches, has the goal of increasing the number of out-migrating juvenile fish that enter the Yolo Bypass. Trapezoidal channels create some limitations for fish passage because they have smaller flows at lower river elevations (because the channel is smaller at this elevation) when winter-run Chinook salmon are out-migrating. Alternative 5 includes multiple gates so that the deeper gate could allow more flow to enter the bypass when the river is at lower elevations. Flows would move to other gates when the river is higher to control inflows while maintaining fish passage conditions.

Alternative 5 incorporates multiple gated notches in the central location on the existing Fremont Weir that would allow combined flows of up to 3,400 cfs. As the river rises, the deeper gate would close and the next gate would open. This alternative would include a supplemental fish passage facility on the western side of Fremont Weir and improvements to allow fish to pass through Agricultural Road Crossing 1 (see Section 2.3). Figure 2-18 shows the key components of this alternative.

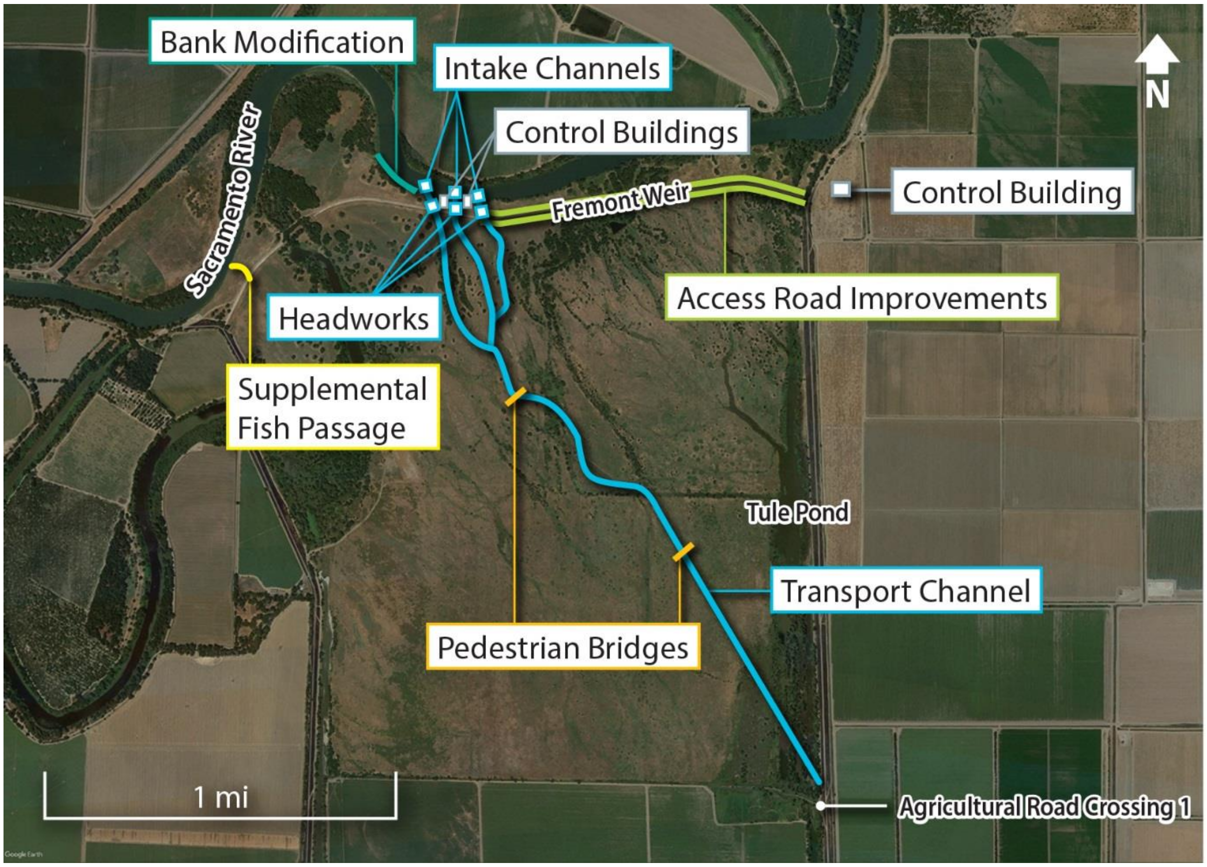


Figure 2-18. Alternative 5 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.8.1 Facilities

2.8.1.1 Intake Channel

Alternative 5 includes four gated headworks (with two sets of gates located in the western structure). Each headworks structure would be connected to the Sacramento River with an intake channel. Also, the Sacramento River bank just upstream and along the intake channel would be modified by removing roughage (existing rock revetment, piles, and large wood) in the wetted channel, resloping the bed and embankment contours, and smoothing channel edges along the intake channel. The channels would be lined with angular rock placed along the bank slopes and rounded rock placed along the channel bottom to avoid scour.

2.8.1.2 Headworks Structure

The approximately 100-foot-long headworks structure would house four bottom-hinge control gates with varying invert elevations, as shown in Figure 2-19 and Figure 2-20. Gates A and B would be located on the west side of the structure (at the central notch location at the existing Fremont Weir), Gate C would be in the middle, and Gate D would be on the eastern side of the structure. The structure would be foundationally supported by multiple 24-inch square piles with the bottom of the pile at elevation of 75 feet below NAVD 88. The gate dimensions are as follows:

- Gate group A includes three culverts with 10-foot-high by 10-foot-wide gates, with an invert set at 14 feet.
- Gate group B includes three culverts with gates that would be the same size as Gate A, with an invert set at 17 feet. These are in the same location as Gate A.
- Gate group C includes 10 box culverts with gates that would be 10 feet high by 10 feet wide, with an invert set at 20 feet.
- Gate group D includes 11 box culverts with gates that would be 10 feet wide by 7 feet high, with an invert set at 23 feet.

All box culverts include downstream bottom-hinged gates.

2.8.1.3 Control Buildings

Due to the maximum distance over which hydraulic lines can function, two types of control buildings are required: a control building on the east levee and two elevated control buildings near the gates. The operating control building on the east levee would be the same as described for Alternative 2.

Alternative 5 would include two additional elevated control buildings to house the hydraulics controls on the river side of the weir near the headworks structures. The buildings would be of similar size and construction as the operating control structure on the east levee but would be raised above the probable maximum flood elevation. The foundation of the raised buildings would consist of H-piles, a reinforced concrete pile cap, and a pair of streamlined reinforced concrete columns on which the building slab would rest.

2.8.1.4 Transport Channel

Alternative 5 includes three meandering transport channels between the intakes and the point where they come together, about 2,000 feet downstream from Fremont Weir. At this point, one channel flows toward to Tule Canal, near Agricultural Road Crossing 1 (see Figure 2-18). A description of the three channels follows:

- Channel AB would connect A and B gate groups to the Tule Canal and would be a rock-lined compound trapezoidal channel 2,250 feet long with a left bench set three feet above the channel bed.
- Channel C would connect the C gate group to the Tule Canal and would be a rock-lined trapezoidal channel 1,930 feet long that connects to Channel AB at its bench.
- Channel D would connect the D gate group to the Tule Canal and would be a rock-lined trapezoidal channel 1,400 feet long that connects to Channel C.

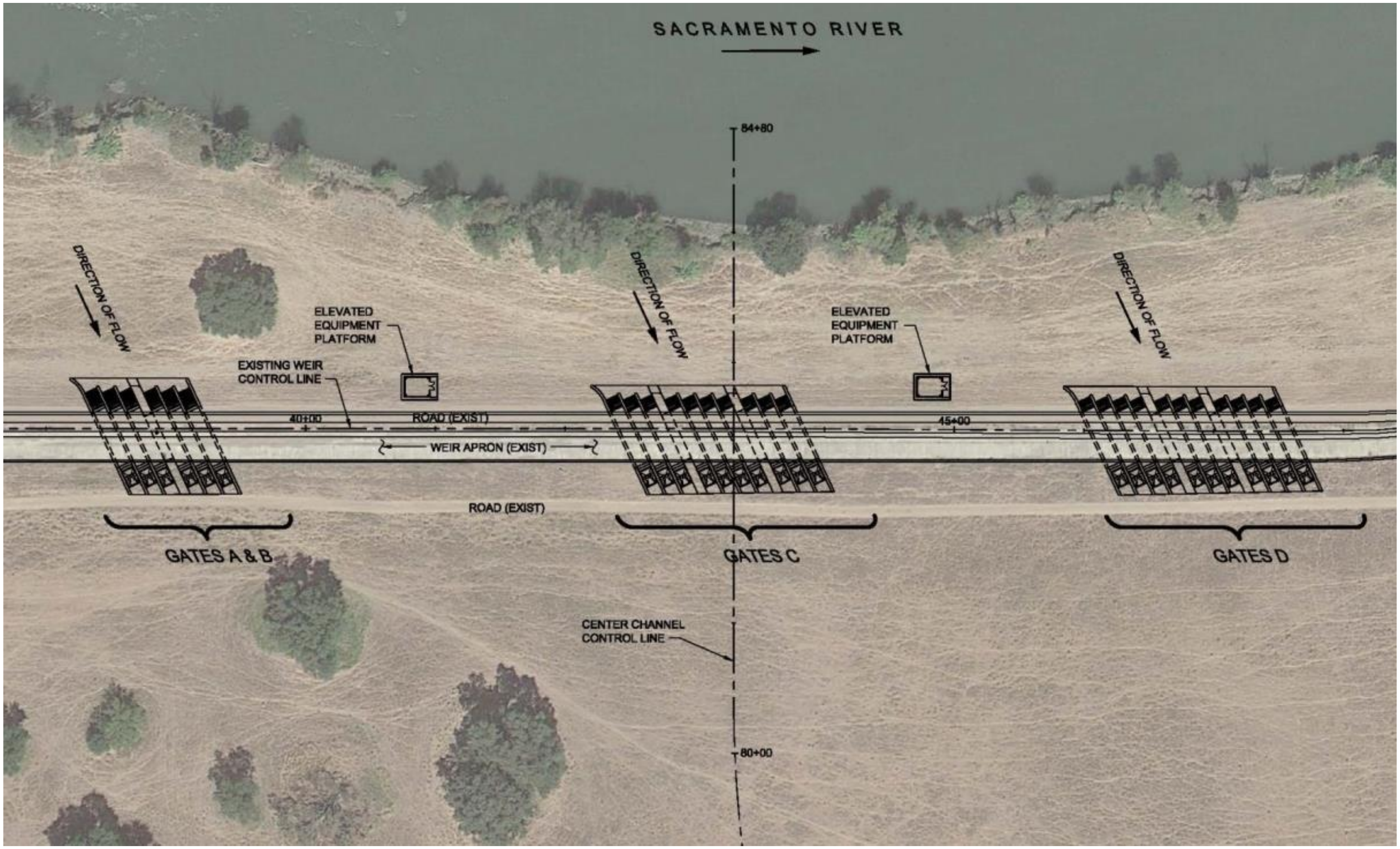


Figure 2-19. Alternative 5 Headworks (view from top looking down)

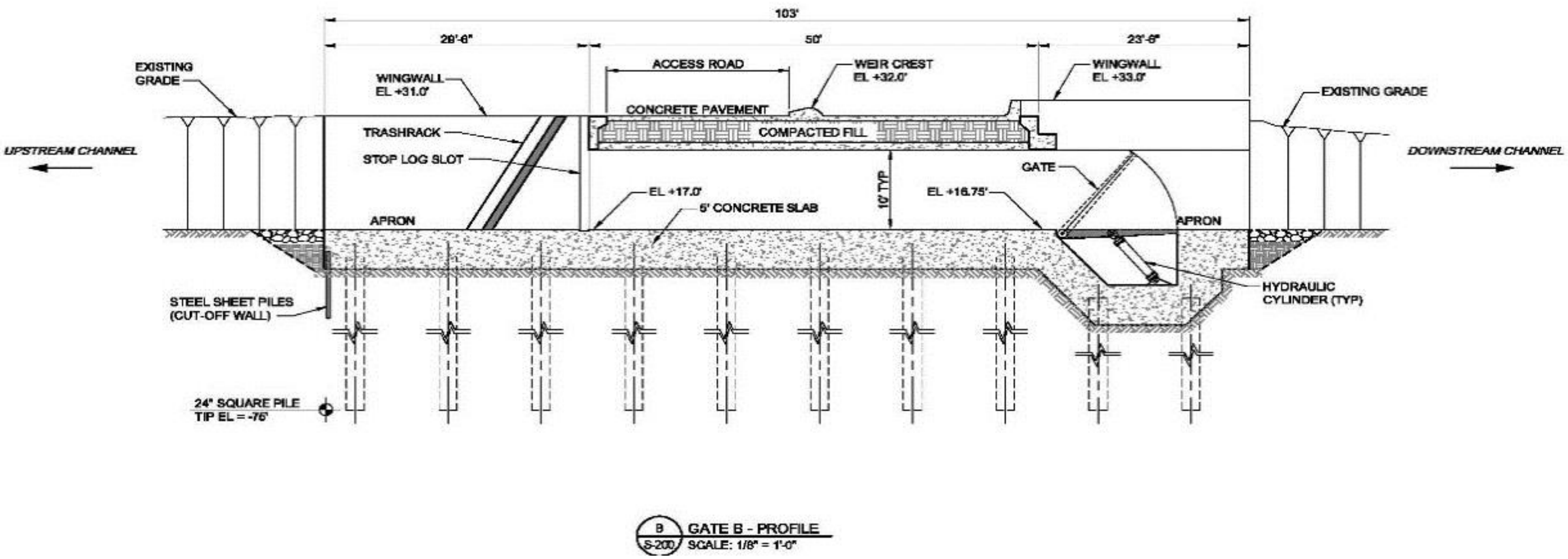


Figure 2-20. Alternative 5 Headworks (view from side of Gate Group B)[5]

[5] Figure shows trash rack on headgates, but this feature has been removed as part of the process to refine alternatives and avoid impacts.

Channel side slopes generally would be 3:1, and a 12-foot-wide maintenance access would be created on either side of each channel. From the point where all three channels are connected, the channel length would be about 8,500 feet to the connection with Tule Canal near Agricultural Road Crossing 1, with a gently downhill slope (a slope of 0.00014).

2.8.1.5 Access Structures

The design of the gates in Alternative 5 includes an area of compacted fill that would allow vehicular passage (see Figure 2-20). Alternative 5 also includes two 200-foot-long, eight-foot-wide steel-trussed pedestrian bridges (see Figure 2-18) to allow recreational users to move through the area when inundation starts, similar to the other alternatives. Similar to Alternative 2, Alternative 5 includes stabilized access roads on the north and south sides of Fremont Weir.

2.8.1.6 Supplemental Fish Passage Facility

An additional fish passage facility would be constructed at a western location along the existing Fremont Weir. This facility would be the same as described for Alternative 1.

2.8.1.7 Tule Canal Floodplain Improvements (Program Level)

Alternative 5 would include floodplain improvements along Tule Canal, just north of I-80. These improvements would not be constructed at the same time as the remaining facilities. They would not be necessary for the project-level components to function but would enhance the performance of the overall alternatives. They are included at a program level of detail to consider all of the potential impacts and benefits of Alternative 5. Subsequent consideration of environmental impacts would be necessary before construction could begin.

The floodplain improvements would develop a series of channels that connect to Tule Canal north of I-80 (see Figure 2-21). These channels would increase inundation and available fish-rearing habitat in the surrounding areas, which are currently managed as wetland habitat for waterfowl. The floodplain improvement channels would have a 30-foot-bottom width with 3:1 side slopes (horizontal to vertical). An operable weir in Tule Canal would help increase the water surface elevation upstream and move water into these channels. These improvements also include a bypass channel around the weir with a 10-foot-bottom width and 3:1 side slopes (horizontal to vertical). The bypass channel would be about 2,100 feet long and convey up to 300 cfs.

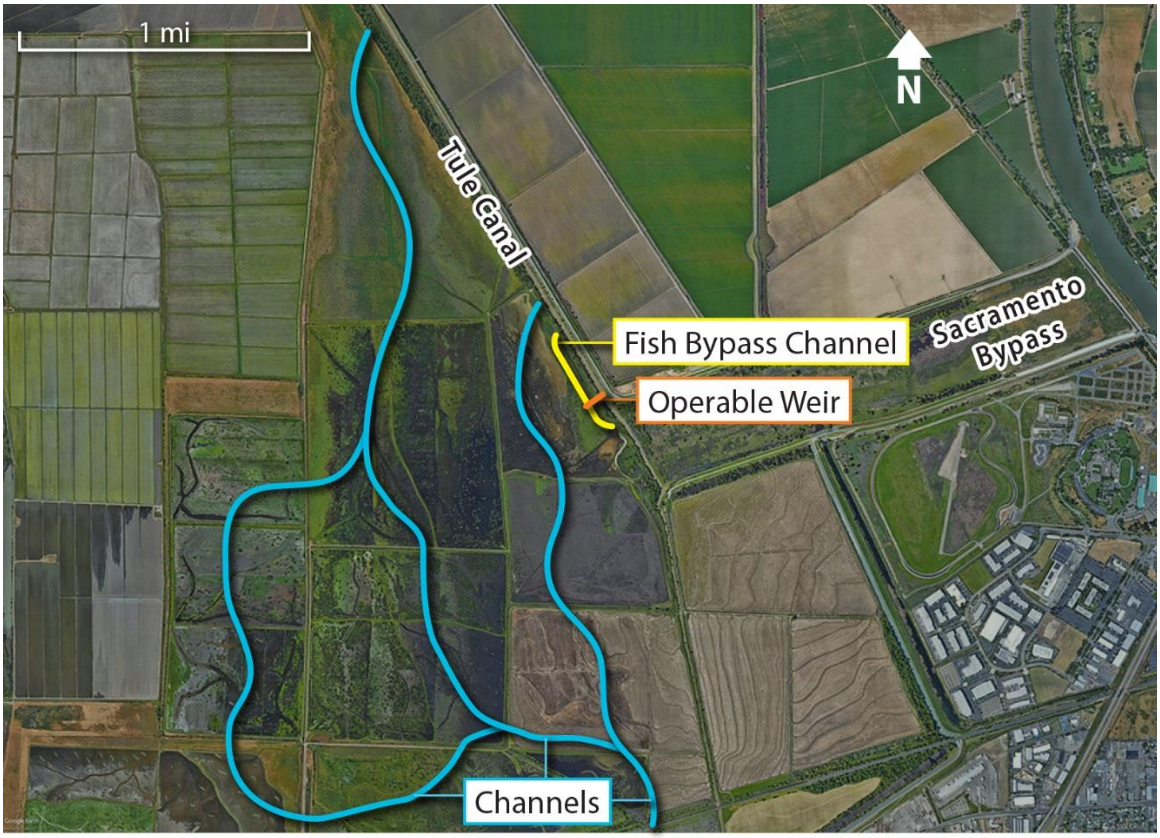


Figure 2-21. Tule Canal Floodplain Improvements (Program Level)

2.8.2 Construction Methods

Construction of the components of Alternative 5 would begin with the demolition of a portion of the existing concrete weir and the clearing and grubbing associated with the channels and canals. These activities are expected to be completed within eight weeks. Groundwater levels are anticipated to be high, especially in the spring months, so dewatering efforts prior to the construction of the floodway control and diversion structures are currently estimated to take three weeks. Additional dewatering would be required for the material removal and regrading at the bank of the Sacramento River near the intake channel.

