Appendix B6. Intake Site Identification and Evaluation (Final Draft)

1. Introduction and Purpose

The purpose of this technical memorandum (TM) is to identify potential intake sites along the Sacramento River and evaluate them for suitability as candidate intake sites for the Delta Conveyance System (Project).

1.1 Organization

This TM is organized as follows:

- Introduction and Purpose
- Methodology
- Analysis and Evaluation
- Conclusions
- Recommendations and Next Steps
- References
- Attachment 1 – Intake Location Analysis

1.2 Background

Potential Sacramento River intake sites were previously identified, considered, and evaluated in support of the Delta Habitat Conservation and Conveyance Program (DHCCP) and the associated California WaterFix Project, which has since been withdrawn from further consideration. The previously identified intake sites were established through a multi-year process involving a Fish Facilities Technical Team (FFTT) comprising agency, stakeholder, and consultant representatives. The result of the process was a recommendation by the five key resource agencies represented on the FFTT to consider five primary candidate sites. Later, three of these five sites were recommended for the Project being considered as part of the DHCCP. Appendix A is a copy of Appendix 3F, Intake Locations Analysis, from the Bay Delta Conservation Plan/California WaterFix Final EIR/EIS (DWR, 2016) and includes a detailed history of the work of the FFTT and the associated efforts to define the previously considered intake site locations.

The previously considered intake site locations and related characteristics identified and evaluated in the previous studies were reviewed and reconsidered for this analysis. In addition, the reach of the Sacramento River between the Town of Freeport and the confluence with Sutter Slough was re-examined to determine whether other viable intake sites were available. Using both the historical and new examination results, a set of candidate intake sites was identified, and information related to this set of sites were reviewed to determine suitability.

For the Delta Conveyance Project (Project) described in the final Environmental Impact Report (EIR) (DWR, 2023), two intakes (C-E-3 and C-E-5) were selected to meet the 6,000 cubic-feet-per-second Project flow capacity criteria.

1.3 Summary of Results

Five candidate sites, C-E-1 through C-E-5, were identified and are shown on Figure 1. These candidate sites are essentially the same as the five upstream sites recommended in the *5-Agency Technical Recommendations for the Location of Bay Delta Conservation Plan (BDCP) Intakes 1-7* (2011). Re-examination of the bathymetry and physical setting of the Sacramento River between the Town of

Freeport and the confluence with Sutter Slough did not reveal any new or additional candidate sites conforming to the siting criteria.

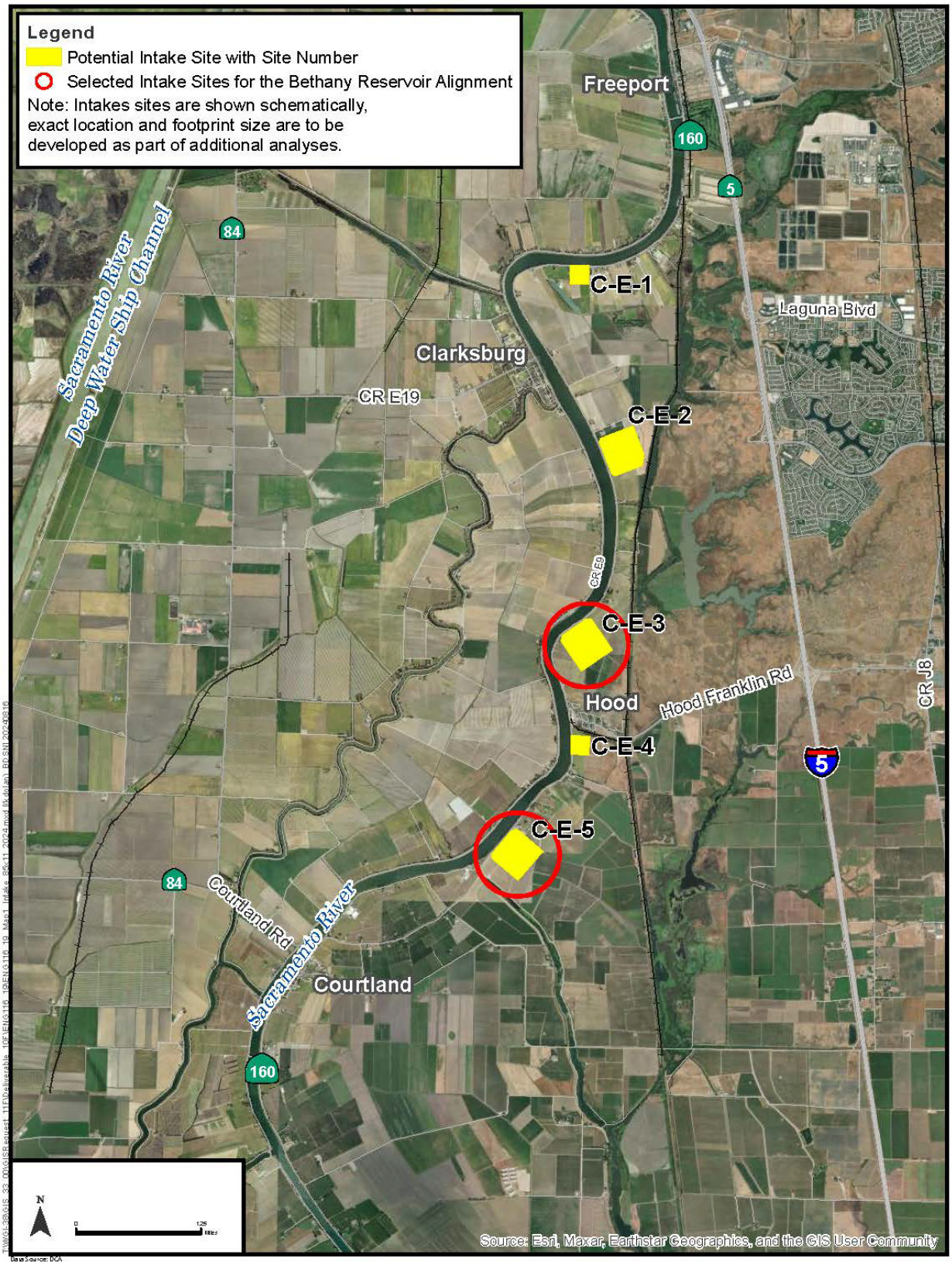


Figure 1. Intake Sites

The five candidate sites were analyzed and considered relative to each other according to the following evaluation categories:

- Bathymetry and River Encroachment
- Property Impacts
- Built Environment Impacts
- Proximity to Existing Development
- Geotechnical Concerns
- Environmental and Habitat Disruption
- Roads and Traffic Impacts

The candidate sites were evaluated and ranked against a set of siting criteria. The results are summarized as follows:

- **Candidate Site C-E-1:** This site has depth and straight bank river conditions that would result in a shorter intake structure, but potentially has the most land-side impacts. It is not recommended for further consideration due to the relatively dense property distribution in the area and the number of properties expected to be directly or indirectly impacted.
- **Candidate Site C-E-2:** This site has depth and straight bank river conditions that meet siting criteria; however, due to the water depth, this site would have the longest vertical plate intake structure and relatively high land-side impacts, mainly related to residential impacts. It is recommended for further consideration if three intake sites are required for the Project.
- **Candidate Site C-E-3:** This site has depth and straight bank river conditions that would result in a shorter intake structure, and has potentially the least land-side impacts, mainly because only one residential structure would be expected to fall inside the permanent footprint. This site is considered the best choice among the candidate sites and is recommended for further consideration.
- **Candidate Site C-E-4:** This site has depth and straight bank river conditions that would result in a shorter intake structure. It ranks very poorly with respect to land-side impacts relative to other sites. Also, this site is directly adjacent to the Town of Hood, and access road development and State Route (SR) 160 regrading work would be expected to extend into the town. It is not recommended for further consideration due to its proximity to Hood, the resulting indirect impact to residences and traffic, and the number of properties that could be directly or indirectly impacted.
- **Candidate Site C-E-5:** This site has depth and straight bank river conditions that exceed siting criteria, resulting in the expectation of a medium-length intake structure. It has relatively fewer land-side impacts, mainly because only one or two residential structures are expected to fall inside the permanent footprint. The site is adjacent to a historic residential structure, but work near that structure is expected to result in only minor direct impacts related to SR 160 regrading, plus indirect impacts from being adjacent to the work area. This site is considered the second best choice among the candidate sites and is recommended for further consideration.

It was recommended that Candidate Sites C-E-3 and C-E-5 be considered for inclusion in the Project to provide two intakes with a Project design capacity of 3,000 cfs, each.

2. Methodology

The methodology employed to determine candidate intakes sites for the Project involves the following process:

- Review previous studies and evaluations to verify the adequacy of previously considered intake sites against current siting criteria (Section 2.2) and bathymetric data.
- Review bathymetric information and select candidate intake site locations along the eastern riverbank that meet current siting criteria and are suitably deep and straight to site an intake structure.
- Conduct an evaluation of the candidate sites against the current siting criteria.
- Rank the remaining candidate sites according to relative suitability.

2.1 Data and Information Sources

The reference information shown in Section 6 was reviewed relative to potential intake sites and their characteristics, as well as for the development of siting criteria. DWR enterprise geographic information system (GIS) information was also used to review property and parcel locations and sensitive environmental habitat locations.

2.2 Siting Criteria

Siting criteria were developed to guide identification and evaluation of candidate intake sites. These criteria were developed from experience with similar intakes, from NOAA guidelines (1997 and 2018), and from California Department of Fish and Wildlife (formerly Department of Fish and Game) (CDFG, 2010) fish screen criteria, as well as other criteria included in the information referenced.

These criteria were synthesized into the following key criteria that guide the identification and evaluation of intake site locations:

- Sacramento River:
  - Intake sites should be located where they would be capable of capturing releases from upstream California State Water Project and Federal Central Valley Project storage reservoirs.
  - Intake sites are to be compatible with the central and eastern corridors being considered for the Project, as follows:
    - Intakes sites should be on the eastern side of the river because access to the western side for construction of the intakes and associated connecting tunnels is only available using a few small bridges and would require extensive logistical development to facilitate construction. Such development would increase impacts without commensurate changes in the intake footprint or operations. Therefore, it is not considered feasible to site intakes on the western side of the river for the central and eastern corridors.
  - Siting considerations along the river should include:
    - Locations with a water depth to accommodate at least 12-foot-tall vertical flat plate screen panels and 8-foot-diameter cylindrical screen units; however, sites that can accommodate 15-foot-tall screen panels are preferred.

  - Sites along the outside of moderate river bends or along straight reaches of the river are preferred to help alleviate sedimentation and debris issues.
  - DWR assessed alternative intake locations upstream and downstream from the siting limits described below as part of development of the upcoming Delta Conveyance Project Environmental Impact Report (EIR). The screening exercise found that these alternate locations did not meet the Project objectives and did not have the potential to lessen potential significant environmental effects.
    - Sites downstream of the Town of Freeport are preferred because they will have less impact on total flow rate in the river and reverse flows affecting the Sacramento Regional Sanitation District's treated wastewater outfall at Freeport.
    - Sites upstream of the confluence with Sutter Slough are preferred because greater bypass (or sweeping) flows are expected to be available in the river to help speed out-migration fish passage.
    - Sites further upstream, but below the confluence with the American River, may help reduce the impact on Delta smelt.
    - Sites upstream of the projected influence of brackish water in the Delta are essential to facilitate long-term operations with suitable water quality. Generally, intake sites along the river upstream of its confluence with Georgiana Slough are considered viable. The actual upstream limit of brackish water for the life of the Project is currently being evaluated and may shift upstream or downstream. This is not expected to change the intake siting process because the application of the Sutter Slough limit is likely to control the most downstream acceptable location.

- Compatibility with Intake Structures:
  - To minimize encroachment of the intake structure into the river flow cross section and minimize the associated impact on flood flow water surface elevations (WSELs), the bathymetry and riverbank configuration must accommodate construction of the intake structure and associated training walls without extending the intake structure screen face into the river more than about 100 feet (preferable) to 125 feet (maximum).
  - The actual impact of this issue will be evaluated in more detail during future engineering analyses.
- Flood Protection – Sites along the river must be suitable for engineered grading of the levee system to provide protection from the 200-year flood and projected sea level rise (SLR).
- River Profile Depth – Adequate depth is required to minimize the length of the fish screens. Areas along the bank of the river with depth equal to or greater than 15 feet are considered suitable because they will accommodate a 12-foot vertical panel screen height and are compatible with cylindrical tee screens. Shorter screens would result in excessively long structures, which is not considered ideal for aquatic species protection.
- Non-shoaling Areas – Sites along straight sections, or ideally, along the outside of moderate river bends are required to prevent excessive shoaling of sediments in front of the structure. Excessive shoaling:
  - May result in operational problems caused by sedimentation in front of the screens
  - May impede the screen cleaner operation
  - May increase the quantity of diverted sediment
  - Would require frequent dredging, which has environmental impacts and causes local disruption

- Environmental Factors – The selection between alternative suitable sites may also be influenced by the following factors:
  - The presence of riparian and terrestrial habitats and species
  - Socio-economic considerations, such as proximity to towns, and other built environment features
- Other Factors – In some cases, proximity to other Delta Conveyance System features may drive the preferred locations for the intakes. For example, screen siting criteria used by the FFTT suggested screens should have at least 1 River Mile (RM) of separation.

2.3 Assumptions

Basic assumptions that apply to identifying and evaluating intake sites include the following:

- Intakes would be located along the Sacramento River downstream of the American River to provide adequate flows for the North Delta diversions and a minimum quantity of downstream flow to meet the needs for water users, recreationists, and environmental conditions.
- Intakes need to be placed far enough upstream to minimize impacts to Delta smelt habitat and to avoid reaches with brackish water in the future as SLR occurs (for example, previous studies have indicated that the North Delta diversions should be upstream of the confluence with Georgiana Slough).
- The intakes must comply with the Anadromous Salmonid Passage Design Guidelines (NOAA, 2018).
- California Department of Fish and Wildlife is assumed to accept the NOAA 2018 guidelines.
- The U.S. Fish and Wildlife Service (USFWS) will require that intake fish screens be designed to protect juvenile Delta fish species, with sizing based on a design approach velocity of 0.2 foot per second (fps). Otherwise, the USFWS is assumed to accept the NOAA 2018 guidelines.
- In accordance with regulatory agency requirements and best practices, the intake fish screens will be sized for juvenile Delta fish species protection using a design approach velocity of 0.2 fps.
- Intakes will use either vertical flat plate or cylindrical tee configuration fish screens and be an on-bank configuration with minimal encroachment into the river cross section.
- Intake structure lengths have been developed by DCA for use in this analysis. The results are documented in the Concept Engineering Report (CER)Appendix B7 *Intake Screen Sizing – North Delta Intakes*.
- The impact of the intake structure(s) on flood flow WSELs will be evaluated as part of the analyses supporting the Project environmental documentation. However, it is assumed for this siting analysis that intake structures that encroach on the river cross section by less than 125 feet from the top of the existing levee will be in compliance with the U.S. Army Corps of Engineers (USACE) goals to limit the rise of maximum WSEL to within the original design profile with minimal impacts. Such compliance will be evaluated in future engineering analyses in support of the Project environmental documents.
- Flood control levee relocations will be permitted by the USACE in accordance with their design requirements.
- Flood control levee penetrations, including gravity flow conduits with operable gates that can be closed automatically or by flood fighting agencies, will be permitted by the USACE in accordance with their design requirements.