Channel excavation would begin early in the construction efforts, with an estimated five construction crews working concurrently on the initial excavation. Grading efforts likely would start at the southern portion of the Fremont Weir Wildlife Area because groundwater levels would be deeper in this part of the construction area at the beginning of the construction season. With multiple crews, construction may proceed in multiple locations. The channel excavations would be completed under both dry and wet conditions (approximately 80 percent dry and 20 percent wet) and would not require dewatering efforts. Excavation of the downstream portion of the transport channel (near Agricultural Road Crossing 1) would be performed under wet conditions.

2.8.2.1 Excavated Material

Alternative 5 would require excavation of the intake channels, transport channels, and downstream facilities. Table 2-21 shows the estimated quantities of excess excavated material that would be generated from each facility and would require removal from the construction area.

Table 2-21. Estimated Excess Excavated Material Quantities for Alternative 5

Component	Estimated Excess Excavated Material (cubic yards)
Intake and Transport Channels	956,776
Headworks	28,710
Supplemental Fish Passage (West)	3,230
Agricultural Road Crossing 1	3,170
Sacramento River Bank Modification	44,523
Fremont Weir Access Road Excavation	4,961
TOTAL	*1,041,370*

In addition to the components included in Table 2-21, Alternative 5 could include additional Tule Canal floodplain grading (analyzed at a program level in this EIS/EIR, as described in Section 2.8.1.7). This Tule Canal floodplain grading would generate an estimated 1,053,970 cubic yards of material. If this element were constructed, the total excess materials would be 2,095,340 cubic yards.

Reclamation or DWR would purchase land within two miles of the edge of the Yolo Bypass to receive this excess material. Alternative 5 would require 69 to 79 acres of land to spoil excess construction-related materials.

2.8.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project sties. These sites and the haul routes would be the same as described for Alternative 1.

2.8.2.3 Staging Areas and Access

The construction easements for Alternative 5 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Site access would be on the same roads as described in Alternative 1. If the Tule Canal floodplain improvements are constructed, access would follow the same routes as described for the southern water control structure under Alternative 4.

2.8.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided in Table 2-22. Equipment specifics may vary based on the contractor's capabilities and the availability of equipment.

Table 2-22. List of Major Equipment Needed for Construction of Alternative 5

List of Major Equipment	
• 0.8-CY backhoe loaders	• 4.5-CY hydraulic excavator
• 1.5-CY front end loader crawler	• 40-TN truck-mounted hydraulic crane
• 10-TN smooth roller	• 4,000-gallon water truck
• 100-TN off highway trucks	• 450-HP dozer crawler
• 100-foot auger track-mounted drill rig	• 6-inch diameter pump engine drive
• 12-foot blade grader	• 75-TN crane crawler pile hammer
• 165-HP dozer	• Concrete mixer truck
• 2.5-CY hydraulic excavator	• Concrete pump boom, truck mounted
• 2.5-inch diameter concrete vibrator	• Extended boom pallet loader
• 24-TN truck end dump	• Flatbed truck
• 3.5-CY hydraulic excavator	• Haul truck oversize transport
• 3-axle haul trucks	• Hydroseeding truck
• 30-CY scrapers	• Pickup trucks, conventional
• 300-kW generator	

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.8.2.5 Construction Schedule and Workers

Construction of Alternative 5 likely would begin in 2020 or 2021 and continue for two construction seasons. Construction in the first year is estimated to last 28 weeks and would be conducted during the non-flood season (construction from April 15 through November 1). No construction would occur after November 1, and efforts would continue for 13 weeks during the following year (after April 15).

Alternative 5 includes multiple headworks structures; construction of these structures would have the longest duration and would start at the beginning of the construction period. Construction would begin in the first season, but the final installation of operating gates and associated equipment would occur in the second season. After the first season of construction, the temporary cofferdam installed for dewatering of the headworks structure would remain in place through the flood season.

Construction would occur 6 days per week for 10 hours per day between 7 a.m. and 6 p.m. Construction workers would be divided into multiple crews and would work one shift per day. Maintenance and equipment upkeep crews would work on equipment at night when it is not in use. The peak number of construction workers, which would be needed for one week in July of the first season, is estimated to be 358.

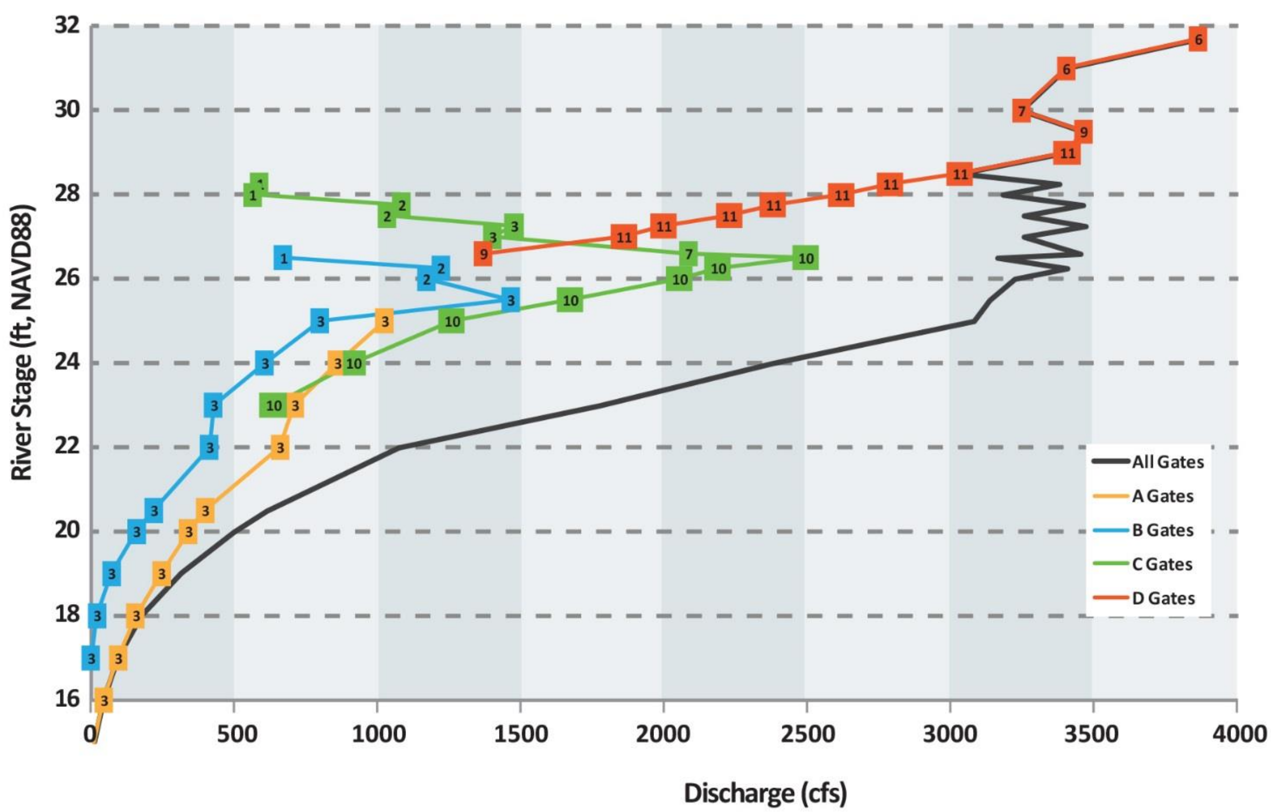
2.8.3 Operations

Operations of the notches would limit flows to about 3,400 cfs. Gate operations could begin each year on November 1 and would first open based on river conditions. The lowest intake (A gates) would operate from a Sacramento River elevation of 15 to 25 feet and would close at higher river elevations. The B gates would operate from 17 feet (i.e., the intake invert elevation) to 26.5 feet. Above 25.5 feet, some B gates would begin to close to reduce flows up to a river elevation of 26.6 feet when the last B gate is fully closed.

The C gates would start to operate as the B gates start to close. The C gates would operate from 23 to 28.25 feet. Above 26.5 feet, some C gates would begin to close to reduce flows through the gates up to a river elevation of 28.5 feet when the last C gate is fully closed.

The D gates would start to operate as the C gates start to close. The D gates would operate from 26.6 to 31.7 feet, which is just below the crest of Fremont Weir. Above 29 feet, the D gates would begin to close to restrict flows through the gates just prior to Fremont Weir overtopping. Because the velocities exceed fish passage criteria above 29 feet as flows approach 3,400 cfs, a minimum of six gates should remain open up to (and during) an overtopping event to prevent supercritical flow (rapid or unstable flow) within the culverts.

Figure 2-22 shows the overlap in the gate operations, with the number in each box showing the number of gates open at each time. The line indicating "all gates" shows the flow added together from all gates operating at the same time. Gate operations to increase inundation could continue through March 15 of each year, based on hydraulic conditions. The gates may remain partially open after March 15 to provide fish passage. However, flows through the gates after March 15 could not exceed 1,000 cfs (the capacity of Tule Canal) so that these flows do not inundate areas outside of the canal.



Note: Numbers show the numbers of gates open at one time

Figure 2-22. Alternative 5 Gate Operations

2.8.4 Inspection and Maintenance

Inspection and maintenance associated with Alternative 5 mainly would include sediment removal and facility inspections. As the river elevation rises, some components would no longer be accessible for maintenance. For river elevations greater than 28 feet, there would be no safe access to the headworks or bridges. Bridge guardrails would be removed before the river elevation reaches 28 feet. The installation of dewatering stoplogs could not be performed under any flow conditions. Table 2-23 provides a list of accessible components at varying river elevations.

Table 2-23. Maintenance Accessibility by River Elevation

River Elevation	Areas Accessible for Maintenance
Below 14 feet	All components of the headworks structures, bridges, gates (upstream and downstream), and operating components. Stoplogs could be installed.
14 to 20 feet (all gates closed)	Gates C and D are accessible; downstream components of Gates A and B, bridges, and operating components. Stoplogs could be installed.
14 to 20 feet (Gates A and B open)	Gates C and D are accessible and upstream bridge deck.
20 to 23 feet (all gates closed)	Gate D is accessible; downstream components of Gates A, B, and C; bridges; and operating components. Stoplogs could be installed.
20 to 23 feet (Gates A, B, and C partially or fully open)	Gate D is accessible and upstream bridge deck.
23 to 28 feet (all gates closed)	Downstream components of gates, bridges, and operating components. Stoplogs could be installed.
23 to 28 feet (gates partially or fully open)	Upstream bridge deck.
Above 28 feet	All components inaccessible.

2.8.4.1 Sediment Deposition

Estimates indicate that approximately 659,000 cubic yards of sediment enter the bypass annually under existing conditions. A portion of this sediment settles in the Yolo Bypass and must be removed through current maintenance efforts. Alternative 5 would increase sediment entering the bypass to around 701,000 cubic yards annually. Most of the additional sediment (about 45 percent) would settle out in Fremont Weir Wildlife Area, about 25 percent would settle downstream of Agricultural Road Crossing 1, and the remaining 30 percent of sediment would remain in suspension and flow out of the bypass. Most of the sediment that settles out would be removed through flood maintenance in the Fremont Weir Wildlife Area, as under existing conditions. Alternative 5 would accumulate an additional 18,900 cubic yards of sediment annually that would be removed every five years.

Reclamation or DWR would purchase land outside the bypass for the sediment removed during maintenance actions. This acquisition would be part of the land acquired for the construction effort, but the acquisition could be phased over time. The maintenance-related sediment removal would require 20 to 23 acres for 50 years of operation.

2.8.4.2 *Vegetation Removal*

Periodic vegetation and debris removal from project channels would be the same as described for Alternative 1.

2.8.5 Monitoring and Adaptive Management

Monitoring activities and the adaptive management framework would be the same as described for Alternative 1.

2.9 Alternative 6: West Side Large Gated Notch

Alternative 6, Large Gated Notch, is a large notch in the western location that would allow flows up to 12,000 cfs to enter the Yolo Bypass. It was designed with the goal of entraining more fish while allowing more flow into the bypass when the Sacramento River is at lower elevations. Typically, winter-run Chinook salmon move downstream during the first high flow event of the season. This flow event is sometimes not high enough to result in what would be considered substantial flows into the bypass under Alternatives 1 through 5. The gated notch could allow more flow to enter during winter-run Chinook salmon out-migration, potentially maximizing fish entrainment. This alternative would include a supplemental fish passage facility on the eastern side of Fremont Weir and improvements to allow fish passage through Agricultural Road Crossing 1 and the channel north of Agricultural Road Crossing 1 (see Section 2.3). The alignment is the same as shown for Alternative 3 in Figure 2-8. Figure 2-23 shows the key components of Alternative 6 and the common elements described in Section 2.3.

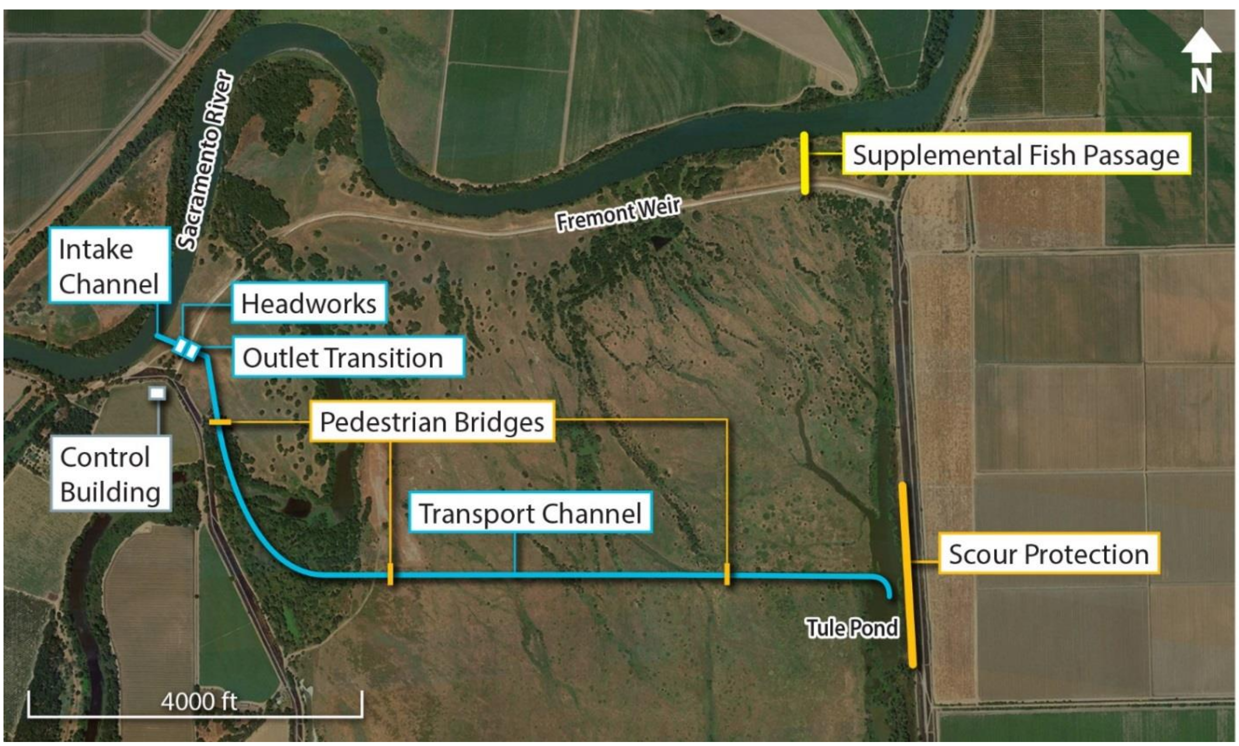


Figure 2-23. Alternative 6 Key Components

The next section includes descriptions of the facilities, construction methods, operations, required maintenance, and environmental commitments associated with this alternative. More detailed construction information is included in Appendix B, *Constructability and Construction Considerations.*

2.9.1 Facilities

2.9.1.1 Intake Channel

The primary purpose of the intake channel is to draw juvenile salmonids and floodplain inundation flows from the Sacramento River to the new headworks structure (described in Section 2.9.1.2) and provide upstream adult fish passage between the headworks structure and the Sacramento River. The intake channel would be constructed with a 230-foot-bottom width. At the downstream end of the intake channel (near the headworks at Fremont Weir), there would be a short transition from the intake channel to the headworks. The intake channel would be rock-lined with rounded rock revetment on the channel bottom and angular rock revetment on the bank slopes to avoid scour. The transition would be constructed with concrete.

2.9.1.2 Headworks Structure

The headworks structure would control the diversion of flow from the Sacramento River to the Yolo Bypass. It would serve as the primary upstream fish passage facility for adult fish and the primary facility for conveying fish-rearing habitat flows and juvenile salmonids onto the Yolo Bypass.

The headworks structure would have five bays that are 40 feet wide and 13.1 feet high. The structure would be a pile-supported, reinforced concrete structure that would bisect the existing Fremont Weir at the western location. The invert elevation would be 16.1 feet. The structure would convey 12,000 cfs at a river elevation of 29.9 feet with all gates lowered (fully open) to meet the applicable requirements for fish passage and flood control. It would house five operating control gates and would include a concrete control structure, an upstream vehicular bridge crossing, and a concrete channel transition that transitions the rectangular sides of the control structure to the side channel slopes of the outlet channel. The overall structure would be 65 feet (upstream to downstream) by 230 feet.

Stoplogs would be provided at each of the five headworks bays upstream of the control structure to dewater the gates for maintenance and as a backup closure for the structure. Six stoplogs are required for each gate. Installation of the stoplogs would require a mobile crane capable of lifting approximately 10,000 pounds. Stoplogs would be stored off site and could only be installed or removed if no flow is moving through the notch or a small amount of flow that would not provide fish passage.

Five hydraulically operated, flush-mounted bottom hinge gates would be used in the headworks structure. These gates would be able to operate under variable river elevations and overtopping events. The top of gate elevation would be flush with the existing Fremont Weir (32 feet). The upstream face of the control gates would be approximately in-line with the upstream face of the existing Fremont Weir. When open, the gates would be flush with the channel invert. The gates would all be the same size, with an invert elevation of 16.1 feet and a size of 40 feet wide by 13.1 feet tall. Debris fins would be installed on the walls between gates to reduce debris accumulation.

The gates would open to allow a maximum flow of 12,000 cfs once the water surface elevation in the river reaches 29.9 feet. Each gate would be capable of independent operation via submersible hydraulic cylinders located beneath the gate. Mechanical and electrical control components for each gate would be housed in a control building outside of the bypass on the eastern levee. Figure 2-24 and Figure 2-25 show the details of the headworks structure.

2.9.1.3 Control Building

The control building would be a single-story concrete masonry unit, measuring 18 feet by 18 feet, located on the western levee. The building would house the same equipment as described for Alternative 1.