- State SR 160 can be relocated nominally further inland at the intake sites to facilitate flood protection and intake construction and operation without impacting its scenic highway designation.
- Only facilities required for flood protection and operation and maintenance of the Project will be sited at the intakes.

3. Analysis and Evaluation

3.1 Identification of Candidate Intake Sites

In accordance with the methodology, the reach of the Sacramento River between the Town of Freeport and the confluence with Sutter Slough was evaluated for potential intake site locations. As a result of the evaluation, five candidate intake site locations were identified, as shown on Figure 1, which are briefly described as follows:

- **Site C-E-1:** Approximate RM 43.9; located on the upstream side of Scribner's Bend. Site selected due to suitable depth and length along the eastern (locally, southern) side of the river and conformance with siting criteria. The site impacts several relatively small residential and agricultural properties. Several homes and one active horse ranch are within the permanent footprint. Scribner's Bend Winery is not within the permanent footprint, but it is relatively close to the work area and may have minor property modifications related to regrading SR 160 on the river side of the property, depending on the final layout.
- **Site C-E-2:** Approximate RM 41.1; located downstream of Scribner's Bend and the Town of Clarksburg, near Scribner Road. Site selected due to suitable length along the eastern side of the river, adequate depth, and conformance with siting criteria. The site impacts several residential and agricultural properties. Several homes are within the permanent footprint. The intersection of SR 160 and Scribner Road is within the permanent footprint and will need to be reconfigured. The Town of Clarksburg is within 1 mile of the site and directly visible.
- **Site C-E-3:** Approximate RM 39.4; located on the upstream side of an unnamed river bend across from the Clarksburg boat ramp and about 1 mile upstream of the Town or Hood. Site selected due to suitable depth and length along the eastern side of the river and conformance with siting criteria. The site impacts several residential and agricultural properties. No homes are within the permanent footprint. Several homes (including Rosebud House) are adjacent to the work area and will have some impacts associated with nearby construction and property modifications due to regrading SR 160 on the river side of the properties.
- **Site C-E-4:** Approximate RM 38.0; located on the upstream side of an unnamed river bend immediately downstream of the Town or Hood. Site selected due to suitable depth along the eastern side of the river and conformance with siting criteria. The site impacts several residential and agricultural properties, including one property owned by DWR that will contain most of the permanent footprint. One residential home is within the permanent footprint. The Town of Hood is immediately adjacent to the work area and will have impacts associated with nearby construction and property modifications due to regrading SR 160.
- **Site C-E-5:** Approximate RM 36.8; located on the upstream side of an unnamed river bend immediately upstream of the northeastern end of Randall Island. Site selected due to suitable depth and length along the eastern side of the river and conformance with siting criteria. The site impacts several residential and agricultural properties. One or two homes (depending on the final configuration) are within the permanent footprint. Several homes, including Hemly historical house,

are adjacent to the work area and will have some impacts associated with nearby construction and property modifications due to regrading SR 160 on one side of the properties.

Note that these sites are essentially the same as the five upstream sites recommended in *the 5-Agency Technical Recommendations for the Location of BDCP Intakes 1-7* (2011). Re-examination of the bathymetry and physical setting of the Sacramento River between the Town of Freeport and the confluence with Sutter Slough did not show additional candidate sites conforming to the siting criteria. However, minor adjustment of the intake structures at the candidate sites identified may be possible during conceptual and preliminary design to help avoid some landside conflicts or impacts.

3.2 Evaluation of Candidate Intake Site Locations

Each of the five candidate sites were evaluated in additional detail according to the following evaluation categories:

- Bathymetry and River Encroachment
- Property Impacts
- Built Environment Impacts
- Proximity to Existing Development
- Geotechnical Concerns
- Environmental and Habitat Disruption
- Roads and Traffic Impacts

The sites are each assigned an overall suitability ranking. Sites with better characteristics are ranked by order of preference, with ranking value of 1 being the best, and higher sequential numbers representing lower ranking sites.

3.2.1 Evaluation Category Descriptions

3.2.1.1 Bathymetry and River Encroachment

Bathymetric surveys were used to evaluate river depth, riverbank side slope, topographic conditions, and general topographic shape of the subaqueous conditions at each candidate intake site. Dry land light detection and ranging (Lidar) survey information was supplemented for the above-water riverbank up to the top of the levee as part of the bathymetric survey mapping provided for examination.

Conceptual intake structure footprints were positioned at each candidate site to help verify that an intake structure can be positioned at the site with a viable fit relative to existing river conditions in accordance with the siting criteria. These conceptual footprints only represent the intake structure at the edge of the river and do not reflect the full development of the intake sites with all required facilities. As such, they are considered reconnaissance structure locations only at this time and are subject to adjustment at all sites retained for further analysis. Such adjustments would be made to optimize the subaqueous position of the structures and to minimize land-side impacts associated with full intake site development. Since development of the intake site layout and footprint at these sites is a future activity, drawings showing the reconnaissance structure location are not provided at this time to avoid premature release of site-specific information.

3.2.1.2 Property Impacts

The number of parcels impacts by the intake facilities expected at each candidate site is considered. Parcels with major impacts due to their location relative to the potential permanent footprint of the intake facilities are identified separately from parcels with lesser impacts, mainly related to the SR 160 improvements adjacent to and through the intake facility sites.

Qualitative reconnaissance information is also presented relative to the existing uses of the impacted parcels.

3.2.1.3 Built Environment Impacts

The direct and indirect impacts on existing structures and other non-land features of each candidate site are considered.

3.2.1.4 Proximity to Existing Development

The proximity of the candidate sites to existing development is considered. The primary focus of this category is the proximity to towns near the sites.

Impacts to residential and agricultural properties are not considered in this category but are considered in the Property Impacts and Built Environment categories.

3.2.1.5 Geotechnical Concerns

The geotechnical conditions that can be discerned from available information at each site are considered, and issues related to each site are described.

3.2.1.6 Environmental and Habitat Disruption

The environmental and habitat impacts at each site are considered using the existing information sources described.

3.2.1.7 Roads and Traffic Impacts

The potential impacts to roads and associated traffic during construction and operation of the intakes are considered.

3.2.2 Evaluation Results

Table 1 includes a summary of the characteristics of each candidate site relative to each evaluation category. Table 2 presents the results of the qualitative environmental and habitat disruption evaluation. A relative ranking is presented regarding the relative suitability of each site.

Table 1. Summary of Alternative Intake Site Characteristics Relative to Evaluation Criteria

Candidate Site	Evaluation Category Bathymetry and River Encroachment	Evaluation Category Property Impacts	Evaluation Category Built Environment Impacts	Evaluation Category Proximity to Existing Development	Evaluation Category Geotechnical Concerns	Evaluation Category Environmental and Habitat Disruption	Evaluation Category Roads and Traffic	Overall Comments	Overall Rank (see Notes)
C-E-1	• Excellent depth (> 20 feet); stable river cross section with no significant change in bathymetric surface. • Close to levee top; river encroachment of structure < 100 feet. • Expect minimum screen length.	• Major impacts estimated on five properties. • Five additional properties estimated to be impacted to a lesser degree by SR 160 grade adjustment only, including Scribner's Bend Winery (commercial vineyard and wedding venue). • Impacts do not consider approximately 5-mile access road. • Rural; residential; and agricultural use, including pasture, truck crops, and vineyard.	• Three permanent residential structures with associated outbuildings within permanent footprint. • One potentially commercial horse ranch within permanent footprint. • Three residential structures with associated outbuildings adjacent to SR 160 regrading with lesser impacts. • Powerline in footprint.	• Work area less than 1 mile from Town of Clarksburg. • Noise and visual impacts to residents, schools, church, and businesses probable.	• Based on limited subsurface data, it appears that this site is underlain by about 90 feet of soft and loose, potentially liquefiable silty sands and sandy silts. • Beneath this upper layer, explorations encountered up to 40 feet of gravel and cobbles. This layer is anticipated to be highly pervious and would present a challenge to dewatering and drilled or driven foundation installation.	• No apparent differentiators for this category. • Refer to detailed summary in Table 2.	• Relocation and associated traffic disruption for SR 160. • No good access to work site. Longest new haul road. May need to use SR 160 or construct ~5 mile dedicated access road from Town of Hood through agricultural area along slough boundary. • About one-third the length of access road would be on existing farm roads. • Bridge required for access road.	• Highest impact site; consistently ranks poorly relative to other sites. • Direct and indirect impacts to multiple agricultural and residential properties. • Access expected to be difficult and costly, with agricultural impacts. • Worst geotechnical conditions. • Longest access road and connecting tunnel which increase overall Project impacts. • River conditions are favorable for shorter intake structure, but little else supports use of this site.	4 (tie)
C-E-2	• Acceptable depth (approximately 15-17 feet); stable in river cross section with no significant change in bathymetric surface. • Close to levee top; river encroachment of structure < 100 feet. • Expect longest screen length.	• Major impacts estimated on five properties. • Three additional properties estimated to be impacted to a lesser degree by SR 160 grade adjustment only. • Impacts do not consider approximately 3-mile access road. • Mostly agricultural land use, including pasture and orchard.	• Three permanent residential structures with associated outbuildings within permanent footprint. • River landing with dock within permanent footprint. • Four residential structures with associated outbuildings adjacent to SR 160 regrading and intake site with lesser impacts. • Impact to River Road and Scribner Road intersection.	• Work area less than 1 mile from Town of Clarksburg. • Noise and visual impacts to residents, schools, church, and businesses probable.	• Based on limited subsurface data, it appears that this site is underlain by about 70 feet of loose, potentially liquefiable silty sands. • Beneath this upper layer, explorations encountered alternating layers of hard silt and clay, and dense sands and gravel.	• Closest to Stone Lakes National Wildlife Refuge. • No additional differentiators for this category. • Refer to detailed summary in Table 2.	• Relocation and associated traffic disruption for SR 160. • No good access to work site. Long new haul road. May need to use SR 160 or construct approximately 3-mile dedicated access road from Town of Hood through agricultural area along slough boundary and along 3 mile access road from Lambert Road. • About half the length of access road would be on existing farm roads. • Bridge required for access road.	• Moderate impact site. • Direct and indirect impacts to multiple agricultural and residential properties. • Acceptable river conditions, but shallowest so would require longest intake structure. • Access expected to be difficult and costly, with agricultural impacts. • Direct visual impact to Town of Clarksburg.	3

Candidate Site	Evaluation Category Bathymetry and River Encroachment	Evaluation Category Property Impacts	Evaluation Category Built Environment Impacts	Evaluation Category Proximity to Existing Development	Evaluation Category Geotechnical Concerns	Evaluation Category Environmental and Habitat Disruption	Evaluation Category Roads and Traffic	Overall Comments	Overall Rank (see Notes)
C-E-3	• Excellent depth (> 20 feet); stable in river cross section with no significant change in bathymetric surface. • Close to levee top; river encroachment of structure < 100 feet. • Expect minimum screen length.	• Major impacts estimated on three properties. • Four additional properties estimated to be impacted to a lesser degree by SR 160 grade adjustment only. • Impacts do not consider approximately 1.5-mile access road. • Agricultural land use, vineyard and orchard.	• One modular residential structure within permanent footprint. • Two farm operations outbuildings within permanent footprint. • Three residential structures with associated outbuildings adjacent to SR 160 regrading and intake site with lesser impacts; one potentially significant (Rosebud House) with minor impact. • Minor powerline in footprint.	• Work area less than 1 mile from Town of Hood. • Noise and visual impacts to residents and businesses probable.	• Based on limited subsurface data, it appears that site is underlain by about 50 feet of loose, potentially liquefiable silty sands. • Beneath this upper layer, explorations encountered alternating layers of hard silt and clay, and dense sands and gravel.	• No apparent differentiators for this category. • Refer to detailed summary in Table 2.	• Relocation and associated traffic disruption for SR 160. • No good access to work site. Moderate new haul road length. May need to use SR 160 or construct approximately 1.5 mile dedicated access road from Town of Hood through agricultural area along slough boundary and along 3 mile access road from Lambert Road • Most of access road would be on existing farm roads.	• Lowest impact site; consistently ranked lowest for impacts relative to other sites. • Favorable river conditions which suggest shortest intake structure • Only one residential structure within permanent footprint. • Access appears to be feasible on existing farm roads with connection to Hood Franklin Road along slough boundary.	1
C-E-4	• Excellent depth (> 20 feet); stable in river cross section with no significant change in bathymetric surface. • Close to levee top; river encroachment of structure < 100 feet. • Expect minimum screen length.	• Major impacts estimated on two properties; one DWR-owned. • At least four additional properties estimated to be impacted to a lesser degree by SR 160 grade adjustment only. • Multiple additional properties in Town of Hood impacted by SR 160 grade adjustment. • Small additional impacts expected for access. • Agricultural land use, including pasture.	• One residential structure with associated outbuildings within permanent footprint; potentially significant property. • Three residential structures with associated outbuildings adjacent to SR 160 regrading and intake site with lesser impacts. • Direct and indirect impacts to homes and businesses within the Town of Hood. Not possible to assess full impact without more detailed engineering.	• Work area about 100 yards from Town of Hood. • Noise, dust, traffic, and visual impacts to residents and businesses expected.	• Based on limited subsurface data, it appears that site is underlain by about 25 feet of soft, potentially liquefiable clay. • Beneath this upper layer, explorations encountered alternating layers of hard silt and clay, and dense sands and gravel.	• No apparent differentiators for this category. • Refer to detailed summary in Table 2.	• Relocation and associated traffic disruption for SR 160. Relocation extends into the Town of Hood and intersection with Hood-Franklin Road. • Good access to work site from short, dedicated, access road from Town of Hood or along 3 mile access road from Lambert Road. Shortest new haul road length. • Possible wetlands impact for access road near Hood.	• High impact site since its adjacent to Town of Hood. • Favorable river conditions which suggest shortest intake structure • Best geotechnical conditions • Minor wetland impacts for access road. • Proximity, disruption, and related impacts to the Town of Hood are unavoidable.	4 (tie)