2.9.1.4 Access Structures

The headworks bridge would be a reinforced concrete, five-span vehicular bridge on the upstream side of Fremont Weir to connect to the existing access road on the upstream side of Fremont Weir. The bridge would span the channels through the new headworks structure. The bridge would be built at nearly the same alignment and elevation as the existing upstream maintenance road and would allow for continued patrolling and maintenance access along the weir as currently exists. The bridge would have a roadway width of 14 feet and an overall width of 18 feet. The top curb elevation would be equal to the top of weir elevation.

Temporary barrier rails (K rails) would be installed and removed such that no part of the bridge extends above the top of weir during an overtopping event. Each bridge span would be 40 feet long, with an end-to-end length of 230 feet.

The headworks bridge would provide a vehicular and pedestrian crossing on the north side of Fremont Weir. As discussed in Alternative 1, the channels south of Fremont Weir could be a barrier to access for recreational users in the Fremont Weir Wildlife Area. For this purpose, Alternative 6 includes three 310-foot-long, eight-foot-wide steel-trussed pedestrian bridges, as shown in Figure 2-23.

2.9.1.5 Outlet Transition

The outlet transition would be a 100-foot-long reinforced concrete channel that provides a gradual hydraulic transition from the headworks into the graded transport channel. The cross-section of the headworks includes five rectangular gates with an invert of 14 feet. The outlet transition would be a small structure that transitions from the headworks gates to the trapezoidal downstream transport channel. The transition would be accomplished with reinforced retaining walls that flair out from the headworks abutment piers and a reinforced concrete slab-on-grade bottom slab, which gradually transitions into the slopes of the trapezoidal transport channel.

2.9.1.6 Transport Channel

The transport (outlet) channel would be a graded trapezoidal channel with a bottom width of 200 feet and side slopes of 3:1 (horizontal to vertical). The transport channel would serve as the primary facility for upstream adult fish passage between the existing Tule Pond and the headworks structure. It would also serve as the primary channel for conveying juvenile

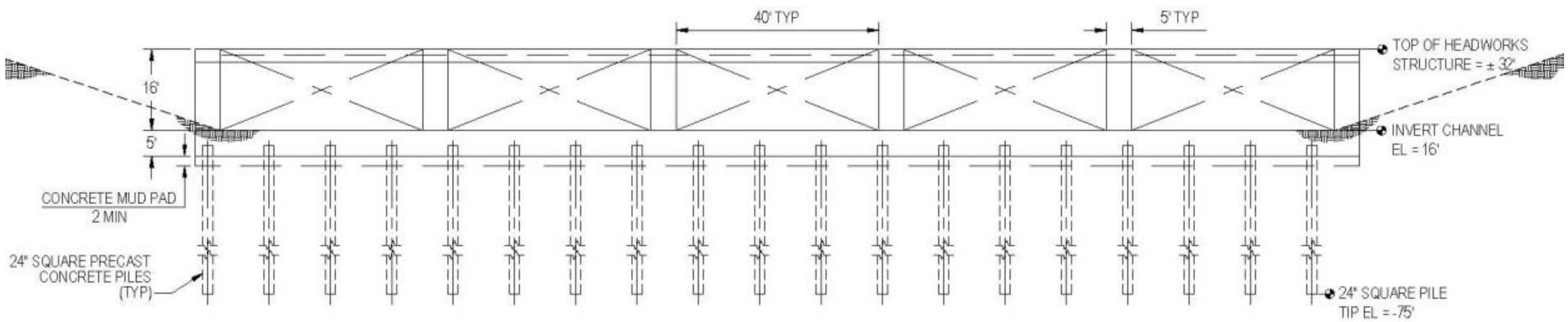


Figure 2-24. Alternative 6 Headworks Cross Section (view from river side)

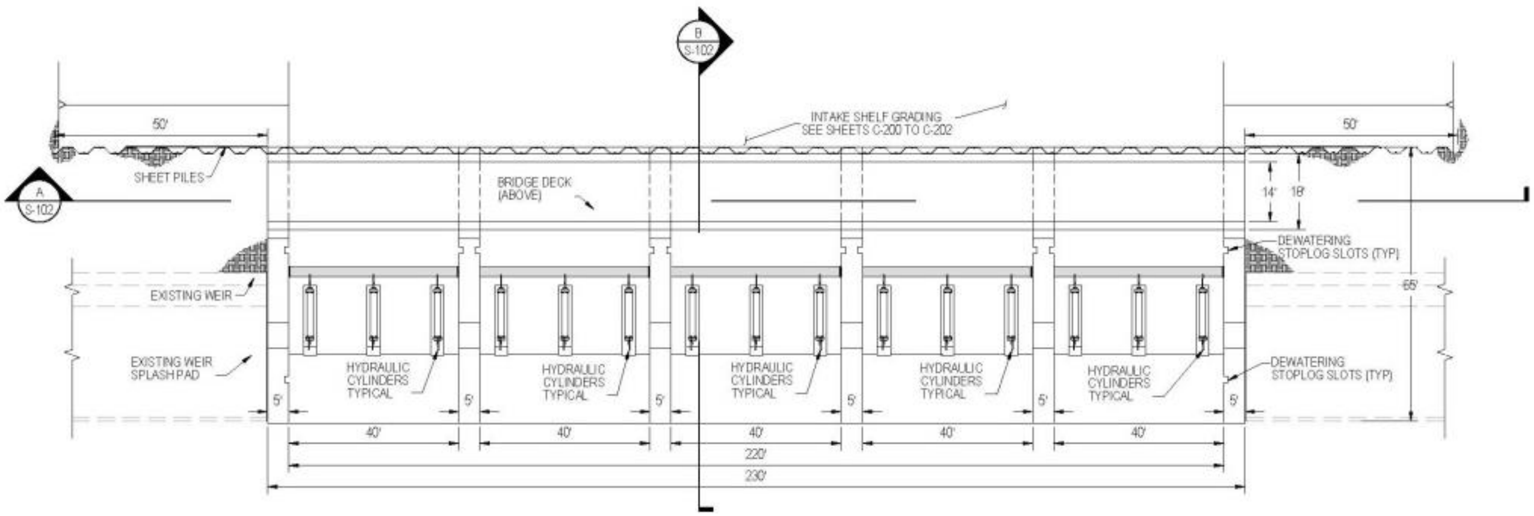


Figure 2-25. Alternative 6 Headworks (view from top of structure)

salmonids and fish-rearing habitat flows from the headworks structure to the existing Tule Pond. Unlike the other transport channels, this channel would convey higher flows and does not need to incorporate benches to help meet velocity criteria. The channel route, length, and slope would be the same as in Alternative 3. The channel would be constructed through the oxbow wetland area in the same was as Alternative 3 so that it is not connected to this wetland area. At the top of each side of the channel, an eight-foot-wide area of rock (a rock key) would be added to reduce the potential for the channel to head cut the channel banks. The facility would also have 12-foot-wide maintenance corridors on each side of the channel.

2.9.1.7 Scour Protection

The transport channel would enter Tule Canal at an angle, which could cause erosion on the eastern Yolo Bypass levee. Rock revetment would be incorporated on the eastern edge of Tule Pond that is 50 feet wide and 2.5 feet thick, with 1.5:1 side slopes (horizontal to vertical). Additionally, there are several locations along the proposed transport channel where the channel could interact with existing scour channels. These areas could experience head cutting as a result of the new facilities. Additional channel revetment would be incorporated at these locations.

2.9.1.8 Supplemental Fish Passage Facility

Alternative 6 would include the same eastern supplemental fish passage facility as described for Alternative 3.

2.9.2 Construction Methods

Construction of the components of Alternative 6 would begin with the demolition of a portion of the existing Fremont Weir and the clearing and grubbing associated with the channels and canals. These activities are expected to be completed within four weeks.

Grading of the transport channel would begin at the downstream outlet at Tule Pond and progress upstream toward the headworks structure, with grading of the intake channel occurring last. This would avoid potential interruptions to the headworks construction and allow construction to occur in the less saturated soil first. Groundwater levels are anticipated to be high, so dewatering efforts prior to the construction of the floodway control and diversion structures are currently estimated to take three weeks. The channel and canal excavations would be completed under both dry and wet conditions and would not require dewatering efforts. Excavation of the downstream reach would be performed under wet conditions. About 60 to 80 percent of the channel excavation could be performed in dry unsaturated soil conditions by scrapers and bulldozers. The remaining 20 to 40 percent would be performed in wet saturated soil conditions by hydraulic excavators and haul trucks.

2.9.2.1 Excavated Material

Alternative 6 would require excavation of the intake channel, transport channel, and downstream facilities. Table 2-24 shows the estimated quantities of excess excavated material that would be generated from each facility and would require removal from the construction area.

Table 2-24. Estimated Excess Excavated Material Quantities for Alternative 6

Component	Estimated Excess Excavated Material (cubic yards)
West Intake Channel	65,710
West Transport Channel	1,552,990
Headworks	12,750
Downstream Channel	72,520
Supplemental Fish Passage (East)	3,540
Agricultural Road Crossing 1	3,170
TOTAL	*1,710,680*

Reclamation or DWR would purchase land within two miles of the edge of the Yolo Bypass to receive this excess material. Alternative 6 would require 35 to 40 acres of land to spoil excess construction-related materials.

2.9.2.2 Construction Materials

Material imported to the project site would be obtained from existing permitted commercial sources located within approximately 65 miles of the project sites. These sites and the haul routes would be the same as described for Alternative 1.

2.9.2.3 Staging Areas and Access

The construction easements for Alternative 6 would encompass staging areas for equipment, mobilization, and spoiling sites. The construction footprints analyzed in this EIS/EIR include space for staging areas. Site access would be on the same roads as described for Alternative 1.

2.9.2.4 Construction Equipment

A list of the major equipment needs for the construction of both the alternative-specific and common downstream channel improvement actions is provided in Table 2-25. Equipment specifics may vary based on the contractor's capabilities and the availability of equipment.

Table 2-25. List of Major Equipment Needed for Construction of Alternative 6

List of Major Equipment	
• 0.8-CY backhoe loaders	• 4.5-CY hydraulic excavator
• 1.5-CY front end loader crawler	• 40-TN truck-mounted hydraulic crane
• 10-TN smooth roller	• 4,000-gallon water truck
• 100-TN off highway trucks	• 450-HP dozer crawler
• 100-foot auger track-mounted drill rig	• 6-inch diameter pump engine drive
• 12-foot blade grader	• 75-TN crane crawler pile hammer
• 165-HP dozer	• Concrete mixer truck
• 2.5-CY hydraulic excavator	• Concrete pump boom, truck mounted
• 2.5-inch diameter concrete vibrator	• Extended boom pallet loader
• 24-TN truck end dump	• Flatbed truck
• 3.5-CY hydraulic excavator	• Haul truck oversize transport
• 3-axle haul trucks	• Hydroseeding truck
• 30-CY scrapers	• Pickup trucks, conventional
• 300-kW generator	

Key: CY = cubic yards; HP = horsepower; kW = kilowatt; TN = ton

2.9.2.5 Construction Schedule and Workers

Construction of Alternative 6 likely would begin in 2020 or 2021 and is estimated to last a total of 28 weeks. Construction is anticipated to be completed in multiple construction seasons (construction from April 15 to November 1). Construction of the headworks structure would have the longest duration and would start at the beginning of the construction period. Construction of channel improvements would commence the same week as the Alternative 6 construction activities.

Construction would occur 6 days per week for 10 hours per day between 7 a.m. and 6 p.m. Construction workers would be divided into multiple crews and would work one shift per day. Maintenance and equipment upkeep crews would work on equipment at night when it is not in use. The peak number of construction workers, which would be needed for one week in the middle of August, is estimated to be 414.

2.9.3 Operations

Alternative 6 would be operated much the same as Alternatives 1 through 3 but would allow flows of up to 12,000 cfs, rather than limiting them to 6,000 cfs. Gate operations could begin each year on November 1 and would first open based on river conditions. All gates would be opened when the river elevation reaches 17.1 feet, which is one foot above the lowest gate invert. If the river continues to rise, the gates would stay open until the flow through the gates reaches 12,000 cfs. The flow through the gates would reach 12,000 cfs when the river elevation is about 29.8 feet; at this point, three of the gates would be programmed to start closing such that 12,000 cfs would not be exceeded. Gate closures would be controlled so that there is not a sudden reduction in flow. Two of the gates would remain fully open throughout operations.

Once Fremont Weir begins to overtop, the three gates being operated would remain in their last position prior to the weir overtopping (generally they would be closed at this point). After the overtopping event is over, the three operating gates would open and close as needed to keep the flow through the gate below, but as close as possible to, 12,000 cfs. All gates would be closed once river elevations fall below 16.1 feet. Gate operations to increase inundation could continue through March 15 of each year, based on hydraulic conditions. The gates may remain partially open after March 15 to provide fish passage. However, flows through the gates after March 15 could not exceed 1,000 cfs (the capacity of Tule Canal) so that these flows do not inundate areas outside of the canal and affect landowners.

2.9.4 Inspection and Maintenance

Inspection and maintenance associated with this alternative would mainly include sediment removal and facility inspections. Inspection and maintenance would be the same as described for Alternative 1.

2.9.4.1 Sediment Deposition

Estimates indicate that approximately 659,000 cubic yards of sediment enters the bypass annually under existing conditions. A portion of this sediment settles in the Yolo Bypass and must be removed through current maintenance efforts. Alternative 6 would increase sediment entering the bypass to an estimated 827,000 cubic yards annually Most of the additional sediment (about 45 percent) would settle out in Fremont Weir Wildlife Area, about 25 percent would settle downstream of Agricultural Road Crossing 1, and the remaining 30 percent of sediment would remain in suspension and flow out of the bypass. Most of the sediment that settles out would be removed through flood maintenance in the Fremont Weir Wildlife Area, as under existing conditions. The additional deposition would be in areas inundated regularly under Alternative 6 (in and around channels), and sediment removal efforts associated with Alternative 6 would focus on the channel system. Alternative 6 would accumulate an additional 75,600 cubic yards of sediment annually that would be removed every five years.

Reclamation or DWR would purchase land outside the bypass for the sediment removed during maintenance actions. This acquisition would be part of the land acquired for the construction effort, but the acquisition could be phased over time. The maintenance-generated sediment removal would require 35 to 40 acres for 50 years of operation.

2.9.5 Monitoring and Adaptive Management

Monitoring activities and the adaptive management framework would be the same as described for Alternative 1.

2.10 Summary Comparison of Alternatives

Based on the above descriptions of the alternatives, Chapters 3 through 22 include detailed impact analyses for the No Action Alternative and six action alternatives. Table 2-26 summarizes the impact analyses for resources that were evaluated under CEQA and NEPA. Table 2-27 summarizes the impact analyses for resources that were evaluated only under NEPA and do not include findings of significance. Table 2-26 uses the following abbreviations:

- B = beneficial
- LTS = less than significant
- MM = mitigation measure
- NI = no impact
- PS = potentially significant
- S = significant
- SU = significant and unavoidable

Table 2-26. Summary of Impacts Analyses and Mitigation Measures for Resources Evaluated under CEQA and NEPA