Candidate Site	Evaluation Category Bathymetry and River Encroachment	Evaluation Category Property Impacts	Evaluation Category Built Environment Impacts	Evaluation Category Proximity to Existing Development	Evaluation Category Geotechnical Concerns	Evaluation Category Environmental and Habitat Disruption	Evaluation Category Roads and Traffic	Overall Comments	Overall Rank (see Notes)
C-E-5	• Good depth (approximately 20 feet); stable in river cross section with no significant change in bathymetric surface. • Close to levee top; river encroachment of structure approximately 105 feet. • Expect moderate screen length.	• Major impacts estimated on four properties. • Five additional properties estimated to be impacted to a lesser degree by SR 160 grade adjustment only. • Impacts do not consider approximately 1.5-mile access road. • Agricultural land use, including orchard and truck crops.	• Two residential structures with associated outbuildings within permanent footprint. May be possible to avoid one. • Two residential structures with associated outbuildings adjacent to SR 160 regrading and intake site with lesser impacts; including Hemly historical house) with indirect impacts. • Minor powerline in footprint.	• Site furthest from towns; over 1 mile to the Town of Hood and almost 2 miles to Town of Courtland. • Noise and visual impacts to residents and businesses possible, but limited by distance.	• Based on limited subsurface data, it appears that site is underlain by about 70 feet of soft and loose potentially liquefiable sandy silts and silty sands. • Beneath this upper layer, explorations encountered alternating layers of hard silt and clay, and dense sands and gravel. • There is a significant thickness of hard clay that may be suitable for seismic lateral foundation support.	• No apparent differentiators for this category. • Refer to detailed summary in Table 2.	• Relocation and associated traffic disruption for SR 160. • No good access to work site. Among shortest new haul road lengths. May need to use SR 160 or construct approximately 3.5 mile dedicated access road from Town of Hood through agricultural area to Lambert Road along slough boundary. • Most of access road would be on existing farm roads. • Possible wetlands impact for access road near Hood.	• Lower impact site; consistently shows lower range of impacts relative to other sites. • Only two residential structures within permanent footprint; one may be possible to avoid, but additional engineering would be required. • Good river conditions for moderate length intake structure. • Proximity to potentially historic structure, but no direct impact except those associated with construction nearby. • Access appears to be feasible on existing farm roads along slough boundary with connection between Hood Franklin and Lambert Roads, although small wetlands impacts may result at Hood.	2

Notes:
A lower-ranking value indicates a better site (that is, Rank 1 is best).
< = less than
> = greater than

Table 2. Intake Siting Qualitative Environmental and Habitat Disruption Evaluation

Major Terrestrial Species that Could Occur at Intake Sites	Habitat Characteristics	Mitigation from Previous Studies	Site C-E-1	Site C-E-2	Site C-E-3	Site C-E-4	Site C-E-5	Summary
Valley Elderberry Longhorn Beetle	Elderberry bushes within 200 feet of riparian corridors. Observed plants along Snodgrass Slough, Railroad Cut, and Elk Slough.	1. Avoid plants with numerous emergent holes for the beetle, if possible. 2. Replant bushes in a mitigation area.	Elderberry bushes could be along river bank and drainages between site and Stone Lakes NWR.	Elderberry bushes could be along river bank and drainages between site and Stone Lakes NWR.	Elderberry bushes could be along river bank and drainages between site and Stone Lakes NWR.	Elderberry bushes could be along river bank, Snodgrass Slough, and drainages between site and Hood or Stone Lakes NWR.	Elderberry bushes could be along river bank, Railroad Cut, and drainages between site and Stone Lakes NWR.	Not a differentiator; mitigation measures are implementable.
Swainson's Hawk	Riparian forest and adjacent non-riparian trees.	1. Start construction between September 15 and March 15 (outside of breeding season). 2. Replant replacement trees in a mitigation area.	Within presumed extent, sightings have occurred within 0.5 mile (per CNDDB).	Within presumed extent, sightings have occurred within 0.5 mile (per CNDDB).	Within presumed extent, sightings have occurred within 0.5 mile (per CNDDB).	Within presumed extent, sightings have occurred within 0.5 mile (per CNDDB).	Within presumed extent, sightings have occurred within 0.5 mile (per CNDDB).	Not a differentiator, as the species distribution covers all sites.
Greater Sandhill Crane and Lesser Sandhill Crane	Forage habitat primarily in harvested row crops, generally corn and other grains, as well as irrigated and fallowed fields. Roosting in shallowly flooded open fields and wetlands.	Avoid starting construction and activities with loud noises during wintering season between September 15 and March 15.	Intake located within low use area; however, adjacent to Stone Lakes NWR with extensive foraging and roosting habitat (per BDCP, 2010).	Intake located within low use area; however, closest site adjacent to Stone Lakes NWR with extensive foraging and roosting habitat (per BDCP, 2010).	Intake located within low use area; however, close and adjacent to Stone Lakes NWR with extensive foraging and roosting habitat (per BDCP, 2010).	Intake located within low use area; however, adjacent to Stone Lakes NWR with extensive foraging and roosting habitat (per BDCP, 2010).	Intake located within low use area; however, adjacent to Stone Lakes NWR with extensive foraging and roosting habitat (per BDCP, 2010).	Not a differentiator between the intakes. Sites C-E-2 and C-E-3 are closest to Stone Lakes NWR, but generally far from foraging areas.
Tricolored Blackbird	Tule and cattail marsh and riparian scrub, including California Blackberry bushes.	Avoid starting construction during breeding season between March 15 and July 15.	Within presumed extent of breeding and foraging habitat (per CDFW).	Within presumed extent of breeding and foraging habitat (per CDFW).	Within presumed extent of non-breeding foraging habitat (per CDFW).	Within presumed extent of non-breeding foraging habitat (per CDFW).	Within presumed extent of non-breeding foraging habitat (per CDFW)	Not a differentiator between the intakes.
Western Burrowing Owl	Disturbed grasslands with visibility for observing prey, including ground-burrowing mammals.	Avoid if possible, and relocate during non-breeding season.	Within presumed extent of breeding and foraging habitat, in grasslands, but not necessarily in orchards and vineyards (per CDFW).	Within presumed extent of breeding and foraging habitat, in grasslands, but not necessarily in orchards and vineyards (per CDFW).	Within presumed extent of breeding and foraging habitat, in grasslands, but not necessarily in orchards and vineyards (per CDFW).	Within presumed extent of breeding and foraging habitat, in grasslands, but not necessarily in orchards and vineyards (per CDFW).	Within presumed extent of breeding and foraging habitat, in grasslands, but not necessarily in orchards and vineyards (per CDFW).	Possible presence within open fields and grasslands. However, burrowing owl can be relocated. Not a differentiator between the intakes.
California Least Tern	Flat, unvegetated areas near aquatic foraging habitat, generally tidal habitat. Not observed near intakes (DWR 2016).	Avoid starting construction during breeding season between April 15 and August 15.	Probably not present due to existing land uses and water characteristics.	Probably not present due to existing land uses and water characteristics.	Probably not present due to existing land uses and water characteristics.	Probably not present due to existing land uses and water characteristics.	Probably not present due to existing land uses and water characteristics.	Not a differentiator between the intakes.
Western Yellow-Billed Cuckoo	Riparian corridors with willow-dominated vegetation and Fremont cottonwoods. Most habitat along Sacramento River between Colusa and Red Bluff.	Avoid starting construction during breeding season between February and August.	Habitat along the Sacramento River near the intakes occurs in small patches, and no confirmed breeding records in this area.	Habitat along the Sacramento River near the intakes occurs in small patches, and no confirmed breeding records in this area.	Habitat along the Sacramento River near the intakes occurs in small patches, and no confirmed breeding records in this area.	Habitat along the Sacramento River near the intakes occurs in small patches, and no confirmed breeding records in this area.	Habitat along the Sacramento River near the intakes occurs in small patches, and no confirmed breeding records in this area.	Not a differentiator between the intakes.

Major Terrestrial Species that Could Occur at Intake Sites	Habitat Characteristics	Mitigation from Previous Studies	Site C-E-1	Site C-E-2	Site C-E-3	Site C-E-4	Site C-E-5	Summary
Western Pond Turtle	Impoundments, irrigation ditches, and other water bodies with stagnant or slow-moving freshwater habitats, and areas within 0.5 mile.	Avoid breeding season; and can relocate if habitat cannot be avoided.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Not a differentiator between the intakes.
California Red Legged Frog	Pools in perennial and seasonal streams and stock ponds. The habitat is generally not located at the intake sites.	Avoid starting construction during breeding season between November 1 and March 31.	No presumed habitat (DWR, 2016).	No presumed habitat (DWR, 2016).	No presumed habitat (DWR, 2016).	No presumed habitat (DWR, 2016).	No presumed habitat (DWR, 2016).	Not a differentiator between the intakes.
California Tiger Salamander	Vernal pools for breeding; and grasslands with burrows for cover, foraging, and aestivation. The habitat is generally not located at the intake sites; however, this species has been observed in the vicinity of Stone Lakes.	Avoid adverse effects on vernal pools.	Vernal pools do not appear to be present at this intake location.	Vernal pools do not appear to be present at this intake location.	Vernal pools do not appear to be present at this intake location.	Vernal pools do not appear to be present at this intake location.	Vernal pools do not appear to be present at this intake location.	Not a differentiator between the intakes.
Giant Garter Snake	Marshes, ponds, sloughs, small lakes, low-gradient streams, Sacramento River, other wetlands, and irrigation and drainage canals.	Avoid starting construction during breeding season between May and September.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Within presumed extent of habitat at this intake location.	Not a differentiator between the intakes.
Aquatic General Migration Corridors	Primary in Sacramento River.	Consider migration patterns for salmonids, Delta smelt, and longfin smelt (per DWR discussions in September 2019).	Migration activities occur during different time periods for each species or subspecies in the Sacramento River between the American River confluence and San Joaquin River confluence.	Migration activities occur during different time periods for each species or subspecies in the Sacramento River between American River confluence and San Joaquin River confluence.	Migration activities occur during different time periods for each species or subspecies in the Sacramento River between American River confluence and San Joaquin River confluence.	Migration activities occur during different time periods for each species or subspecies in the Sacramento River between American River confluence and San Joaquin River confluence.	Migration activities occur during different time periods for each species or subspecies in the Sacramento River between American River confluence and San Joaquin River confluence.	Not a differentiator between the intakes because all intakes are located within the same reach.

Notes:
The various potential intake locations are all located along the Sacramento River near riparian habitat. While several species are present or presumed present at the potential intake locations, most species can be avoided or relocated. Therefore, species or habitat presence is not considered a differentiator for intake site selection.
BDCP, 2010 = 2010 Bay Delta Conservation Plan GIS files
CNDDB= California Natural Diversity Database GIS files, September 2019 release
CDFW=California Department of Fish and Wildlife GIS files
NWR = National Wildlife Refuge

4. Conclusions

4.1 Candidate Sites

Five candidate sites were identified and are shown on Figure 1. These candidate sites are essentially the same as the five upstream sites recommended in the *5-Agency Technical Recommendations for the Location of BDCP Intakes 1-7* (2011). Re-examination of the Sacramento River's bathymetry and physical setting between the Town of Freeport and the confluence with Sutter Slough did not reveal new or additional candidate sites conforming to the siting criteria.

4.2 Candidate Site Evaluation

The candidate sites were evaluated and qualitatively ranked in accordance with the evaluation categories. The results are summarized in this section.

4.2.1 Candidate Site C-E-1

This site has suitable river conditions for an intake and its depth is expected to result in an intake structure of minimum length parallel to the river. However, this site has potentially the highest land-side impacts due to the number of residential and agricultural properties affected. It is not recommended for further consideration due to the relatively dense property distribution in the area and the number of properties expected to be directly or indirectly impacted.

The site potentially has the worst geotechnical characteristics relative to dewatering during construction, driving and drilling foundation piles and piers, and potential liquefaction.

The intake site and SR 160 regrading effort directly impact about 10 properties, not including the impacts related to a 5 to 8 miles of access road that may be considered to minimize traffic and wear and tear on SR 160 and Hood-Franklin Road. The impacts on properties and the built environment associated with using this site appear to be substantially greater than all other sites being considered except Candidate Site C-E-4.

4.2.2 Candidate Site C-E-2

This site has suitable river conditions for an intake and its relatively shallow depth is expected to result in an intake structure with the longest length parallel to the river. This site has relatively high land-side impacts, mainly related to residential impacts. It is recommended for further consideration if three intake sites are required for the Project.

The intake site and SR 160 regrading effort directly impact about eight properties, not including the impacts related to a 3 to 6 mile access road that may be considered to minimize traffic and wear and tear on SR 160 and Hood-Franklin Road. The site is visible from the Town of Clarksburg. The impacts of using this site appear to be moderate relative to Candidate Sites C-E-1 and C-E-4; and greater than Candidate Sites C-E-3 and C-E-5.

4.2.3 Candidate Site C-E-3

This site has suitable river conditions for an intake and its depth is expected to result in an intake structure with minimum length parallel to the river. This site is considered to potentially have the least land-side impacts, mainly because only one modular residential structure would be expected to fall

inside the permanent footprint. This site is considered the best choice among the candidate sites and is recommended for further consideration.

The intake site and SR 160 regrading effort directly impact about seven properties, not including the impacts related to a 1.5 to 3 mile access road that may be considered to minimize traffic and wear and tear on SR 160 and Hood-Franklin Road. The impacts of using this site appear to be lower than all other sites being considered.

4.2.4 Candidate Site C-E-4

This site has suitable river conditions for an intake and its depth is expected to result in an intake structure with minimum length parallel to the river. However, this site is considered to have very high land-side impacts because it would be directly adjacent to the Town of Hood. Access road development and SR 160 regrading work would be expected to extend into the town. It is not recommended for further consideration due to its proximity to Hood, the resulting indirect impacts to residences and traffic, and the number of properties that could be directly or indirectly impacted.

Not including an unknown number of properties in Hood, the intake site and SR 160 regrading effort directly impact about five properties. Additional impacts can be expected related to a 3-mile access road from the eastern side of Hood that may be considered to minimize traffic and wear and tear through Hood, on Hood-Franklin Road, and on SR 160. The impacts on Hood as well as properties and the built environment associated with using this site appear to be substantially greater than all other sites being considered except Candidate Site C-E-1.

4.2.5 Candidate Site C-E-5

This site has suitable river conditions for an intake and its depth is expected to result in an intake structure with moderate length parallel to the river. This site generally has lower land-side impacts, mainly because only one or two residential structures are expected to fall inside the permanent footprint. The site is adjacent to a historic residential structure, but work near that structure is expected to result in only minor. mostly indirect, impacts related to SR 160 regrading and from being adjacent to the work area. This site is considered the second best choice among the candidate sites and is recommended for further consideration.

The intake site and SR 160 regrading effort directly impact about nine properties, not including the impacts related to a 3.5-mile access road that may be considered to minimize traffic and wear and tear on Hood Franklin Road and SR 160. The impacts of using this site appear to be consistently lower than all other sites being considered except Candidate Site C-E-3.

5. Recommendations and Next Steps

5.1 Recommendations

It is recommended that for an alternative with a Project design capacity of 6,000 cfs (including the Bethany Reservoir Alignment, Candidate Sites C-E-3 and C-E-5 be included in the Project as the primary sites.

Since no more than three intake sites appear to be necessary for a single tunnel conveyance system, it is recommended that Candidate Sites C-E-1 and C-E-4 be eliminated from further consideration.