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Flood Control					
Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass	No Action	S	2 additional occurrences of monthly flows greater than the maximum existing conditions monthly flow, 136,869 cfs.	--	S
	All Action Alternatives	LTS	Differences in month-to-month flow, but no change in number of occurrences of monthly flows greater than 136,869 cfs, compared to existing conditions. There would be no change compared to the No Action Alternative.	--	LTS
Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport	No Action	S	2 additional occurrences of monthly flows greater than the maximum existing conditions monthly flow, 72,231 cfs	--	S
	All Action Alternatives	LTS	Differences in month-to-month flow, but the same number of occurrences of monthly flow greater than 72,231 cfs compared to existing conditions. There would be no change compared to the No Action Alternative.	--	LTS
Impact HYD-3: Change in 100-year Flood Hazard Area	No Action	LTS	No changes would occur to channel geometry and peak flood flows would not be impeded or redirected.	--	LTS
	1, 2, 3	LTS	Increases in peak WSE in the Yolo Bypass of up to 0.01 foot; decreases in peak WSE on the Sacramento River of up to 0.04 feet compared to existing conditions and the No Action Alternative.	--	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	4	LTS	Decreases in peak WSE in the Yolo Bypass and on the Sacramento River of up to 0.15 feet compared to existing conditions and the No Action Alternative.	--	LTS
	5	LTS	Increases in peak WSE in the Yolo Bypass of up to 0.01 feet; decreases in peak WSE on the Sacramento River of up to 0.1 feet compared to existing conditions and the No Action Alternative.	--	LTS
	6	LTS	Increases in peak WSE in the Yolo Bypass of up to 0.02 feet; decreases in peak WSE on the Sacramento River of up to 0.16 feet compared to existing conditions and the No Action Alternative.	--	LTS
Surface Water Supply					
Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta	No Action	LTS	Average water supply changes were less than 5% relative to existing conditions. Dry and critical years would be as high as 6% but annual change would be 2%	---	LTS
	1, 2, 3, 4, 5 (Project), 6	LTS	The change would be less than 1% for all build alternatives	---	LTS
	5 (Program)	NI	----	----	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta	No Action	S	Long term decreases would be on average between 11-18%. In dry and critical years, there would be an average annual reduction of 6% and as much as 20% decrease in January.	---	S
	1, 2, 3, 4, 5 (Project), 6	LTS	The change would be less than 1% for all build alternatives	---	LTS
	5 (Program)	NI	----	----	NI
Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta	No Action	S	During average years, there would be 4% decrease compared to existing conditions and during dry and critical years a decrease by as much as 17% in February.	---	S
	1, 2, 3, 4, 5 (Project), 6	LTS	The change would be less than 1% for all build alternatives	---	LTS
	5 (Program)	NI	----	----	NI
Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta	No Action	S	During average years, there would be an increase compared to existing conditions and during dry and critical years a decrease by as much as 11% in November.	---	S
	1, 2, 3, 4, 5 (Project), 6	LTS	The change would be less than 1% for all build alternatives	---	LTS
	5 (Program)	NI	----	----	NI
Impact WS-5: Increase in Incidents of Term 91 being Triggered	No Action	S	There would be 84 instances when Term 91 would be initiated but not in the existing conditions.	---	S
	All Action Alternatives	NI	---	---	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Water Quality					
Impact WQ-1: Construction-or maintenance related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water	No Action	NI	---	---	NI
	All Action Alternatives	S	Construction activities could increase downstream sedimentation and turbidity and might mobilize sediment-associated contaminants.	MM-HAZ-1 MM-WQ-1-3	LTS
Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	S	Project-related flow through bypass may increase the rate and area of inundation and could increase the amount of sediment and constituents of concern entering the bypass.	MM-WQ-4	SU
	5 (Program)	LTS	The surrounding areas could experience inundation due to operation as managed wetland habitat.	----	LTS
Groundwater					
Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	Temporary dewatering activities would affect groundwater levels.	---	LTS
	5 (Program)	NI	---	---	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	S	On-site spills or waste discharge runoff during construction could impact groundwater quality.	MM-HAZ-1, MM-WQ-1-3	LTS
	5 (Program)	NI	---	---	NI
Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	Recharge to the groundwater aquifer could be slightly impeded.	---	LTS
	5 (Program)	NI	---	---	NI
Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	Increased recharge groundwater could introduce new contaminants of concern.	---	LTS
	5 (Program)	NI	---	---	NI
Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	Reductions in supplies would be short-term and infrequent.	---	LTS
	5 (Program)	NI	---	---	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	The potential increase in groundwater pumping in lieu of surface water deliveries would be short-term, infrequent and of small magnitude.	---	LTS
	5 (Program)	NI	---	---	NI
Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	The potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.	---	LTS
	5 (Program)	NI	---	---	NI
Aquatic Resources					
Impact FISH-1: Potential Disturbance to Fish Species or their Habitat due to Erosion, Sedimentation, and Turbidity	No Action	NI	---	—	NI
	All Action Alternatives	S	A minimal increase in sedimentation and turbidity during construction could temporarily adversely affect fish	MM-WQ-2, 3	LTS
Impact FISH-2: Potential Disturbance to Fish Species or their Habitat due to Hazardous Materials and Chemical Spills	No Action	NI	---	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	All Action Alternatives	S	A minimal increase in the potential to release hazardous materials or chemicals into water bodies could adversely affect fish species of focused evaluation in the immediate vicinity and downstream of the construction area	MM-WQ-1	LTS
Impact FISH-3: Potential Disturbance to Fish Species or their Habitat due to Aquatic Habitat Modification	No Action	NI	---	—	NI
	1	S	28.9 acres (temporary impacts) and 47.1 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS
	2	S	27.4 acres (temporary impacts) and 72.5 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS
	3	S	32.5 acres (temporary impacts) and 80.9 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS
	4	S	168.4 acres (temporary impacts) and 117.4 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS
	5	S	25.6 acres (temporary impacts) and 85.7 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS
	6	S	32.3 acres (temporary impacts) and 107.2 acres (permanent impacts) of vegetated area would have the potential to be disturbed during construction	MM-TERR-7; MM-FISH-1	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact FISH-4: Potential Disturbance to Fish Species or their Habitat due to Hydrostatic Pressure Waves, Noise, and Vibration	No Action	NI	---	—	NI
	All Action Alternatives	S	Impacts would be substantial if impact pile driving was conducted in the Sacramento River; impact would be LTS if a vibratory pile driver can be used for construction of cofferdam	MM-FISH-2	LTS
Impact FISH-5: Potential Disturbance to Fish Species or their Habitat due to Stranding and Entrainment	No Action	NI	---	—	NI
	All Action Alternatives	S	Minimal and temporary increase in the potential for fish species of focused evaluation to be entrained or stranded could occur during construction	MM-FISH-3	LTS
Impact FISH-6: Potential Disturbance to Fish Species or their Habitat due to Predation Risk	No Action	NI	---	—	NI
	All Action Alternatives	S	A minimal and temporary increase in the risk of predation for species of focused evaluation could occur due to potential indirect effects of construction and maintenance activities	MM-WQ-1-3; MM-FISH-2-3	LTS
Impact FISH-7: Potential Disturbance to Fish Species due to changes in Fish Passage Conditions	No Action	NI	---	—	NI
	All Action Alternatives	LTS	Fish species of focused evaluation would either not be present near temporary fish passage blockages, or would not be substantially affected by temporary blockages	---	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact FISH-8: Potential Disturbance to Fish Species or their Habitat due to Direct Harm	No Action	NI	---	—	NI
	All Action Alternatives	S	Minimal and temporary increase in the risk of direct harm for fish species of focused evaluation could occur due to construction and maintenance-related equipment, personnel, or debris	MM-FISH-3-4	LTS
Impact FISH-9: Impacts to Fish Species of Focused Evaluation and Fisheries Habitat Conditions due to changes in Flows in the Sacramento River	No Action	S	Substantial changes in Sacramento River flows could adversely affect fish species of focused evaluation	—	SU
	All Action Alternatives	LTS	Minimal changes in Sacramento River flows would not adversely affect fish species of focused evaluation	—	LTS
Impact FISH-10: Impacts to Fish Species of Focused Evaluation and Fisheries Habitat Conditions due to changes in Water Temperatures in the Sacramento River	No Action	S	Substantially less suitable water temperatures in the Sacramento River could adversely affect fish species of focused evaluation	—	SU
	All Action Alternatives	LTS	Similar Sacramento River water temperatures would not adversely affect fish species of focused evaluation	—	LTS
Impact FISH-11: Impacts to Fish Species of Focused Evaluation and Fisheries Habitat Conditions due to Changes in Delta Hydrologic and Water Quality Conditions	No Action	S	Delta habitat conditions would be substantially more suitable for fish species of focused evaluation during some months, and substantially less suitable during some months	—	SU
	All Action Alternatives	LTS	Similar Delta habitat conditions would not adversely affect fish species of focused evaluation	—	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact FISH-12: Impacts to Fisheries Habitat Conditions due to Changes in Flow-Dependent Habitat Availability in the Study Area (Yolo Bypass/Sutter Bypass)	No Action	B	Expected increases in floodplain inundation in the Yolo and Sutter bypasses may increase hydraulic habitat availability for fish species of focused evaluation	—	B
	All Action Alternatives	B/LTS	Substantial increases in hydraulic habitat availability in the Yolo Bypass would improve conditions for fish species of focused evaluation; minimal reductions in hydraulic habitat availability in the Sutter Bypass would not adversely affect fish species of focused evaluation	—	B/LTS
Impact FISH-13: Impacts to Fisheries Habitat Conditions due to Changes in Water Quality in the Study Area	No Action	LTS	Minor potential for increased concentrations of contaminants in the Yolo Bypass and Delta would not be expected to adversely affect fish species of focused evaluation	—	LTS
	All Action Alternatives	LTS	Minor potential for increased concentrations of contaminants in the Yolo Bypass and Delta would not be expected to adversely affect fish species of focused evaluation	—	LTS
Impact FISH-14: Impacts to Aquatic Primary and Secondary Production in the Study Area	No Action	B	Expected increases in primary and secondary production in the Yolo and Sutter bypasses and the Delta would improve conditions for fish species of focused evaluation	—	B
	All Action Alternatives	LTS	Expected increases in primary and secondary production in the Yolo Bypass and Delta would improve conditions for fish species of focused evaluation; minor reductions in primary and secondary production in the Sutter Bypass are not expected to adversely affect fish species of focused evaluation	—	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact FISH-15: Impacts to Fish Species of Focused Evaluation due to changes in Adult Fish Passage Conditions through the Yolo Bypass	No Action	B	Increased flows entering the Yolo Bypass would be expected to improve adult fish passage conditions through the Yolo Bypass, benefiting fish species of focused evaluation	—	B
	1, 2, 3, 5	B	Adult fish passage through the Yolo Bypass would occur more often, benefiting fish species of focused evaluation	—	B
	4	S	Adult fish passage through the Yolo Bypass would occur less frequently, adversely affecting fish species of focused evaluation	MM-FISH-5	LTS
	6	S	Adult fish passage through the Yolo Bypass could occur less frequently, potentially adversely affecting fish species of focused evaluation	—	SU
Impact FISH-16: Impacts to Fish Species due to changes in Potential for Stranding and Entrainment	No Action	LTS	No facilities would be constructed that would increase the potential for stranding and entrainment of fish species of focused evaluation; therefore, there would be no change from existing conditions	—	LTS
	1, 2, 3, 5, 6	LTS	Minor increased potential for fish stranding in the Yolo Bypass would not be expected to adversely affect fish species of focused evaluation	—	LTS
	4	S	The presence of substantially different hydraulic conditions in the Yolo Bypass could increase the potential for stranding, potentially adversely affecting fish species of focused evaluation	—	SU

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact FISH-17: Impacts to Fish Species due to changes in Potential for Predation	No Action	LTS	—	—	LTS
	1, 2, 3, 5, 6	LTS	Minor increased potential for predation of fish species would not be expected to adversely affect fish species of focused evaluation	—	LTS
	4	S	The presence of the water control structures and bypass channels could adversely affect fish species of focused evaluation due to increased potential for predation	—	SU
Impact FISH-18: Impacts to Chinook Salmon Species/Runs due to Changes in Viable Salmonid Population Parameters	No Action	LTS	—	—	LTS
	All Action Alternatives	LTS	Viable Salmonid Population parameters would be similar or improved for all Chinook salmon runs	—	LTS
Impact FISH-19: Impacts to Fish Species of Focused Evaluation and Fisheries Habitat Conditions due to Changes in Hydrologic Conditions in the SWP/CVP System	No Action	S	Substantial reductions in reservoir storages could adversely affect fish species of focused evaluation	—	SU
	All Action Alternatives	LTS	Generally insubstantial changes in reservoir storages and instream flows would not be expected to adversely affect fish species of focused evaluation	—	LTS
Impact FISH-20: Conflict with Adopted Habitat Conservation Plan, Natural Community Conservation Plan, or Other Approved Local, Regional, or State Habitat Conservation Plan	No Action	LTS	—	—	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	All Action Alternatives	LTS	No conflicts with habitat conservation plans would be expected	—	LTS
Impact FISH-21: Impacts to Fish Species of Focused Evaluation and Fisheries Habitat Conditions due to Tule Canal Floodplain Improvements (Program Level)	No Action	NI	—	—	NI
	5 (Program)	S	Could result in construction-related impacts to habitat in the Yolo Bypass, and operations of the water control structure and bypass channel could adversely affect fish species of focused evaluation	MM-WQ-1-3; MM-TERR-7; MM-FISH-1-5	SU
Vegetation, Wetlands, and Wildlife Resources					
Impact TERR-1: Potential Mortality or Loss of Habitat for Special-Status Plant Species	No Action	NI	---	—	NI
	1	S (C, M), LTS (O)	Lowest construction-related impacts to suitable and occupied habitat; approximately 29 acres of temporary habitat and 48 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction.	MM-TERR-1	LTS
	2	S (C, M), LTS (O)	Approximately 31 acres of temporary habitat and 85 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction; potential for impacts to other special-status plant species if found during pre-construction surveys.	MM-TERR-1, 19	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	3	S (C, M), LTS (O)	Approximately 33 acres of temporary habitat and 82 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction; potential for impacts to other special-status plant species if found during pre-construction surveys	MM-TERR-1, 19	LTS
	4	S (C, M), LTS (O)	Highest construction-related impacts to suitable and occupied habitat; approximately 139 acres of temporary habitat and 146 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction; potential for impacts to other special-status plant species if found during pre-construction surveys.	MM-TERR-1, 19	LTS
	5	S (C, M), LTS (O)	Approximately 28 acres of temporary habitat and 96 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction; potential for impacts to other special-status plant species if found during pre-construction surveys.	MM-TERR-1, 19	LTS
	6	S (C, M), LTS (O)	Approximately 34 acres of temporary habitat and 109 acres of permanent habitat losses; 1 woolly rose-mallow plant would be directly affected during construction; potential for impacts to other special-status plant species if found during pre-construction surveys.	MM-TERR-1, 19	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact TERR-2: Potential Disturbance or Mortality of Valley Elderberry Longhorn Beetle and Loss of Its Habitat (Elderberry Shrubs)	No Action	NI	—	—	NI
	1, 2, 5	S (C, M), LTS (O)	No elderberry shrubs identified in the APE; potential for disturbance if elderberry shrubs colonize the area before construction or during maintenance activities	MM-TERR-2–11	LTS
	3, 4	S (C, M), LTS (O)	Approximately 1.3 acre of temporary habitat and 1.8 acres of permanent habitat losses; potential for disturbance if elderberry shrubs colonize the area before construction or during maintenance activities	MM-TERR-2–11	LTS
	6	S (C, O, M)	Approximately 1.2 acre of temporary habitat and 2.7 acres of permanent habitat losses; potential for disturbance if elderberry shrubs colonize the area before construction or during maintenance activities; additional adverse effects on elderberry shrubs could occur in areas with more flooding during operations than elderberry can tolerate.	MM-TERR-2–11	LTS
Impact TERR-3: Potential Disturbance or Mortality of, and Loss of Suitable Habitat for, Giant Garter Snake	No Action	NI	—	—	NI
	1	S (C, M), LTS (O)	Approximately 24 acres of temporary habitat and 33 acres of permanent habitat losses; permanent loss of the 20-acre Tule Pond, flooding of occupied burrows, and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	2	S (C, M), LTS (O)	Approximately 15 acres of temporary habitat and 25 acres of permanent habitat losses; permanent loss of the 20-acre Tule Pond, flooding of occupied burrows, and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS
	3	S (C, M), LTS (O)	Approximately 19 acres of temporary habitat and 30 acres of permanent habitat losses; permanent loss of the 20-acre Tule Pond, flooding of occupied burrows, and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS
	4	S (C, M), LTS (O)	Approximately 117 acres of temporary habitat and 91 acres of permanent habitat losses; permanent loss of the 20-acre Tule Pond, flooding of occupied burrows, and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS
	5	S (C, M), LTS (O)	Less than 2 acres of temporary habitat and 16 acres of permanent habitat losses; flooding of occupied burrows and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS
	6	S (C, M), LTS (O)	Approximately 20 acres of temporary habitat and 29 acres of permanent habitat losses; permanent loss of the 20-acre Tule Pond, flooding of occupied burrows, and long-term maintenance activities.	MM-TERR-2–6, 11–14; WQ-1, 2	LTS
Impact TERR-5: Potential Disturbance or Mortality of Nesting Bird Species and Removal of Suitable Nesting and Foraging Habitat	No Action	NI	—	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	1	S (C, M), LTS (O)	Approximately 29 acres of temporary habitat and 48 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	2	S (C, M), LTS (O)	Approximately 31 acres of temporary habitat and 85 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season	MM-TERR-2–6, 11, 16	LTS
	3	S (C, M), LTS (O)	Approximately 33 acres of temporary habitat and 82 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	4	S (C, M), LTS (O)	Approximately 139 acres of temporary habitat and 146 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season	MM-TERR-2–6, 11, 16	LTS
	5	S (C, M), LTS (O)	Approximately 28 acres of temporary habitat and 96 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	6	S (C, M), LTS (O)	Approximately 34 acres of temporary habitat and 109 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
Impact TERR-5: Potential Disturbance or Mortality of Nesting Bird Species and Removal of Suitable Nesting and Foraging Habitat	No Action	NI	—	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	1	S (C, M), LTS (O)	Approximately 29 acres of temporary habitat and 48 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	2	S (C, M), LTS (O)	Approximately 31 acres of temporary habitat and 85 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season	MM-TERR-2–6, 11, 16	LTS
	3	S (C, M), LTS (O)	Approximately 33 acres of temporary habitat and 82 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	4	S (C, M), LTS (O)	Approximately 139 acres of temporary habitat and 146 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season	MM-TERR-2–6, 11, 16	LTS
	5	S (C, M), LTS (O)	Approximately 28 acres of temporary habitat and 96 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
	6	S (C, M), LTS (O)	Approximately 34 acres of temporary habitat and 109 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the nesting season.	MM-TERR-2–6, 11, 16	LTS
Impact TERR-6: Potential Disturbance, Injury, or Mortality of Special-Status Tree-Roosting Bats and Removal of Roosting Habitat	No Action	NI	—	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	1	S (C, M), NI (O)	Approximately 25 acres of temporary habitat and 36 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
	2	S (C, M), NI (O)	Approximately 28 acres of temporary habitat and 72 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
	3	S (C, M), NI (O)	Approximately 29 acres of temporary habitat and 64 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
	4	S (C, M), NI (O)	Approximately 93 acres of temporary habitat and 93 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
	5	S (C, M), NI (O)	Approximately 27 acres of temporary habitat and 89 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
	6	S (C, M), NI (O)	Approximately 30 acres of temporary habitat and 88 acres of permanent habitat losses; adverse effects from long-term maintenance activities if conducted during the maternity season.	MM-TERR-2–6, 11, 17	LTS
Impact TERR-7: Potential Disturbance or Mortality of American Badger and Loss of Its Habitat	No Action	NI	—	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	1	S (C), NI (O, M)	Approximately 18 acres of temporary habitat and 19 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
	2	S (C), NI (O, M)	Approximately 21 acres of temporary habitat and 49 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
	3	S (C), NI (O, M)	Approximately 20 acres of temporary habitat and 43 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
	4	S (C), NI (O, M)	Approximately 64 acres of temporary habitat and 66 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
	5	S (C), NI (O, M)	Approximately 20 acres of temporary habitat and 72 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
	6	S (C), NI (O, M)	Approximately 21 acres of temporary habitat and 60 acres of permanent habitat losses.	MM-TERR-2–6, 18	LTS
Impact TERR-8: Potential Loss of Sensitive Natural Communities	No Action	NI	—	—	NI
	1	S (C), NI (O, M)	Approximately 10 acres of temporary habitat and 25 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS
	2	S (C), NI (O, M)	Approximately 8 acres of temporary habitat and 26 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS
	3	S (C), NI (O, M)	Approximately 10 acres of temporary habitat and 29 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS
	4	S (C), NI (O, M)	Approximately 22 acres of temporary habitat and 34 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	5	S (C), NI (O, M)	Approximately 8 acres of temporary habitat and 17 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS
	6	S (C), NI (O, M)	Approximately 10 acres of temporary habitat and 36 acres of permanent habitat losses.	MM-TERR-2, 3, 5, 6, 11; WQ-1, 2	LTS
Impact TERR-9: Potential Effects on USACE, CDFW, and RWQCB Jurisdictional Areas	No Action	NI	—	—	NI
	1, 5	S (C), NI (O, M)	Alternatives 1 and 5 have a similar range of effects; Alternative 5 has the lowest construction effects on jurisdictional areas.	MM-TERR-2, 3, 5, 6, 11; MM-WQ-1, 2	LTS
	2, 3, 6	S (C), NI (O, M)	Alternatives 2, 3, and 6 have a similar range of effects.	MM-TERR-2, 3, 5, 6, 11; MM-WQ-1, 2	LTS
	4	S (C), NI (O, M)	Alternative 4 has the greatest construction effects on jurisdictional areas.	MM-TERR-2, 3, 5, 6, 11; MM-WQ-1, 2	LTS
Impact TERR-10: Potential Interference with Movement of Native Resident or Migratory Wildlife Species	No Action	NI	—	—	NI
	All Action Alternatives	LTS (C), NI (O, M)	During construction minimal effect would occur to migratory wildlife. No effect would occur over existing conditions for operations or maintenance.	—	LTS
Impact TERR-11: Conflict with Provisions of an Adopted HCP/NCCP or Other Approved Local, Regional, or State Habitat Conservation Plan	No Action	NI	—	—	NI
	All Action Alternatives	NI	No effect on an adopted HCP/NCCP or other conservation plans.	—	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact TERR-12: Potential Effects of Tule Canal Floodplain Improvements (Program Level)	No Action	NI	--	—	NI
	1, 2, 3, 4, 5 (Project), 6	NA	--	—	NI
	5 (Program)	S (C, O, M)	Permanent loss of approximately 324.9 acres of freshwater emergent wetland and 59 acres of other types of habitat.	MM-TERR-2–19; WQ-1, 2	LTS
Cultural Resources					
Impact CULT-1: Impacts on Identified Archaeological Sites and Historic-Era Built Resources Resulting from Construction	No Action	NI	---	—	NI
	All Action Alternatives	S	Potential for permanent adverse effects for cultural resources	MM-CULT-1	LTS
Impact CULT-2: Impacts on Archaeological Sites and Historic-Era Built Resources to Be Identified Through Future Inventory Efforts	No Action	NI	---	—	NI
	All Action Alternatives	S	Potential for permanent adverse effects for cultural resources	MM-CULT-2	LTS
Impact CULT-3: Impacts on Archaeological Sites that May Not Be Identified through Inventory Efforts	No Action	NI	---	—	NI
	All Action Alternatives	S	Potential for permanent adverse effects for cultural resources	MM-CULT-3, 4	SU
Impact CULT-4: Damage to Buried Human Remains	No Action	NI	---	—	NI
	1, 2, 3, 4, 5 (Project), 6	S	Potential for permanent adverse effects for cultural resources	MM-CULT-5	LTS
	5 (Program)	S	Potential for permanent adverse effects for cultural resources	MM-CULT-5	SU