6. References

2011. 5-Agency Technical Recommendations for the Location of BDCP Intakes 1-7.

California Department of Fish and Game (CDFG). 2010. "Appendix S, Fish Screen Criteria." June 19, 2000 version. *California Salmonid Stream Habitat Restoration Manual*. 4th Ed. Wildlife and Fisheries Division.

California Department of Water Resources (DWR). 2009. Value Planning Study for Diversion Facilities Along the Sacramento River, Revision B, Final Draft. Delta Habitat Conservation & Conveyance Program, DHCCP Washington Team.

California Department of Water Resources (DWR). 2010. Evaluation of DHCCP Proposed Intake Locations. Division of Engineering.

California Department of Water Resources (DWR). 2016. Bay Delta Conservation Plan/California WaterFix Final EIR/EIS.

California Department of Water Resources (DWR). 2023. *Delta Conveyance Project Final Environmental Impact Report*. SCH# 2020010227. December

Fish Facilities Technical Team (FFTT). 2008. Conceptual Proposal for Screening Water Diversion Facilities along the Sacramento River. Preliminary Draft. Bay-Delta Conservation Plan.

Fish Facilities Technical Team (FFTT). 2011. *BDCP Fish Facilities Technical Team Technical Memorandum.* Bay Delta Conservation Plan.

National Oceanic and Atmospheric Administration (NOAA). 1997. Fish Screening Criteria for Anadromous Salmonids, National Marine Fisheries Service Southwest Region.

National Oceanic and Atmospheric Administration (NOAA). 2018. NOAA Technical Memorandum NMFS-NWFSC-1xx, NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Guidelines. Peer Review Draft. National Marine Fisheries Service West Coast Region, Environmental Services Branch.

Bathymetric data sources were as follows:

Author. 2010. Bathymetric Mapping of Sacramento River (informally referred to as the Fugro Bathymetry; formal citation requested).

California Department of Water Resources (DWR). 2019. Bathymetric survey on the Sacramento River from the confluence with the American River to Courtland. North Central Region Office, Bathymetry Data Collection Section.

Attachment 1
Intake Location Analysis

Appendix 3F
Intake Location Analysis

3F.1 Introduction

The purpose of this appendix is to describe the process(es) and steps utilized to identify and refine potential new intake locations for analysis in the Bay Delta Conservation Plan (BDCP)/California WaterFix Environmental Impact Report/Environmental Impact Statement (EIR/EIS). The identification of potential intake locations was accomplished through an iterative process involving engineers and resource experts most familiar with existing facility operations, river hydrology, and the biological resources in the Delta. This process included convening a Fish Facilities Technical Team, conducting a Value Planning Study, and participating in numerous collaborative meetings with technical staff from the various agencies and consultants collaborating in the BDCP process to discuss evolving information.

Currently, the coequal goals of the BDCP are restoring the Delta ecosystem while at the same time securing a reliable water supply. This objective is also the policy of the State of California, as reflected in the 2009 legislation commonly referred to as the Delta Reform Act[1]. The California Department of Water Resources (DWR) and United States Bureau of Reclamation (Reclamation) are jointly seeking to protect at-risk fish species either through improving existing diversion facilities and/or by building new diversion facilities with state-of-the-art fish screening capabilities.

Since the 1970s, several variations of new diversion facilities have been suggested and/or evaluated to address these issues. As technologies and criteria have evolved and data have been collected over past decades, diversion concepts have developed accordingly. For the BDCP, two general approaches have been proposed to date for diverting and screening water conveyed through the Delta. First, the addition of diversion facilities further north on the Sacramento River has been evaluated. In the alternative, the BDCP has considered use of the existing consolidated diversion at Clifton Court Forebay with the inclusion of improvements that address BDCP objectives relating to species concerns and reliability of water supply.

3F.2 Sacramento River Diversion Facilities

One option for improving survival conditions for delta fisheries is to withdraw water from the Sacramento River upstream of the aquatic habitats most favorable to at-risk fish species. By adding new points of diversion to the northern limits of the legal Delta, it is expected the threat to vulnerable species can be significantly decreased. For example, implementing new points of diversion on the Sacramento River could help avoid intake exposure for smelt species. Through the DHCCP and BDCP processes, several conveyance options using new points of diversion have been evaluated, each including improved means of fish protection. These evaluations have indicated that when new Sacramento River facilities are operated in tandem with the existing South Delta pumps, the flexibility of Central Valley Project and State Water Project operations can be increased to allow

[1] Sacramento-San Joaquin Delta Reform Act of 2009, SBX7 1.

operators to divert water from Northern or Southern facilities in response to the needs of various life stages of affected species as they move in and out of the Delta.

3F.3 Fish Facilities Technical Team (FFTT) 2008 Proposal

In 2008, the BDCP brought together State and federal regulatory agency and industry experts as the Fish Facilities Technical Team (FFTT) and charged them with developing, analyzing and proposing concepts on fish screen technologies and facilities for intake facilities with a maximum diversion capacity of 15,000 cubic feet per second (cfs) as part of an isolated conveyance system. The focus of the FFTT was to provide the BDCP Conveyance Workgroup with initial direction and recommendations regarding location, composition and arrangement of fish protective diversion facilities.

The FFTT provided its recommendations in an August 2008 draft report *Conceptual Proposal for Screening Water Diversion Facilities along the Sacramento River*. The FFTT developed several intake concepts that would suit the conveyance options being explored under the BDCP. It is important to note that the FFTT intake concepts were developed strictly looking at the requirements of diverting water from the river and not how the water would be conveyed beyond the levees bordering the river. Thus, existing land use, infrastructure constraints, and other criteria were not included for consideration during the initial FFTT evaluation. Further, the FFTT was directed by the Conveyance Workgroup to focus on a reach of the Sacramento River between the City of Sacramento and Walnut Grove for locating fish screen intake facilities.[2] Based on the review of available information, the team identified twelve potentially suitable locations, identified as locations A-L (see Figure 3F-1), for placing a diversion facility. Based on the selected locations and various screening techniques available the FFTT proposed four intake concepts.

[2] *Conceptual Proposal for Screen Water Diversion Facilities along the Sacramento River*, p. 9, (FFTT/BDCP August 2008). Northern locations were recommended to reduce the exposure of delta smelt, longfin smelt and other estuarine species. (FFTT 2008, page 5)

The FFTT proposed intake concepts included the following[3]:

Diversion Concept	Facility Type/Location	Number and Capacity
A	Combined In-River (Dual) and On-Bank Intakes at Cross-Section Locations C (Freeport), F (Hood), and H (Courtland)	Three sites at 5,000 cfs each
B	Series of Cylindrical Screens at Locations from A (Sacramento) to L (Walnut Grove)	Ten sites with fifteen screens per site for a maximum of 1,500 cfs per site
C	Combined In-River (Dual) and On-Bank Intakes at Cross-Section Locations from A (Sacramento) to L (Walnut Grove)	Ten sites at 1,500 cfs each
D	Combined In-River (Dual) and Cylindrical Screens at Cross-Section Locations from A (Sacramento) to L (Walnut Grove)	Ten sites at 1,500 cfs each

Key elements that were considered by the FFTT when identifying potential intake concepts included river bathymetry, hydraulics, temporal and spatial distribution of salmonid and smelt species, opportunities to minimize predation, sediment management, flood control, and navigational impacts. Several key conclusions relative to intake locations were:

- Intakes should be located as far north as possible to minimize encroachment on Delta smelt habitat. This approach also improves sweeping velocities at intakes as a result of muted tidal backwater effects[4].
- Intakes should be located within straight reaches of the river to avoid complex flow patterns, scour, and sediment issues associated with river bends.
- Existing riparian habitat should be avoided.