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact CULT-5: Impacts on Paleontological Resources Resulting from Construction	No Action	NI	---	—	NI
	All Action Alternatives	LTS	Limited potential for adverse effects on paleontological resources	—	LTS
Land Use and Agricultural Resources					
Impact AGR-1: Physically divide a community or conflict with a relevant land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect.	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Actions associated with the Project would be consistent with relevant existing land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environment effect and would not occur near a community.	---	LTS
Impact AGR-2: Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance, which may also be protected under the Williamson Act or other conservation programs, to nonagricultural or incompatible uses	No Action	NI	---	---	NI
	1, 2, 3, 5 (Project), 5 (Program), 6	LTS	Impacts to agricultural land would occur, but Prime Farmland, Unique Farmland, or Farmland of Statewide Importance lands would not be converted to nonagricultural uses by construction or increased periods of inundation	---	LTS
	4	S	Impacts to agricultural land would occur and there would be a change to Prime Farmland and Unique Farmland.	MM-AGR-1	SU

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Geology and Soils					
Impact GEO-1: Substantial increase in sediment deposition in the Yolo Bypass	No Action	NI	---	---	NI
	All Action Alternatives	LTS	The increased amount of sediment deposited in the Yolo Bypass would be removed during maintenance activities	---	LTS
Impact GEO-2: Induce levee instability at the Yolo Bypass east levee	No Action	NI	---	---	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	Construction would take place outside of the waterside toe of the existing levee and could impact levee stability.	---	LTS
	5 (Program)	NI	---	---	NI
Impact GEO-3: Substantially increase soil erosion at the Yolo Bypass east levee	No Action	NI	---	---	NI
	1, 5	NI	---	---	NI
	2, 3, 4, 6	LTS	Soil erosion could increase, but the design incorporates erosion control measures at the Yolo Bypass east levee.	---	LTS
Recreation					
Impact REC-1: Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated	No Action	NI	---	—	NI
	All Action Alternatives	LTS	Construction effects would limit recreational uses (including hunting) in established wildlife areas for one construction period. Long term inundation effects for access for educational and other recreational activities would be reduced due to areas not being accessible due to water levels.	MM-REC-1	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Visual Resources					
Impact VIS-1: Short-Term Construction-Related Changes in Scenic Vistas, Scenic Resources, and Existing Visual Character	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Short-term construction activities would include the presence of heavy construction equipment.	---	LTS
Impact VIS-2: Long–Term Changes in Scenic Vistas, Scenic Resources, and Existing Visual Character	No Action	NI	---	---	NI
	All Action Alternatives	S	Changes to the physical environment would impact the visual composition, including vegetation removal and the addition of permanent structures.	MM-VIS-1	LTS
Impact VIS-3: Substantial Changes in Light or Glare	No Action	NI	---	---	NI
	All Action Alternatives	LTS	A new source of light or glare would not be created that would affect residents or visitors.	---	LTS
Public Services, Utilities, and Power					
Impact UTIL-1: Affect the provision of governmental services or facilities, including fire and police protection, parks, and schools	No Action	NI	---	---	NI
	All Action Alternatives	LTS	The use of the local workforce and construction controls for hazardous conditions would have limited effects.	---	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact UTIL-2: Create the need for new stormwater facilities	No Action	NI	---	---	NI
	All Action Alternatives	S	The implementation of BMPs would control stormwater runoff and associated soil erosion and adequately treat anticipated stormwater runoff generated during construction and maintenance.	MM-WQ-3	LTS
Impact UTIL-3: Generate solid waste in need of disposal, which could exceed the capacity of landfills	No Action	NI	---	---	NI
	All Action Alternatives	LTS	There is adequate capacity at the landfill to accommodate disposal needs and excavated soil would not be disposed of at a public landfill.	---	LTS
Impact UTIL-4: Use and/or depletion of local or regional energy supplies	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Electricity used would be provided to the site by temporary generators during construction and maintenance. Operation of the headworks structure would have low power requirements. Construction would require the transport of material to be hauled to and from the sites.	---	LTS
Transportation					
Impact TRAN-1: Construction Personnel Traffic	No Action	NI	----	----	NI
	All Action Alternatives	LTS	Construction personnel would not be expected to substantially encroach upon the peak travel periods in the region.	----	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact TRAN-2: Construction Events and Vehicle Traffic	No Action	NI	----	----	NI
	1	LTS	Traffic associated with construction would not substantially alter traffic and transportation conditions in the area.	----	LTS
	2 - 6	S	Traffic associated with construction would potentially introduce congestion to nearby highway facilities due to the amount of expected hourly truck trips as a result of riprap and RSP hauling	MM-TRAN-3	LTS
Impact TRAN-3: Construction Roadway Conditions	No Action	NI	----	----	NI
	All Action Alternatives	S	Roadways would substantially degrade in quality due to vehicle weight and volume during material hauls and vehicle maneuvers.	MM-TRAN-1, 2	LTS
Impact TRAN-4: Maintenance related traffic	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Traffic associated with maintenance would not substantially alter traffic and transportation conditions in the area.	---	LTS
Air Quality and Greenhouse Gases					
Impact AQ-1: Violate air quality standards or contribute substantially to an existing or projected air quality violation	No Action	NI	---	---	NI
	1, 2, 5	S	PM_{10} and NO_x construction emissions would exceed the significance thresholds established by the air districts, and NO_x operational emissions would exceed Yolo-Solano AQMD's significance threshold.	MM-AQ-1-4	SU

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	3, 4	S	PM_{10} and NO_x construction emissions would exceed the significance thresholds for the air districts.	MM-AQ-1-5	SU
	6	S	PM_{10}, ROG, and NO_x construction emissions would exceed the significance thresholds for the air districts.	MM-AQ-1-5	SU
Impact AQ-2: Conflict with or obstruct implementation of the applicable air quality plan	No Action	NI	---	---	NI
	1, 2, 5	S	PM_{10} and NO_x construction emissions would exceed the significance thresholds for the air districts, and NO_x operational emissions would exceed Yolo-Solano AQMD's significance threshold.	MM-AQ-1-4	SU
	3, 4	S	PM_{10} and NO_x construction emissions would exceed the significance thresholds for the air districts.	MM-AQ-1-5	SU
	6	S	PM_{10}, ROG, and NO_x construction emissions would exceed the significance thresholds for the air districts.	MM-AQ-1-5	SU
Impact AQ-3: Expose sensitive receptors to substantial pollutant concentrations	No Action	NI	---	---	NI
	All Action Alternatives	LTS	TAC emissions would be temporary and no sensitive receptors are in the immediate vicinity of the construction footprint.	---	LTS
Impact AQ-4: Create objectionable odors affecting a substantial number of people	No Action	NI	---	---	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	All Action Alternatives	LTS	Construction would be temporary and no receptors are in the immediate vicinity.	---	LTS
Impact AQ-5: Generate criteria pollutants greater than general conformity *de minimis* thresholds	No Action	NI	---	---	NI
	1, 2, 3	LTS	Emissions would be less than the general conformity *de minimis* thresholds.	---	LTS
	4, 5, 6	S	NOx emissions would be greater than the general conformity *de minimis* thresholds.	MM-AQ-1-4	SU
Impact AQ-6: Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment	No Action	NI	---	---	NI
	1, 2, 3	LTS	GHG emissions would not exceed the significance threshold.	---	LTS
	4, 5, 6	S	GHG emissions would exceed the significance threshold.	MM-AQ-6	LTS
Impact AQ-7: Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs	No Action	NI	---	---	NI
	1, 2, 3	LTS	GHG emissions would not exceed the significance threshold.	---	LTS
	4, 5, 6	S	GHG emissions would exceed the significance threshold.	MM-AQ-6	LTS
Hazardous Materials and Health and Safety					
Impact HAZ-1: Increase risk of exposure from hazardous materials to the public and construction workers	No Action	NI	---	---	NI

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	All Action Alternatives	S	The risk of exposure to the public and construction workers from hazardous materials associated with construction projects would increase.	MM-WQ-2	LTS
Impact HAZ-2: Accidental release of hazardous materials	No Action	NI	---	---	NI
	All Action Alternatives	S	The risk of accidental release of hazardous materials would increase during construction, operation, and maintenance activities.	MM-WQ-1	LTS
Impact HAZ-3: Accidental release of hazardous materials from contaminated soil and/or groundwater	No Action	NI	---	---	NI
	1, 2, 3, 5 (Project), 6	S	The risk of accidental release of hazardous materials from contaminated soil and/or groundwater would increase during construction activities due to proximity of well sites and unknown soil contamination.	MM-HAZ-1	LTS
	4, 5 (Program)	S	The risk of accidental release of hazardous materials from contaminated soil and/or groundwater would increase during construction activities due to proximity of well sites and natural gas pipelines and unknown soil contamination.	MM-HAZ-1, 3	LTS
Impact HAZ-4: Increase the risk of wildfire within the vicinity of the Project area	No Action	NI	---	---	NI
	1, 2, 3, 5, 6	S	The risk of accidental release of wildfire within the vicinity of the project area would increase during construction activities due to sparks or contact between power lines and construction equipment.	MM-HAZ-2	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
	4	S	The risk of accidental release of wildfire within the vicinity of the project area would increase during construction activities due to sparks or contact between power lines and construction equipment.	MM-HAZ-2, 3	LTS
Impact HAZ-5: Expose workers to hazardous materials and other safety risks associated with low flying aircraft	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Construction workers could be exposed to pesticides and herbicides.	---	LTS
Impact HAZ-6: Temporarily interfere with emergency response and evacuation plan for the area	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Conflicts with emergency vehicles or evacuation efforts would have a low potential of occurring.	---	LTS
Impact HAZ-7: Public use of Fremont Weir Wildlife Area for hunting or other uses could cause unsafe situations for the public and/or construction workers	No Action	NI	---	---	NI
	All Action Alternatives	S	Construction workers could be exposed unsafe conditions due to hunting or other recreation activities at the FWWA.	MM-REC-1	LTS
Impact HAZ-8: Risk of exposure to mosquito-borne viruses could increase as a result of inundation period expansion in the Yolo Bypass for fish passage and rearing	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Increased inundation periods of the Yolo Bypass would increase the risk of exposure to mosquito-borne viruses.	---	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Noise					
Impact NOI-1: Exposure of persons to or generation of noise and vibration levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies	No Action	NI	---	---	NI
	1, 2, 5	LTS	Noise and vibrations from construction, operation, and maintenance noise could occur, but levels would be consistent with the general plans of Yolo and Sutter counties.	---	LTS
	3, 4, 6	S	Construction noise would not be consistent with the Sutter County General Plan.	MM-NOI-1	SU
Impact NOI-2: Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels	No Action	NI	---	---	NI
	All Action Alternatives	S	Vibrations from loaded haul trucks along the haul routes could exceed the annoyance threshold for adjacent residential receptors during construction and maintenance	MM-NOI-1	SU
Impact NOI-3: A substantial permanent increase in ambient noise levels in the Project vicinity	No Action	NI	---	---	NI
	All Action Alternatives	LTS	Permanent increases in ambient noise levels could occur, but would be minimal.	---	LTS

Impact	Alternative	CEQA Level of Significance Before Mitigation	NEPA Magnitude and Direction of Impacts	Mitigation Measures	CEQA Level of Significance After Mitigation
Impact NOI-4: A substantial temporary or periodic increase in ambient noise levels in the Project vicinity	No Action	NI	---	---	NI
	All Action Alternatives	S	Ambient noise levels for road-side receptors along the haul and commute routes could increase substantially from construction- and maintenance-related traffic.	MM-NOI-1	SU
Impact NOI-5: Exposure of people residing or working in the Project area to excessive noise levels from public or private airports	No Action	NI	---	---	NI
	All Action Alternatives	LTS	People residing or working in the Project area would not be exposed to excessive noise levels from public or private airports.	---	LTS
Population and Housing					
Impact POP-1: Construction-Related Increase in Population and Corresponding Housing Needs	No Action	NI	---	---	NI
	All Action Alternatives	LTS	No new housing or infrastructure would be needed and there would be a negligible impact on population.	---	LTS

Key: APE = area of potential effect; AQMD = Air Quality Management District; B = beneficial; BMP = best management practice; C = construction; CDFW = California Department of Fish and Wildlife; cfs = cubic feet per second; CVP = Central Valley Project; FWWA = Fremont Weir Wildlife Area; GHG = greenhouse gases; HCP = Habitat Conservation Plan; LTS = less than significant; M = maintenance; NCCP = Natural Communities Conservation Plan; NI = no impact; NO_x = nitrogen oxides; O = operations; PM_{10} = inhalable particulate matter; ROG = reactive organic gases; RSP = rock slope protection; RWQCB = Regional Water Quality Control Board; S = significant; SU = significant and unavoidable; SWP = State Water Project; USACE = United States Army Corps of Engineers; WSE = water surface elevation

Table 2-27. Summary of Impact Analyses for NEPA-only Resources

Impact	Alternative	Magnitude and Direction of Impacts	Effects Determination
Socioeconomics			
Impact SOC-1: Increase employment, income, and output in the regional economy	No Action	-	No adverse effect
	1	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 366 jobs, $18.8 M in labor income, $55.9 M in revenue Annual Maintenance Impacts: Increase of 6 jobs, $0.4 M in labor income, $0.9 M in revenue
	2	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 585 jobs, $31.2 M in labor income, $87.1 M in revenue Annual Maintenance Impacts: Increase of 6 jobs, $0.4 M in labor income, $1.0 M in revenue
	3	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 620 jobs, $32.7 M in labor income, $82.6 M in revenue Annual Maintenance Impacts: Increase of 6 jobs, $0.4 M in labor income, $1.0 M in revenue
	4	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 876 jobs, $35.7 M in labor income, $123.6 M in revenue Annual Maintenance Impacts: Increase of 8 jobs, $0.4 M in labor income, $1.2 M in revenue
	5 (Project)	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 1,127 jobs, $59.1 M in labor income, $138.9 M in revenue Annual Maintenance Impacts: Increase of 10 jobs, $0.5 M in labor income, $1.6 M in revenue

Impact	Alternative	Magnitude and Direction of Impacts	Effects Determination
	5 (Program)	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 286 jobs, $16.4 M in labor income, $63.0 M in revenue Annual Maintenance Impacts: Increase of 10 jobs, $0.5 M in labor income, $1.6 M in revenue
	6	Construction would temporarily increase employment, labor income, and revenue. Maintenance would occur annually and would increase employment, labor income, and revenue.	Construction Impacts: Increase of 1,045 jobs, $55.6 M in labor income, $152.0 M in revenue Annual Maintenance Impacts: Increase of 11 jobs, $0.5 M in labor income, $1.8 M in revenue
Impact SOC-2: Decrease employment, income, and output in the regional economy resulting from conversion of cropland to nonagricultural use	No Action	-	No adverse effect
	1, 2, 3	Conversion of croplands to nonagricultural use would have adverse effects on the regional economy.	Loss of 0.6 jobs, $33,100 in labor income, $102,300 in revenue; Minor impacts to regional economics due to changes to groundwater levels surrounding the bypass; no effect to forward linkages in the regional economy; potential loss of crop insurance policies or increase in premiums; increase of $1 to $29 per acre in operating costs
	4	Conversion of croplands to nonagricultural use would have adverse effects on the regional economy.	Loss of 1.3 to 1.5 jobs, $68,200 to $88,200 in labor income, $284,500 to $360,700 in revenue; Minor impacts to regional economics due to changes to groundwater levels surrounding the bypass; no effect to forward linkages in the regional economy; potential loss of crop insurance policies or increase in premiums; increase of $1 to $29 per acre in operating costs

Impact	Alternative	Magnitude and Direction of Impacts	Effects Determination
	5 (Project)	Conversion of croplands to nonagricultural use would have adverse effects on the regional economy.	Loss of 0.7 jobs, $39,900 in labor income, $135,200 in revenue; Minor impacts to regional economics due to changes to groundwater levels surrounding the bypass; no effect to forward linkages in the regional economy; potential loss of crop insurance policies or increase in premiums; increase of $1 to $29 per acre in operating costs
	5 (Program)	-	No effect
	6	Conversion of croplands to nonagricultural use would have adverse effects on the regional economy.	Loss of 0.9 jobs, $50,500 in labor income, $150,700 in revenue; Minor impacts to regional economics due to changes to groundwater levels surrounding the bypass; no effect to forward linkages in the regional economy; potential loss of crop insurance policies or increase in premiums; increase of $1 to $29 per acre in operating costs
Impact SOC-3: Changes to water supply to North of Delta and South of Delta contractors affecting the regional economy	No Action	-	No adverse effect
	1, 2, 3, 4, 5 (Project), 6	Reductions would not be substantial enough to warrant water rate increases that could affect the regional economy.	Infrequent, less than 1% reduction in monthly deliveries
	5 (Program)	-	No effect
Environmental Justice			
Impact EJ-1: Exposure of a minority and/or low-income population to adverse and disproportionately high effects or hazards from project construction	No Action	-	No Impact
	All Action Alternatives	Adverse and disproportionately high noise and air quality impacts would not occur to the minority populations surrounding the Project area due to construction.	Adverse and Disproportionate Effect Would Not Occur

Impact	Alternative	Magnitude and Direction of Impacts	Effects Determination
Impact EJ-2: Conversion of cropland to nonagricultural use could result in a disproportionately high effect on minority and/or low-income employment	No Action	-	No Impact
	All Action Alternatives	The conversion of croplands to a non-production state would result in a marginal (<1%) reduction in farmworker jobs, which are held largely by minority and low-income groups.	Adverse and Disproportionate Effect Would Not Occur
Impact EJ-3: Project construction activities and annual maintenance could increase minority and/or low-income employment.	No Action	-	No impact
	All Action Alternatives	Construction activities would create temporary jobs that would be supplied by workers in Yolo, Sutter, Solano, and Sacramento counties, which could include those in Census Tracts 101.02, 112.06, and 114, all of which have minority populations over 50 percent.	Beneficial
Impact EJ-4: Project actions could reduce educational opportunities offered in the YBWA on low-income students	No Action	-	No Impact
	All Action Alternatives	The reduction in the number of field trips available at the YBWA could affect up to 30 percent of Title 1 schools in DJUSD and up to 57 percent of Title 1 schools in SCUSD.	Adverse and Disproportionate Effect Could Occur

Key: DJUSD = Davis Joint Unified School District; M = million; SCUSD = Sacramento City Unified School District; YBWA = Yolo Bypass Wildlife Area

2.11 References

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3 Approach to the Environmental Analysis

The Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Project) area is broadly defined to ensure evaluation of potential direct, indirect, and cumulative effects. The areas where direct, indirect, and cumulative effects may occur differ according to resource area; therefore, the geographic range described varies by resource. Resources are described in sufficient detail to understand the significant effects of the project alternatives.

3.1 Project Area

The Project area under all alternatives includes the Yolo Bypass, which is in the Yolo Basin of the Sacramento Valley near the cities of Davis and West Sacramento in Yolo County, and small portions of Sutter and Solano counties. The approximately 69,000-acre Yolo Bypass stretches north to Fremont Weir, south to the Liberty Island/Cache Slough Complex area, and follows the west side of the Sacramento River, as shown in Figure 1-1. Physical infrastructure within the Yolo Bypass includes Fremont, Sacramento, Wallace, and Lisbon weirs. The Project area also includes the lower Sacramento River Basin in Sacramento, Solano, Sutter, and Yolo counties.

3.2 Chapter Contents and Definition of Terms

Chapters 4 through 22 include the environmental and regulatory setting for 19 resource topics as well as discussions of methods, significance criteria, environmental consequences, mitigation measures for direct and indirect impacts, and cumulative impacts, organized by resource topic. Resources analyzed in these chapters are:

- Chapter 4: Flood Control, Hydraulics, and Hydrology
- Chapter 5: Surface Water Supply
- Chapter 6: Water Quality
- Chapter 7: Groundwater
- Chapter 8: Aquatic Resources and Fisheries
- Chapter 9: Vegetation, Wetlands, and Wildlife Resources
- Chapter 10: Cultural Resources and Indian Trust Assets
- Chapter 11: Land Use and Agricultural Resources
- Chapter 12: Geology and Soils
- Chapter 13: Recreation
- Chapter 14: Visual Resources

- Chapter 15: Public Services, Utilities, and Power
- Chapter 16: Socioeconomics
- Chapter 17: Transportation
- Chapter 18: Air Quality and Greenhouse Gases
- Chapter 19: Hazardous Materials and Health and Safety
- Chapter 20: Noise
- Chapter 21: Population and Housing
- Chapter 22: Environmental Justice

Chapter 23 discusses other disclosures required by National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), including the irreversible and irretrievable commitment of resources, the relationship between short-term uses and long-term productivity, and growth-inducing impacts.

The NEPA/CEQA requirements for this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) are summarized in the following subsection, followed by an overview of the structure and approach for the impact analysis provided in Chapters 4 through 22.

3.2.1 NEPA and CEQA Requirements

Both NEPA and CEQA require analysis of all phases of a proposed action, including development and operation. The NEPA/CEQA requirements for the environmental setting and consequences chapters are similar but not identical. These requirements are summarized below along with the organization and general assumptions used in the environmental analysis contained in this EIS/EIR. The reader is referred to the individual technical chapters regarding specific assumptions, methodology, and CEQA significance criteria (thresholds of significance) used in the analyses.

3.2.1.1 Affected Environment/Environmental Setting

Council on Environmental Quality (CEQ) Regulations specify that an EIS "shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of an impact, with less important material summarized, consolidated, or simply referenced" (Title 40 Code of Federal Regulations [CFR] Section 1502.15).

Section 15125(a) of the State of California (State) CEQA Guidelines states that the environmental setting sections of an EIR "must include a description of the physical environment conditions in the vicinity of the project, as they exist at the time that the Notice of Preparation (NOP) is published, or if no NOP is published, at the time the environmental analysis commences from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which the lead agency determines whether an impact is significant."

The California Department of Water Resources (DWR) initiated the CEQA process by issuing an NOP on March 4, 2013 (State Clearinghouse #2013032004). The environmental setting in this Draft EIS/EIR was based on conditions as of 2013.

3.2.1.2 Environmental Consequences

The CEQ Regulations specify that a Federal agency preparing an EIS must consider the effects of the proposed action and alternatives on the environment. These include effects on ecological, aesthetic, historical, and cultural resources as well as economic, social, and health effects. Environmental effects are categorized as direct, indirect, or cumulative effects. An EIS must also discuss possible conflicts with the objectives of Federal, State, regional, and local land use plans, policies, and controls for the area concerned; energy requirements and conservation potential; urban quality; the relationship between short-term uses of the environment and long-term productivity; and irreversible or irretrievable commitments of resources. An EIS must identify relevant, reasonable mitigation measures that are not already included in the proposed action or alternatives to the proposed action that could avoid, minimize, rectify, reduce, eliminate, or compensate for the project's adverse environmental effects (40 CFR Section 1502.14, 1502.16, 1508.8). Executive Order (EO) 12898 (1994) requires NEPA documents to evaluate effects to environmental justice communities to identify and address "disproportionately high and adverse human health or environmental effects" of programs on minority and low-income populations. The evaluation of socioeconomic effects required by NEPA does not require a significance conclusion unless there is a "cause and effect" for a physical change resulting from the impact.

The State CEQA Guidelines explain that the environmental analysis for an EIR must evaluate impacts associated with the project and identify mitigation for any potentially significant impacts.

3.2.2 Significance Criteria

The thresholds of significance for impacts generally are based on the environmental checklist in Appendix G of the CEQA Guidelines, as amended. These thresholds also encompass the factors considered under NEPA to determine the context, duration, and intensity of its impacts while meeting the more specific requirements of CEQA.

3.2.2.1 Impact Comparisons and Organization

Under CEQA, the environmental analysis compares the alternatives under consideration, including the No Project Alternative (referred to in this Draft EIS/EIR as the No Action Alternative), to existing conditions, defined at the time when the NOP was published (March 4, 2013). Under NEPA, the effects of the alternatives under consideration are determined by comparing effects between alternatives and against effects from the No Action Alternative. Consequently, baseline conditions differ between NEPA and CEQA.

Under NEPA, the No Action Alternative (i.e., expected future conditions without the project) is the baseline to which the action alternatives are compared, and the No Action Alternative is compared to existing conditions. Under CEQA, existing conditions are the baseline to which all alternatives are compared. If the No Action Alternative is unchanged from existing conditions, the impact analyses do not separate impacts compared to the No Action Alternative and existing conditions. However, for resources where the No Action Alternative may vary from existing conditions (such as in Chapter 4, *Flood Control, Hydraulics, and Hydrology*), the impact analysis compares each action alternative to both the No Action Alternative and existing conditions to characterize potential impacts.

The No Action Alternative is defined as the expected future conditions without the project, which includes other projects that have an approved decision document (Notice of Determination [NOD] for CEQA and Record of Decision [ROD] for NEPA) at the time of publication of the Draft EIS/EIR. Future projects included in the baseline of the No Action Alternative are summarized in Table 3-1.

In this Draft EIS/EIR, impacts are presented numerically and sequentially in each section. Impacts are presented with a two- to four-letter code representing the resource section and a number, followed by a short statement describing the impact. These impact numbers and statements are in bold. The impact numbering begins under the No Action Alternative. The impact sequence is carried throughout each alternative discussion. If an impact is not relevant to a specific alternative, the impact is not discussed; therefore, the impact statement sequence may skip a number.

3.2.2.2 Impact Levels

Impact levels are categorized based on their level of significance and whether they can be mitigated to lessen the impact on the environment. This Draft EIS/EIR uses the following terminology based on the State CEQA Guidelines to denote the significance of each environmental impact. CEQ Regulations for NEPA do not require significance determinations in an EIS but do require a discussion of the context and intensity of the impacts. These considerations are disclosed in each resource chapter impact discussion before the level of CEQA significance for the impact is presented.

- No Impact: No impact indicates that the construction, operation, or maintenance of the alternatives would not have any direct or indirect impacts on the environment. It means that no change from existing conditions would result from implementation of the alternative.
- Less than Significant: These are impacts resulting from the implementation of the alternative that are short term or will have little effect on the surrounding environment, residences, or operations in the Project area. CEQA does not require mitigation for this impact level.
- Significant: Significant impacts are those that exceed the impact thresholds provided for each resource section and therefore could have substantial effects on the environment, residents, and/or operations in the Project area. Under CEQA, mitigation measures or alternatives to the proposed action must be provided, where applicable, to avoid or reduce the magnitude of significant impacts. Impacts are then reevaluated after mitigation and could result in the following impact categories:
  - Less than Significant after Mitigation: These are impacts that would have a significant effect to a resource prior to implementing mitigation measures. Once mitigation measures are in place, however, these impacts would no longer have a significant effect on the Project area.

Table 3-1. Projects Considered for the No Action Alternative

Project	Agency	Description
Battle Creek Salmon and Steelhead Restoration Project	United States Bureau of Reclamation (Reclamation), Pacific Gas and Electric Company, California State Water Resources Control Board (SWRCB), United States Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW), Federal Energy Regulatory Commission (FERC), California Bay Delta Authority, and additional partners	The Battle Creek Salmon and Steelhead Restoration Project is being implemented near the town of Manton, California, in Shasta and Tehama counties. Upon its completion, the project will reestablish approximately 42 miles of prime salmon and steelhead habitat on Battle Creek and an additional 6 miles on its tributaries. Public scoping began in 2000, and the EIS/EIR was finalized in July 2005. The Findings of Fact was released in 2007 (California Department of Fish and Game [CDFG] 2007) and the ROD in 2008 (Reclamation 2008). Construction began in 2010 and will continue through 2020 to complete all phases (Reclamation 2017a).
California EcoRestore projects	California Natural Resources Agency	California EcoRestore is an initiative that will attempt more than 30,000 acres of critical Sacramento-San Joaquin Delta (Delta) restoration pursuant to the NMFS's 2009 *Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and the State Water Project* and the 2008 USFWS biological opinion (BO) for Delta Smelt. A broad range of projects are included in the California EcoRestore initiative to accomplish enhancements and improvements to the overall health of the Delta, including projects within or adjacent to the Yolo Bypass (California Natural Resources Agency 2017a). The California EcoRestore projects described below are in various stages of development, from conceptual to completed.
Agricultural Road Crossing #4 Fish Passage Improvement Project	DWR, Reclamation	This is a future project that would include modification of the southernmost agricultural road crossing in the Tule Canal to improve adult fish passage.

Project	Agency	Description
Cache Slough Area Restoration – Prospect Island	DWR, CDFW	The Cache Slough Complex is in the northern Delta where Cache Slough and the southern Yolo Bypass meet. It currently includes Liberty Island, Little Holland Tract, Prospect Island, Little Egbert Tract, and the surrounding waterways. Levee height on these tracts is restricted and designed to allow overtopping in large flow events to convey water from the upper Yolo Bypass. Since 1983 and 1998, respectively, Little Holland Tract and Liberty Island have remained breached. Restoration is occurring naturally on the islands. Restoration in the Cache Slough Complex was identified as an Interim Delta Action by Governor Schwarzenegger in July 2007 and was evaluated through the *Bay Delta Conservation Plan* (BDCP) process. The Cache Slough Complex has potential for restoration success because of its relatively high tidal range, historic dendritic channel network, minimal subsidence, and remnant riparian and vernal pool habitat. Restoration efforts would support native species, including delta smelt, longfin smelt, Sacramento splittail, and Chinook salmon, by creating or enhancing natural habitats and improving the food web that fish require. Surrounding lands that are at elevations that would function as floodplain or marsh if not separated by levees could also be included in the Cache Slough Area. This broader area includes roughly 45,000 acres of existing and potential open water, marsh, floodplain, and riparian habitat. The goals of restoration in the Cache Slough Complex are to: 1) reestablish natural ecological processes and habitats to benefit native species, 2) contribute to scientific understanding of restoration ecology, and 3) maintain or improve flood safety. Three restoration actions are currently contemplated in the Cache Slough Complex, including restoration actions at Calhoun Cut, Little Holland Tract, and Prospect Island (DWR 2008).
Fremont Weir Adult Fish Passage Modification Project	DWR, Reclamation	DWR and Reclamation propose to modify the existing Fremont Weir fish ladder to provide improved upstream passage for salmonids and sturgeon when the Sacramento River overtops Fremont Weir and immediately after the Sacramento River recedes below Fremont Weir; improve fish passage conditions in the channel that extends from the existing fish ladder upstream to the Sacramento River; improve fish passage conditions in the scour channel that extends from the existing fish ladder downstream to an existing deep pond; and remove one earthen agricultural road crossing and replace one earthen agricultural road crossing with a structure that allows for improved fish passage through the Tule Canal and continued agricultural utility. The Final Initial Study/Environmental Assessment was released in August 2017. Reclamation's Finding of No Significant Impact (Reclamation 2017b) and DWR's Final Mitigated Negative Declaration (DWR 2017a) were both released in August 2017. Construction is anticipated to begin in late 2017 or May 2018.

Project	Agency	Description
Knights Landing Outfall Gate	Reclamation District 108	This project constructed a positive fish barrier on the downstream side of the existing Knights Landing Outfall Gates (KLOG) in the Colusa Basin Drain (CBD) and placed a small amount of riprap on the right bank of the CBD immediately downstream of the KLOG. The project serves primarily as a fish passage improvement action that will prevent salmon entry into the CBD while maintaining outflows and appropriate water surface elevations. A secondary purpose of this project is to address an existing erosion site on the right bank of the CBD channel immediately downstream of the KLOG structure to enhance stability. The project was completed in November 2015 (California Natural Resources Agency 2017b).
Lisbon Weir Modification Project	DWR, Reclamation	Modification of Lisbon Weir will provide an upgrade for adult migrating fish that currently face a migration delay in the Yolo Bypass. When the bypass is not flooded, salmon can only pass this rock weir when flood tides open a small section of flap gate or when a strong high tide overtops the weir. This project would improve fish passage throughout the tidal cycle while maintaining a reliable agricultural diversion. Project planning is still at a conceptual level. Construction is anticipated to begin after 2018 (DWR 2017b).
Lower Putah Creek Realignment Project	Yolo Basin Foundation, DWR, Reclamation	This project will restore ecological functions and enhance fish passage in Lower Putah Creek from the western boundary of the Yolo Bypass Wildlife Area (YBWA) to the Toe Drain. The project would create a new, realigned channel from the existing Putah Creek channel at the western YBWA boundary that would cross the YBWA, connect to tidal channels previously restored by CDFW at the southeast end of the YBWA, and enter the Toe Drain downstream of Lisbon Weir. The channel design would provide fish passage for salmonids, increase area of wetland habitat subject to tidal influence in the CDFW-restored tidal area, and increase the area of floodplain-rearing habitat for species of management concern (specifically salmonids). Project goals include: 1) improve passage, rearing, and emigration of adult and juvenile salmonids; 2) enhance habitat for salmonids and other Delta native species and wildlife within a realigned channel; 3) enhance ecological functions of the recently restored tidal habitats on the YBWA; and 4) preserve and enhance, where possible, existing beneficial uses, including public access, wildlife viewing, hunting, and fishing. This project is in the planning, designing, and environmental regulation and permitting phase of development under an Ecosystem Restoration Program Grant Agreement (California Natural Resources Agency 2017c).

Project	Agency	Description
Prospect Island Tidal Habitat Restoration Project	DWR, CDFW	This project would restore tidal action to the interior of Prospect Island in the southern end of Yolo Bypass, partially fulfilling the 8,000-acre tidal habitat restoration obligations contained within the 2008 USFWS BO. The project would result in a suite of overarching long-term ecosystem benefits, including enhancement of primary productivity and food availability for fisheries in the Delta; an increase in the quantity and quality of salmonid-rearing habitat and habitat for other listed species; enhancement of water quality, recreation, and carbon sequestration in tidal marshes; promotion of habitat resiliency; and promotion of habitat conditions that support native species. Current design of the project includes breaching the external Miner Slough levee and removing a portion of the internal cross levee to open the site to daily tidal inundation. The Draft EIR was released August 2016, and the final EIR is expected by the end of 2017. Construction is estimated to begin in mid-2018 and be completed in 2020 (California Natural Resources Agency 2017d).
Tule Red Tidal Marsh Restoration Project	State and Federal Contractors Water Agency (SFCWA), DWR	This project would open more than 400 acres of wetlands to daily tides in the southern Suisun Marsh to benefit native fish species. This restoration project involves breaching a natural berm to allow for full daily tidal exchange through the interior of the project site and creation of a network of channels to convey water across the marsh plain. The Addendum for the Tule Red Tidal Restoration Project to the Suisun Marsh Plan (SMP) Habitat Management, Preservation, and Restoration Plan EIS/EIR was circulated in 2016. The SMP EIR was certified by CDFW in December 2011. The SMP EIS ROD was signed by Reclamation and USFWS in April 2014 (SFCWA 2016). Construction began in 2016 and is anticipated to be complete in 2018 (California Natural Resources Agency 2017e).
Wallace Weir Fish Rescue Facility Project	DWR, Reclamation District 108	Wallace Weir is a water control structure on the Knights Landing Ridge Cut where it enters the west side of the Yolo Bypass. Adult salmon have been found in dead-end agricultural ditches upstream of the weir in the CBD system, especially when flows in the Knights Landing Ridge Cut are high. These fish rarely, if ever, make it back to the Sacramento River to continue their upstream migration to spawning grounds, thus, dying in these dead-end ditches. The earthen dam, which washes away during high flow events, will be replaced with a permanent structure that will prevent migration of salmon and sturgeon into the CBD. The project also includes a facility to allow for efficient trapping and relocation of fish to the Sacramento River. All permitting has been completed, and the project is under construction (DWR 2017c).

Project	Agency	Description
California WaterFix	DWR, Reclamation	The BDCP is a habitat conservation plan and natural community conservation plan proposed by DWR, Reclamation, USFWS, and NMFS to contribute to the recovery of listed species, restore a more naturally functioning Delta ecosystem, and provide a reliable source of fresh water from the Delta for drinking water. The BDCP included construction of new water delivery infrastructure and aquatic habitat restoration. In 2015, a new sub-alternative (Alternative 4A) replaced Alternative 4 of the proposed BDCP as the CEQA and NEPA preferred alternative. Alternative 4A, known as California WaterFix, represents a separation of the proposed conveyance facility from the habitat restoration measures that were included in the BDCP. The habitat restoration measures are now included in the California EcoRestore initiative. The proposed conveyance facility includes construction of three new intakes in the north Delta that would supply two new parallel underground pipelines. The pipelines would convey diverted water to the existing export facilities in the south Delta. Mitigation for California WaterFix is expected to include approximately 2,300 acres of habitat restoration and up to 13,300 acres of habitat protection (California Natural Resources Agency 2017f). Restoration and protection actions would be focused mainly in the Delta, but could also result in restoration of portions of the Yolo Bypass. The final EIR/EIS for California WaterFix was released in December 2016. DWR issued the NOD in July 2017 (DWR 2017d).

Project	Agency	Description
Environmental Permitting for Operation and Maintenance (EPOM)	DWR	DWR is mandated to maintain and operate certain levees, channels, and on appurtenant structures of the Sacramento River Flood Control Project (SRFCP) along the Sacramento River and tributaries, and part of the Middle Creek Project in Lake County, on behalf of the State pursuant to California Water Code Sections 8361 and 12878 et seq., and in accordance with federal requirements. The SRFCP levees, channels, and structures are located along the Sacramento River and its tributaries between Red Bluff and the area just south of Rio Vista, and a portion of the Middle Creek Project located near Clear Lake in Lake County. DWR maintenance activities include, but are not limited to: (1) levee maintenance (e.g., rodent abatement and damage repair, vegetation management, erosion repair, toe drain, levee crown and access road maintenance, unauthorized encroachment removal, stability berm reconstruction, and fencing/levee protection) to ensure serviceability in times of floods, and provide visibility and access for inspections, maintenance, and flood fighting activities; (2) channel maintenance (e.g., sediment removal, debris/obstruction, vegetation management, and channel and bank scour repair) to maintain flood conveyance capacity and structural integrity of channel and associated flood control structures; (3) flood control structure maintenance and repair (e.g., pumping plants, weirs and outfall gates, and bridge maintenance and repair, and pipe/culvert repair, replacement, and abandonment); and (4) data collection. The EPOM would allow the continuation of these maintenance activities within the regulatory limitations imposed by the required permits. The draft EIR was released for public review in January 2017, and a portion of the draft EIR was recirculated in September 2017 (DWR 2017e). EPOM would provide long-term maintenance of the Fremont Weir Wildlife Area and would include maintenance of the Fremont Weir Adult Fish Passage Modification Project structure.
Oroville Facilities FERC Relicensing and License Implementation	DWR	The Oroville Facilities, as part of the SWP, are also operated for flood management, power generation, water quality improvement in the Delta, recreation, and fish and wildlife enhancement. The objective of the relicensing process is 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 FERC hydroelectric license. The initial FERC license for the Oroville Facilities, issued on February 11, 1957, expired on January 31, 2007. DWR published the Final EIR in June 2008 and the NOD in July 2008 (DWR 2017f). DWR is awaiting the FERC license renewal.

Project	Agency	Description
EchoWater Project	Sacramento Regional County Sanitation District	The Sacramento Regional County Sanitation District is upgrading its existing secondary treatment facilities at the Sacramento Regional Wastewater Plant to meet new National Pollutant Discharge Elimination System (NPDES) permit requirements. Project implementation would not result in an increase in permitted wastewater treatment capacity; however, it would result in improved treated effluent water quality. The project will upgrade existing secondary treatment facilities to advanced unit processes including improved nitrification/denitrification and filtration. The plant discharges to the Sacramento River downstream of the Fremont Weir and upstream of the Delta. Construction began in 2015 and facilities needed to meet the NPDES requirements will be completed in 2021 (Sacramento Regional County Sanitation District 2017).

Key: BDCP = Bay Delta Conservation Plan; BO= biological opinion; CBD = Colusa Basin Drain; CDFG = California Department of Fish and Game; CDFW = California Department of Fish and Wildlife; CEQA = California Environmental Quality Act; Delta = Sacramento-San Joaquin Delta; DWR = California Department of Water Resources; EIS/EIR = environmental impact statement/environmental impact report; EPOM = Environmental Permitting for Operation and Maintenance; FERC = Federal Energy Regulatory Commission; KLOG = Knights Landing Outfall Gates; NEPA = National Environmental Policy Act; NMFS = National Oceanic and Atmospheric Administration National Marine Fisheries; NOD = Notice of Determination; NPDES = National Pollutant Discharge Elimination System; Reclamation = United States Bureau of Reclamation; ROD = Record of Decision; SFCWA = State and Federal Contractors Water Agency; SMP = Suisun Marsh Plan; SRFCP - Sacramento River Flood Control Project; SWP = State Water Project; SWRCB = California State Water Resources Control Board; USFWS = United States Fish and Wildlife Service; YBWA = Yolo Bypass Wildlife Area

- Significant and Unavoidable: These are impacts on a resource where effects cannot be mitigated to a less than significant level.

- Beneficial: Beneficial impacts are changes to the condition of a resource that provide long-term or permanent improvements to that resource.

3.2.3 Mitigation Measures

Mitigation measures are provided for each significant impact where mitigation would be feasible and effective to reduce impacts of the action alternatives. Mitigation measures avoid, minimize, rectify, reduce, or compensate for significant impacts of the action alternatives to reduce them to a less-than-significant level, in accordance with CEQA Guidelines Section 15126.4. Under NEPA, mitigation can be incorporated for adverse effects, but the Federal lead agency does not have a similar procedural obligation as under CEQA to implement that mitigation.

For each impact where mitigation is proposed, the significance of the impact after mitigation is stated, as described above. No mitigation measures are proposed when an impact conclusion is "less than significant," "no impact," or "beneficial."

3.2.4 Significant and Unavoidable Impacts

Where sufficient feasible mitigation is not available to reduce impacts to a less than significant level, the impacts are identified as "significant and unavoidable." Under CEQA, a project with significant and unavoidable impacts could proceed, but the CEQA lead agency would be required to:

1. Conclude in findings that there are no feasible means of substantially lessening or avoiding the significant impact in accordance with State CEQA Guidelines Sections 15091(a)(1), 15091(a)(2), or 15091(a)(3)
2. Prepare a statement of overriding considerations, in accordance with CEQA Guidelines Section 15093, explaining why the CEQA lead agency would proceed with the project in spite of the potential for significant impacts

3.3 Cumulative Impacts

Each resource section includes an evaluation of cumulative effects. This section examines the effects of the Project and how they may combine with the effects of other past, present, and future projects or actions to create significant impacts on specific resources.

Cumulative effects are those environmental effects that, on their own, may not be considered significant but when combined with similar effects over time have the potential to result in significant effects. Cumulative effects are important because they allow decision makers to look not only at the impacts of an individual project but also at the overall impacts on a specific resource, ecosystem, or human community over time from several different projects. NEPA and CEQA require consideration of cumulative effects in an EIS and EIR.

3.3.1 National Environmental Policy Act

According to the CEQ's regulations for implementing NEPA, cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions (40 CFR Section 1508.7)."

NEPA regulations require an analysis of direct, indirect, and cumulative effects and define "effects" as ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative (40 CFR Section 1508.8). Additionally, NEPA regulations state that both connected and cumulative actions must be considered and discussed in the same document as the Proposed Action (40 CFR Section 1508.25(a)(1) and (2)).

3.3.2 California Environmental Quality Act

CEQA Guidelines define cumulative effects as:

"Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.

a. The individual effects may be changes resulting from a single project or a number of separate projects.

b. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time (CEQA Guidelines Section 15355)."

According to the CEQA Guidelines, a lead agency must discuss the cumulative impacts of a project when the total cumulative effect (the project's incremental effects combined with the effects of past, present, and probable future projects) would be significant and the project's incremental contribution to that significant cumulative effect would be "cumulatively considerable," or significant (CEQA Guidelines Section 15065(a)(3); Section 15130(a)). If the cumulative impact would not be significant, an EIR must briefly indicate why (CEQA Guidelines Section 15130(a)(2)).

In an EIR, a lead agency can determine that a project's contribution to a significant cumulative impact would be minimal (referred to as "less than cumulatively considerable") and therefore not significant. A project's contribution to a significant cumulative impact also can be less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure designed to address the significant cumulative impact. The lead agency must identify facts supporting this conclusion (CEQA Guidelines Section 15130(a)(3)).

3.3.3 Methods and Assumptions

The following subsections further describe the methodology and assumptions used to complete the cumulative effects analysis for the Project.

3.3.3.1 Methodology for Analyzing Cumulative Impacts

Although NEPA guidelines do not provide specific guidance on how to conduct a cumulative impact analysis, Reclamation identifies associated actions (past, present, or future) that, when viewed with the proposed or alternative actions, may have significant cumulative impacts. Cumulative impacts should not be speculative but should be based on reasonably foreseeable long-range plans, regulations, or operating agreements.

CEQA Section 15130(b)(1) identifies two methods that may be used to analyze cumulative impacts:

1. "A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency," and/or
2. "A summary of projections contained in an adopted general plan or related planning document, or prior environmental document which has been adopted or certified, which described or evaluated regional or area-wide conditions contributing to the cumulative impact. Any such document shall be referenced and made available to the public at a location specified by the lead agency."

This document analyzes cumulative effects using the project method identified above.

3.3.3.2 Cumulative Past, Present, and Reasonably Foreseeable Future Actions Considered

This section describes the past, present, and reasonably foreseeable, probable future actions and projects that have or could contribute to cumulative effects. Reasonably foreseeable probable future actions are actions that are currently under construction, approved for construction, or in final stages of formal planning. The future actions considered in this cumulative effects analysis are actions that would occur within or near the study area that potentially would affect resources that also may be affected by the Project. These actions were identified by reviewing agency websites reviewing planning and environmental documents. Actions were evaluated for inclusion in the cumulative effects analysis based on three criteria that all must be met to be considered reasonably foreseeable:

- The action has an identified sponsor actively pursuing project development; has completed or issued NEPA and/or CEQA compliance documents, such as a Draft EIS or EIR; and appears to be "reasonably foreseeable" given other considerations such as site suitability, funding and economic viability, and regulatory limitations.
- Available information defines the action in sufficient detail to allow meaningful analysis.
- The action could affect resources also potentially affected by the Project.

The actions presented in Table 3-2 have been qualitatively considered in the cumulative effects assessment of the Project. They consist of projects, resource management plans and programs, and development projects.

When comparing the cumulative condition to existing conditions for the CEQA analysis, all projects presented in Table 3-1, Projects Considered for the No Action Alternative, are also incorporated as part of the cumulative condition.

Table 3-2. Past, Present, and Future Actions and Projects Considered for the Cumulative Analysis

Project	Agency	Description
American River Common Features General Reevaluation Report (GRR)	United States Army Corps of Engineers (USACE)	The American River Common Features Project (ARCFP) was authorized by the Water Resources Development Act (WRDA) of 1996 to increase flood protection for the City of Sacramento. The ARCFP was authorized to strengthen the north and south levees of the American River and raise and strengthen the upper 12 miles of the east levee of the Sacramento River in the Natomas area. The WRDA of 1999 expanded the scope of the ARCFP to include raising and/or strengthening additional portions of levees along the American River and the Natomas Cross Canal. The USACE completed a post-authorization change study of the ARCFP in 2015 and prepared the final American River Watershed Common Features GRR (USACE 2015a) to indicate the results of reevaluating the ARCFP and identifying the levee improvements needed to provide at least a 200-year level of flood protection for the City of Sacramento and the Natomas area. Needed improvements include widening Sacramento Weir and the Sacramento Bypass on the east side of the Yolo Bypass, upstream of the confluence of the American and Sacramento rivers. This would be accomplished by constructing a new Sacramento Bypass north levee set back 1,500 feet from the existing levee, removing the existing Sacramento Weir north levee, and constructing a new weir section to lengthen the existing Sacramento Weir. USACE prepared a final EIS/EIR for the GRR's project alternatives in December 2015 (USACE 2015b).
Bay-Delta Water Quality Control Plan Update	SWRCB	The SWRCB is updating the 2006 Bay-Delta Water Quality Control Plan (WQCP) in four phases (SWRCB 2017): Phase I: Modifies water quality objectives (i.e., establishes minimum flows) on the Lower San Joaquin River and Stanislaus, Tuolumne, and Merced rivers to protect the beneficial use of fish and wildlife and modifies the water quality objectives in the southern Delta to protect the beneficial use of agriculture. The recirculated Supplemental Environmental Document for Phase I of the update to the Bay-Delta WQCP was released in 2016. Phase II: Evaluates and potentially amends existing water quality objectives that protect beneficial uses and the program of implementation to achieve those objectives. Water quality objectives that could be amended include Delta outflow criteria. Phase III: Requires changes to water rights and other measures to implement changes to the WQCP from Phases I and II. Phase IV: Evaluates and potentially establishes water quality criteria and flow objectives that protect beneficial uses on tributaries to the Sacramento River.

Project	Agency	Description
Central Valley Flood Management Planning (CVFMP) Program	DWR	DWR launched the CVFMP program in 2008 to improve integrated flood management in California's Central Valley. The CVFMP program efforts include the preparation of the Central Valley Flood Protection Plan (CVFPP) to fulfill the requirements of the Central Valley Flood Protection Act of 2008 (DWR 2017g). A guidance document was adopted in 2012.
CVFPP	DWR	The CVFPP was prepared by DWR in coordination with local flood management agencies, the Central Valley Flood Protection Board (CVFPB), USACE, Federal Emergency Management Agency, and Reclamation. The CVFPP is a guidance document that proposed a State system-wide investment approach for improving integrated flood management and flood risk-reduction for areas protected by State Plan of Flood Control (SPFC) facilities along the Sacramento River and San Joaquin River systems. The SPFC represents the portion of the Central Valley flood management system for which the State has provided assurances of non-federal cooperation to the United States. SPFC facilities include levees, weirs, bypass channels, pumps, and dams. The CVFPP provides general planning and guidance for flood management system improvements over the next 20 to 25 years. The CVFPP was last adopted by the CVFPB in August 2017 and will be updated every 5 years. The NOP was released for the 2017 CVFPP update in April 2016 (DWR 2017h). The CVFPP and associated studies and plans from the contributing planning efforts mentioned after this point are all in the feasibility study and planning stages. CEQA and NEPA documents have not been completed for those plans. The planning efforts that contribute to the 2017 CVFPP recommendations include the Sacramento River Basin-Wide Feasibility Study, Lower Sacramento River/Delta North Regional Flood Management Plan, and the Central Valley Flood System Conservation Strategy. • Sacramento River Basin-Wide Feasibility Study. The Sacramento River Basin-Wide Feasibility Study (BWFS) documents the new information that provides the foundation for the 2017 CVFPP update by refining and evaluating elements broadly identified in the 2012 CVFPP. The Sacramento River BWFS evaluates options for improving the bypass system. Improvements include potential expansion of the Yolo Bypass and Fremont Weir, the Sacramento Bypass, and the Sutter Bypass (DWR 2017h). Expansion would be accomplished through various combinations of levee setbacks, weir expansions, and new bypass channels integrated with ecosystem restoration actions.

Project	Agency	Description
		• Lower Sacramento/Delta North Regional Flood Management Plan. Following adoption of the 2012 CVFPP, DWR launched a regional effort to help local agencies describe local flood management priorities, challenges, and potential funding mechanisms. The Lower Sacramento/Delta North Regional Flood Management Plan (RFMP) was developed by FloodProtect, a regional working group that includes counties, cities, flood management agencies, local maintaining agencies, water agencies, emergency response agencies, citizen groups, and tribes. RFMP planning is integrated with BWFS planning so that recommended regional improvements are considered in BWFS preparation. The Lower Sacramento/Delta North RFMP established the flood management vision for the region and identified regional solutions to flood management problems at a pre-feasibility level, including improvements to existing flood management facilities (FloodProtect 2014). The Yolo Bypass is a focus area of the Lower Sacramento/Delta North RFMP. • Central Valley Flood System Conservation Strategy (Conservation Strategy). The Conservation Strategy is integral to implementing the 2012 CVFPP State System-wide Investment Approach. The Conservation Strategy will provide a comprehensive, long-term approach to improving riverine habitat and floodplains as part of an integrated flood management plan. The Conservation Strategy will include up-to-date science and planning information, a regional permitting approach, a comprehensive and science-based approach to vegetation management, and clear ecological targets with measurable objectives. A Draft Conservation Strategy was published in 2016.
Delta Plan	Delta Stewardship Council	The Delta Plan, adopted in 2013, is a long-term management plan for the Delta. Required by the 2009 Delta Reform Act, it creates new rules and recommendations to further the State's coequal goals for the Delta, which are to improve statewide water supply reliability and protect and restore a vibrant and healthy Delta ecosystem, all in a manner that preserves, protects, and enhances the unique agricultural, cultural, and recreational characteristics of the Delta (Delta Stewardship Council 2013). The Delta Stewardship Council is currently updating the Delta Plan to adapt to changing circumstances and conditions. In 2016, updates to performance measures and single-year water transfer regulations were adopted. Updates to the Delta levees investment strategy and conveyance, storage, and operations are currently being considered.

Project	Agency	Description
Delta Wetlands Project	Semitropic Water Storage District	The Delta Wetlands Project involves the construction of a new water diversion and storage system on two islands in the Delta – Bacon Island and Webb Tract (Reservoir Islands). The Reservoir Islands provide for a total estimated storage capacity of 215,000 acre-feet (AF). The Delta Wetlands Project would increase the availability of high-quality water in the Delta for export or outflow through the following (Semitropic Water Storage District 2011): 1) diversion of water on to the Reservoir Islands during high-flow periods (i.e., December through March); 2) storage of water on the Reservoir Islands; 3) mitigation for wetland and wildlife effects of the water storage operations on the Reservoir Islands by implementing a habitat management plan on Bouldin Island and Holland Tract; 4) supplemental water storage in Semitropic Groundwater Storage Bank and the Antelope Valley Water Bank; 5) discharging water for export to designated south-of-Delta users when excess CVP or SWP pumping capacity is available (i.e., typically July through November); and 6) releasing water for water quality and outflow enhancement in the Bay-Delta Estuary typically from September through November.
Folsom Dam Water Control Manual Update	USACE	USACE is working to update the water control manual for Folsom Dam. The updated manual would reflect the physical changes from recent construction, including the new auxiliary spillway that is scheduled for completion in 2017. The manual also would consider changes to operating rules for dam safety and flood risk management. The update is scheduled to coincide with completion of construction of the auxiliary spillway in 2017.
Liberty Island Conservation Bank	Reclamation District 2093	This project received permits and approvals in 2009 to create a conservation bank on the northern tip of Liberty Island that would preserve, create, restore, and enhance habitat for native Delta fish species, including Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, delta smelt, and Central Valley fall- and late fall-run Chinook salmon (Reclamation District 2093 2009). The project consists of creating tidal channels, perennial marsh, riparian habitat, and occasionally flooded uplands on the site. The project also includes the breaching of the northernmost east/west levee and preservation and restoration of shaded riverine aquatic habitat along the levee shorelines of the tidal sloughs. The island’s private levees failed in the 1997 flood and were not recovered, leaving all but the upper 1,000 acres and the adjacent levees permanently flooded. These upper acres encompass the proposed bank. The lower nearly 4,000 acres will remain, at least for the near future, predominantly open water and subtidal because tidal elevations are too great for marsh or riparian habitat (Reclamation District 2093 2009).

Project	Agency	Description
Lower Cache Creek Flood Risk Management Feasibility Study and the Woodland Flood Risk Reduction Project	USACE, DWR, City of Woodland	The Lower Cache Creek Flood Risk Management Feasibility Study will evaluate a combination of one or more flood control measures, including a setback levee along Cache Creek, stream channel improvements, a north Woodland floodway, and a northern bypass into the Colusa Drain (USACE 2015c). USACE, DWR, and the City of Woodland are preparing a draft feasibility report and draft EIS/EIR to evaluate impacts associated with this proposed flood-risk reduction project. In addition, the City of Woodland is partnering with DWR through its Urban Flood Risk Reduction program to identify and implement a State/city flood-risk reduction project that complies with the State Bill 5 requirement that urban communities have 200-year flood protection. The Woodland Flood Risk Reduction Project and associated environmental review are still in the planning stages. The project is planned to be compatible with alternatives currently being evaluated by USACE as part of the ongoing feasibility study, which is expected to be completed in 2017.
Lower Elkhorn Basin Levee Setback Project	DWR	The Lower Elkhorn Basin Levee Setback Project is the first phase of implementation of recommendations from the 2012 CVFPP and associated studies carried out by DWR. The project would contribute to the CVFPP goals of providing improved public safety for approximately 780,000 people by reducing river levels (stages) in the Sacramento River and increasing the capacity of the Yolo and Sacramento bypasses near the urban communities of Sacramento and West Sacramento, as well as Woodland, Clarksburg, and rural communities (California Natural Resources Agency 2015). The improvements also would provide system resiliency and opportunities to improve ecosystem functions such as increasing inundated floodplain habitat for fish rearing and improving the connection to the Sacramento Bypass Wildlife Area. The project consists of approximately seven miles of setback levees in the Lower Elkhorn Basin along the east side of the Yolo Bypass and the north side of the Sacramento Bypass. The project would remove all or portions of the existing levees that would be set back, remove portions of local reclamation district cross levees, and improve or relocate related infrastructure (California Natural Resources Agency 2015). DWR is coordinating closely with USACE and CVFPB to obtain necessary permits to carry out this project. DWR is also coordinating with local reclamation districts and land-use agencies on specific infrastructure relocation and improvements. The Notice of Intent and NOP for the EIS/EIR were released in September 2016. Construction of the selected alternative is expected to begin in 2020.
Lower Putah Creek 2 North American Wetlands Conservation Act (NAWCA) Project	Solano County Water Agency	The Lower Putah Creek 2 NAWCA Project authorizes the restoration of wildlife habitat by restoring the floodplain along 6,500 linear feet of Lower Putah Creek's south bank and 1,500 linear feet of McCune Creek's north bank.

Project	Agency	Description
Lower Yolo Restoration Project	SFCWA, DWR, and Memorandum of Agreement Partners	The project is a tidal and seasonal salmon habitat program restoring tidal flux to about 1,100 acres of existing pasture land. The project site includes Yolo Ranch, also known as McCormack Ranch, which was purchased in 2007 by the Wetlands Water District (SFCWA 2011). The goal of this project is to provide important new sources of food and shelter for a variety of native fish species at the appropriate scale in strategic locations, in addition to ensuring continued or enhanced flood protection. The Lower Yolo Restoration Project is part of an adaptive management approach in the Delta to learn the relative benefits of different fish habitats, quantify the production and transport of food, and understand how fish species take advantage of new habitat.
North Bay Aqueduct Alternative Intake Project	DWR, Solano County Water Agency	DWR issued an NOP in December 2009 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 segment of pipe. The proposed alternative intake would be operated in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The project would be designed to improve water quality and provide reliable deliveries of SWP supplies to its contractors, the Solano County Water Agency and the Napa County Flood Control and Water Conservation District (DWR 2009).
North Delta Fish Conservation Bank	Wildlands, Inc., The Trust for Public Land, Reclamation District 2093	In 2013, USFWS, NMFS, and CDFW approved the North Delta Fish Conservation Bank to serve as an 811-acre bank located on Liberty Island at the southern end of the Yolo Bypass. The conservation bank will provide habitat benefits to delta smelt and other state and federally listed species. The conservation bank will enhance 657 acres of tidal marsh wetlands, including emergent marsh, seasonal wetland, riparian, and shallow open water habitats, in addition to 68 acres of tidal channel enhancement and over 32 acres of tidal emergent marsh creation through the removal of levees and lowering a portion of the existing floodplain habitat. (Wildlands, Inc. 2017)
North Delta Flood Control and Ecosystem Restoration Project	DWR	Consistent with objectives contained in the CALFED Bay-Delta Program Record of Decision, the North Delta Flood Control and Ecosystem Restoration Project is intended to improve flood management and provide ecosystem benefits in the North Delta area through actions such as construction of setback levees and configuration of flood bypass areas to create quality habitat for species of concern (DWR 2010). These actions are focused on McCormack-Williamson Tract and Staten Island. The purpose of the project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the Project study area. The Project area encompasses approximately 197 square miles (DWR 2010). The Final EIR was certified in November 2010.

Project	Agency	Description
Sacramento International Airport Land Use Compatibility Plan	Sacramento Area County of Government	The Sacramento Airport Land Use Compatibility Plan, adopted in 2013, identifies zones for safety, noise contours, and height restrictions along with associated compatible land uses surrounding the airport. The plan addresses noise, safety, glare, visibility, and actions that may attract wildlife within the Airport Influence Areas.
Sacramento River Bank Protection Project	USACE Sacramento District, CVFPB	The Sacramento River Bank Protection Project (SRBPP) was authorized by Section 203 of the Flood Control Act of 1960. The SRBPP is designed to enhance public safety and help protect property along the Sacramento River and its tributaries by protecting existing levee and flood control facilities of the Sacramento River Flood Control Project. The USACE, Sacramento District, is responsible for implementation of the SRBPP in coordination with its non-federal partner, the CVFPB. The SRBPP was originally authorized to rehabilitate 430,000 linear feet of bank protection (Phase I). In 1974, the WRDA authorized an additional 405,000 linear feet. In 2007, the WRDA gave supplemental authorization for an additional 80,000 linear feet. A draft post-authorization change report and draft programmatic EIS/EIR have been prepared for the supplemental authorization (USACE 2016a). Actions under the supplemental authorization may include bank protection in the form of rock revetment, biotechnical bank stabilization, setback levees, or construction of adjacent levees. Identified protection sites include a portion of the northern Yolo Bypass. Additional project-level environmental documentation will be prepared in the future to address specific project sites under this program (USACE and CVFPB 2014).
Sacramento River General Reevaluation Report	USACE	The Sacramento River GRR is being prepared by the USACE to reevaluate the Sacramento River Flood Control Project, which consists of levees, weirs, pumping plants, and bypass channels that help reduce the risk of flooding in the Sacramento Valley and Delta. The reevaluation focuses on ecosystem benefits in the flood system and flood system improvements within the flood conveyance system. The reevaluation also includes considerations for long-term operations and maintenance of system improvements (USACE 2016b). Flood system improvements to be considered include widening bypasses, modifying weir operations, and constructing setback levees. Ecosystem benefits to be considered include restoration of aquatic and riparian habitat and enhanced fish passage. Flood system improvements and ecosystem benefits include considerations within the Yolo Bypass. The SRGRR is in preparation; CEQA and NEPA documents have not been completed.

Project	Agency	Description
Sacramento-San Joaquin Delta Estuary Total Maximum Daily Load (TMDL) for Methylmercury	Central Valley RWQCB	The Central Valley RWQCB has identified the Delta as impaired because of elevated levels of methylmercury in Delta fish that pose a risk for human and wildlife consumers. As a result, it has initiated the development of a water quality attainment strategy to resolve the mercury impairment. The strategy has two components: the methylmercury TMDL for the Delta and the amendment of the WQCP for the Sacramento River and San Joaquin River Basins (the Basin Plan) to implement the TMDL program. The draft Basin Plan amendment would require methylmercury load and waste load allocations for dischargers in the Delta and the Yolo Bypass to be met as soon as possible but no later than 2030. The regulatory mechanism to implement the Delta Mercury Control Program for point sources would be through NPDES permits. Nonpoint sources would be regulated in conformance with the SWRCB's Nonpoint Source Implementation and Enforcement Policy. Both point and nonpoint source dischargers would be required to conduct mercury and methylmercury control studies to develop and evaluate management practices to control mercury and methylmercury discharges. The RWQCB will use the study results and other information to amend relevant portions of the Delta Mercury Control Program during the Delta Mercury Control Program Review (Central Valley RWQCB 2010). The draft Basin Plan amendment also would require proponents of new wetland and wetland restoration projects scheduled for construction after 2011 to either participate in a comprehensive study plan or implement a site-specific study plan, evaluate practices to minimize methylmercury discharges, and implement newly developed management practices as feasible. Projects would be required to include monitoring to demonstrate effectiveness of management practices. Activities, including changes to water management and storage in and upstream of the Delta, changes to salinity objectives, dredging and dredge materials disposal and reuse, and changes to flood conveyance flows, would be subject to the open water methylmercury allocations. Agencies would be required to include requirements for projects under their authority to conduct control studies and implement methylmercury reductions as necessary to comply with the allocations by 2030 (Central Valley RWQCB 2010).

Project	Agency	Description
Shasta Lake Water Resources Investigation	Reclamation	Reclamation undertook the Shasta Lake Water Resources Investigation to determine the type and extent of federal interest in a multiple purpose plan to modify Shasta Dam and Reservoir to increase survival of anadromous fish populations in the upper Sacramento River; increase water supplies and water supply reliability to agricultural, municipal and industrial users, and environmental purposes; and, to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood damage reduction, and related water resources needs, consistent with the objectives of the CALFED Bay-Delta Program. The alternatives for expansion of Shasta Lake include, among other features, raising the dam from 6.5 to 18.5 feet above current elevation, which would result in additional storage capacity of 256,000 to 634,000 AF, respectively (Reclamation 2015). The increased capacity is expected to improve water supply reliability and increase the cold-water pool, which would provide improved water temperature conditions for anadromous fish in the Sacramento River downstream of the dam. The final EIS was released in 2014, and the final feasibility study was released in 2015. No ROD has been issued.
Sites Reservoir Project	Sites Project Authority and Reclamation	The Sites Reservoir Project involves the construction of offstream surface storage north of the Delta for enhanced water management flexibility in the Sacramento Valley, increased California water supply reliability, and storage and operational benefits for programs to enhance water supply reliability, both locally and State-wide, benefit Delta water quality, and improve ecosystems. Secondary objectives for the project are to: 1) allow for flexible hydropower generation to support integration of renewable energy sources, 2) develop additional recreation opportunities, and 3) provide incremental flood damage reduction opportunities (Sites Project Authority and Reclamation 2017). The Draft EIR/EIS was released for public review on August 14, 2017.

Project	Agency	Description
Upstream Sacramento River Fisheries Projects		Ongoing and reasonably foreseeable projects with the potential to affect aquatic resources and fisheries upstream of the Yolo Bypass and the Delta include levee improvement and other flood control management projects in and near the Sacramento, Feather, Yuba, and American rivers; modification of Shasta Dam operations under amendments to the 2009 *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and the State Water Project* (i.e., water temperature management); and increasing flood protection and useable storage capacity in Folsom Lake. These projects include: • Sacramento River Flood Control Project • Natomas Levee Improvement Program • Folsom Dam Modifications • Long-term CVP and SWP Operations and 2009 *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and the State Water Project* Reasonable and Prudent Alternative Amendments • Upper Yuba Project • Yuba River Basin Project • Central Valley Project Improvement Act projects on the Sacramento River and its tributaries
Yolo Habitat Conservation Plan/Natural Communities Conservation Plan and the Yolo Local Conservation Plan	Yolo County Joint Powers Authority	The Yolo Habitat Conservation Plan (HCP)/Natural Communities Conservation Plan (NCCP) and Yolo Local Conservation Plan were formerly known as the Yolo Natural Heritage Program. The Yolo HCP/NCCP covers 12 endangered and threatened species and 15 natural communities, enabling agencies to construct projects and implement activities that affect the habitat of the covered species, and establishes a framework to protect, enhance, and restore natural resources within Yolo County. The Yolo Local Conservation Plan expands on the Yolo HCP/NCCP to cover species and natural communities of local concern not included in the Yolo HCP/NCCP (Yolo Habitat Conservancy 2016). Covered activities include ongoing operation and maintenance of existing flood control facilities and implementation of habitat enhancement, restoration, and creation actions included in the Yolo HCP/NCCP Conservation Strategy. The planning and environmental review process for the HCP/NCCP is nearly complete. A Public Review Draft of the HCP/NCCP and a Draft EIR/EIS were released for a 90-day comment period on June 1, 2017, and the public comment period closed on August 30, 2017.

Project	Agency	Description
Yuba River Development Project Relicensing	Yuba County Water Agency	The Yuba County Water Agency is seeking to renew their 50-year FERC license for the Yuba River Development Project (FERC Project No. 2246). The Yuba River Development Project is located on the Yuba River, the Middle Yuba River, and Oregon Creek in Yuba County, California, and consists of one reservoir (New Bullards Bar on the North Yuba River), two diversion dams (Our House Diversion Dam on the Middle Yuba River and Log Cabin Diversion Dam on Oregon Creek), three powerhouses (New Colgate, Fish Release, and Narrows No. 2), and various recreational facilities and appurtenant facilities (Yuba County Water Agency 2016). New Bullards Bar Reservoir has a capacity of 969,600 AF. The initial FERC license expired April 30, 2016, and the Yuba County Water Agency has engaged in FERC's Integrated Licensing Process to prepare an application for a new license. The Yuba County Water Agency filed a Draft Application for a New License Major Project – Existing Dam, on December 3, 2013, and a Final Application for a New License Major Project – Existing Dam, on April 28, 2014. A Final Application Amendment is due in 2017.

Key: AF = acre-feet; ARCFP = American River Common Features Project; BWFS = Basin-Wide Feasibility Study; CDFW = California Department of Fish and Wildlife; CEQA = California Environmental Quality Act; Conservation Strategy = Central Valley Flood System Conservation Strategy; CVFMP = Central Valley Flood Management Planning; CVFPB = Central Valley Flood Protection Board; CVFPP = Central Valley Flood Protection Plan; CVP = Central Valley Project; Delta = Sacramento-San Joaquin Delta; DWR = California Department of Water Resources; EIS/EIR = environmental impact statement/environmental impact report; FERC = Federal Energy Regulatory Commission; GRR = General Reevaluation Report; HCP = Habitat Conservation Plan; NAWCA = North American Wetlands Conservation Act; NCCP = Natural Communities Conservation Plan; NEPA = National Environmental Policy Act; NMFS = National Oceanic and Atmospheric Administration National Marine Fisheries; NOP = Notice of Preparation; NPDES = National Pollutant Discharge Elimination System; Reclamation = United States Bureau of Reclamation; RFMP = Regional Flood Management; ROD = Record of Decision; RWQCB = Regional Water Quality Control Board; SFCWA = State and Federal Contractors Water Agency; SPFC = State Plan of Flood Control; SRBPP = Sacramento River Bank Protection Project; SWP = State Water Project; SWRCB = California State Water Resources Control Board; TMDL = Total Maximum Daily Load; USACE = United States Army Corps of Engineers; USFWS = United States Fish and Wildlife Service; WQCP = Water Quality Control Plan; WRDA = Water Resources Development Act

3.3.3.3 Geographic Scope and Timeframe

Most of the cumulative effects likely would occur within the Project area, which includes the Yolo Bypass and the land adjacent to and surrounding it that would be affected by construction. However, several impacts of the project have the potential to extend beyond the boundaries of the Project area. For instance, water quality impacts have the potential to affect water quality downstream of the Project area. In these cases, the geographic scope has been expanded to account for potential cumulative effects. Table 3-3 presents the geographic scope analyzed for cumulative effects by resource type.

Table 3-3. Cumulative Effects Analysis Geographic Scope by Resource

Resource	**Geographic Scope**	
	Same Area of Analysis Utilized in Alternatives Analysis	**Other**
Flood Control, Hydraulics, and Hydrology	X	Delta region, Sacramento River system
Surface Water Supply	X	Sacramento River system
Water Quality	X	Sacramento River system
Groundwater	X	Yolo, Colusa, and Sutter subbasins
Aquatic Resources and Fisheries	X	Sacramento River system
Vegetation, Wetlands, and Wildlife Resources	X	Sacramento River system
Cultural Resources and Indian Trust Assets	X	(not applicable)
Land Use and Agricultural Resources	X	(not applicable)
Geology and Soils	X	Sacramento River system
Recreation	X	Delta region, Sacramento River system
Visual Resources	X	entire Yolo Bypass
Public Services, Utilities, and Power	X	entire Yolo Bypass
Socioeconomics	X	
Transportation	X	Sacramento River system
Air Quality and Greenhouse Gases	X	Sacramento Valley Air Basin
Hazardous Materials and Health and Safety	X	entire Yolo Bypass
Noise	X	(not applicable)
Population and Housing	X	(not applicable)
Environmental Justice	X	(not applicable)

The timeframe for the cumulative effects analysis varies, depending upon the nature of the impacts. Construction-related short-term impacts would end with the completion of construction; therefore, the cumulative effects analysis timeframe for these would only extend until construction is complete. Several more long-term impacts have the potential to persist after construction. The effects of these impacts are considered long-term; therefore, a 20-year timeframe is assumed for the cumulative analysis.

3.3.3.4 Determining Significance

CEQA requires a determination of the significance of the effects on cumulative conditions similar to the evaluation of project effects; however, NEPA does not require a significance conclusion. See Section 3.2.2 for more details.

3.3.3.5 Mitigation for Significant Cumulative Impacts

The requirements for mitigation for cumulative effects are the same as those described for project effects; see Section 3.2.3 for more details.

3.3.3.5.1 National Environmental Policy Act

Under NEPA, a discussion on mitigation for adverse environmental effects is required in an EIS (40 Section Part 1502.16(h), 40 CFR Section 1502.14(f)); however, a final set of mitigation measures, selected for implementation, is adopted in a ROD. If mitigation measures presented in the EIS are not adopted, the reasons why must be explained in the ROD (40 CFR Section 1505.2(c)). This cumulative effect analysis identifies potential mitigation for substantial cumulative effects. The ROD will present the final mitigation measures adopted as part of the project that will be completed for the alternative selected for implementation.

3.3.3.5.2 California Environmental Quality Act

As required by CEQA, an EIR must examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects (CEQA Guidelines Section 15130). This cumulative effects analysis will identify all feasible mitigation measures for effects of the project determined to be “cumulatively considerable.” The approval of the EIR and subsequent CEQA findings will describe the feasible mitigation measures adopted as part of the project.

If a significant cumulative effect is identified and the project’s incremental contribution to that significant cumulative effect would be “cumulatively considerable,” feasible mitigation measures are proposed. If no feasible mitigation would be possible (i.e., the technology does not exist) to reduce or avoid the impact, the cumulative effect is considered significant and unavoidable.

3.3.3.6 Qualitative Assessment and Other Actions

Effects of past, present, and reasonably foreseeable probable future actions were assessed qualitatively for all resource areas. Existing information on current and historical conditions was used to evaluate the combined effects of past actions on each resource area. For present and reasonably foreseeable probable future actions, a list of related actions was compiled. The combined effects of these past, present, and reasonably foreseeable probable future actions were then evaluated together with those of the project alternatives.

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