3F.4 Value Planning Study Team

Recognizing that other factors play a role in constraining options and contributing to feasible intake location choices, a Value Planning Study Team (VPS Team) was assembled to assist in further defining intake locations and configurations. The VPS Team completed a Value Planning Study (VPS) to further evaluate potential intake schemes considering factors beyond the limits of the river boundaries. The VPS Team was comprised primarily of independent participants spanning a broad cross-section of technical disciplines (including civil engineers, mechanical engineers, and biologists), met for a week-long workshop that included a half-day tour of proposed intake locations to provide the team with perspective on existing conditions and constraints to intake siting. Three members of the FFTT were included on the VPS Team to maintain continuity and information transfer. The VPS was developed to analyze potential options considering operational flexibility, maintainability, community impacts, conveyance requirements, economics, and infrastructure

[3] *North Delta Intakes Facilities for the Draft EIR/S*. Table 3.1 FFTT Proposed Diversion Concepts. (11-30-2010 Draft).

[4] Although intake locations were recommended to be as far north as possible they must also be sufficiently downstream from the SRCSD discharge for water quality considerations and also south of the confluence of the Sacramento and American Rivers for flow considerations.

impacts, among other considerations. A list of roughly forty intake concepts was developed for the east and west conveyance routes, with varying capacities, locations and technologies. Ultimately, twenty-three options were advanced for comparison, addressing both east and west conveyance alignments along with an additional eight options specific to the west alignment only and including in-river, near-bank, and on-bank screen configurations. Eight performance factors were applied:

- Operational flexibility
- Maintainability
- Constructability/construction ease
- Fish protection/fish benefits
- Landowner and community impacts
- River impacts
- Safety
- Security

The VPS Team produced a list of feasible intake concepts as well as performance factors and approximate costs by which to compare the options. A criteria and evaluation matrix was developed as a decision support tool to compare the performance of a series of concepts using a weighted list of characteristics or factors (California Department of Water Resources 2009a).Selection of Intake Locations for EIR/EIS Analysis

Based on what was analyzed by the FFTT and the VPS Team, initial intake locations were selected for evaluation by the BDCP lead agencies. Subsequent to the FFTT and VPS Team efforts, more in-depth evaluations were conducted to select the appropriate number of intakes and a preferred arrangement of locations that would meet a variety of criteria, such as fish protection, land use impacts, impacts to terrestrial species habitat, river geomorphology, hydraulics, and use of best available intake technology. This decision making process served as the basis for defining intake facility locations for evaluation in the Draft EIR/EIS. These evaluations led to the identification of five separate intake facilities, each with a maximum diversion capacity of 3,000 cfs, to be located between Freeport and Courtland.

In January 2009, a subset of Lead-Agency staff held meetings to refine locations of intake sites for all conveyance alignment options according to various environmental and land impact factors. A collaborative process was used to adjust intake sites in an attempt to minimize impacts. Available geographic information system (GIS) datasets used included:

- Property boundaries/parcel lines
- Rare species habitat zones
- Existing points of diversion on the Sacramento River
- Existing Land Use
- Wetland delineation
- River cross-sections
- United States Fish and Wildlife Service (USFWS) fish trapping data
- Ground level surveillance

A site tour was also conducted in coordination with lead agency staff to give participants a view of the physical setting and existing site conditions at the various potential intake locations. This trip was instrumental in providing first hand perspective on the somewhat typical site conditions that exist for all of the intake locations.

Intake locations were differentiated by an evaluation of exposure of special status fish species to the intake screens, acreage of special status terrestrial species impacted by the intake locations, and acreages of land where existing uses would be changed by intake facilities. Physical locations identified by the FFTT were adjusted to minimize landside impacts. The result of this process and the respective adjustments are reflected in Figure 3F-2.

After the refinement of the intake locations, discussions were held with lead agency representatives and BDCP/DHCCP in December of 2009 to develop key design and environmental factors that could be used to screen intake location options. The primary purpose of the screening process was to determine a smaller set of potential intake locations. Key factors that were decided upon were:

- Individual points of diversion should be limited based on FFTT and VPS study results.
- Omit options exclusively involving cylindrical screen technology due to design limitations.[5]
- Use a single screening technology rather than multiple technologies based on O&M challenges[6].
- Eliminate options involving ten intakes because of the increase in community and species impacts.
- Eliminate options involving six intakes because they are similar to and represented by options with five intakes.
- Eliminate intake options at the southern end of the study reach due to tidal influence, higher probability of Delta smelt abundance, and potential impacts on natural flow in Sutter and Steamboat Sloughs.

The result, after applying these factors in several iterations, was a set of five potential intake combinations.[7]

3F.4.1 Conceptual Engineering Report Concept Planning Conclusions

Next, based on the process outlined above, Lead Agency staff selected initial intake locations for the East and West preliminary intake sites based on analysis prepared in a conceptual engineering report (CER). The CER recommended five 3,000 cfs capacity intakes. Locations A (west of the Pocket Area), B (south boundary of the Pocket Area), D (southern east-west leg of the Freeport Bend), F (just downstream of Hood), and G (between Hood and Courtland) were selected for the western

[5] Cylindrical screens consist of a series of dual screens (see ATO CER, Appendix B [DWR 2010a]). The space between the dual screens has the potential to provide opportunity and area for use by predatory species. Drawbacks to this screen configuration also include the number of moving parts and hydraulic components, exposure to impact damage from debris/bed load, single source manufacturing, and potential for producing structures in the watercourse which supports predation.

[6] The use of a uniform (single) screen technology for all of the intake facilities has advantages including uniformity of design, exchangeable parts, uniform training for operations and maintenance employees and consolidation of operations and maintenance activities.

[7] *Proposed North Delta Intake Facilities for the Draft EIR/S*, Table 3.4 & Figure 3.6, p. 3-21 (DWR 2010b).

isolated conveyance facility; and locations B, D, E (due east of Clarksburg), F, and G were chosen for the eastern isolated conveyance facility. For the Through-Delta conveyance alignment, two 2,000 cfs intakes were selected at locations F and G.

Location C (due west of Freeport) was eliminated due to its proximity to an existing intake at Freeport and its location about 0.5 miles south of the existing Sacramento Regional County Sanitation District (Sacramento Regional) treatment plant outfall. Intake locations E and E1 were eliminated from consideration for the west conveyance option because of their proximity to an existing community. Intake location B is as far north as an intake can be for the eastern isolated conveyance facility without substantially impacting urban development in Sacramento.

Locations D and E were preferred for the eastern isolated conveyance facility because they are located at the north end of the study reach and because water from these two intakes and an intake at location B can be transported to an eastern conveyance facility with a minimum of land use disturbance. Intake locations F and G were preferred, for both alignments, because they can also be joined to a single canal to move the water from all five intakes to a conveyance facility with a minimum of land use disturbance and impacts to terrestrial habitat.

Additionally, existing conditions and preliminary impact analyses were conducted in support of the EIR/EIS. This information was available to the lead and responsible agencies to further refine intake locations during their formulation of EIR/EIS alternatives and review of preliminary impact analysis results.

In September 2009, representatives of the EIR/EIS lead and responsible agencies took a site tour and recorded their field observations and recommendations for intake locations. The purposes of the tour were as follows: to incorporate updated information from the administrative draft EIR/EIS document and draft alternatives development analysis, along with recommendations based on the professional judgment of agency representatives; to confirm the relative suitability of currently proposed intake sites; to make recommendations for adjustments, if needed; and to provide supporting rationales excluding certain areas from further consideration due to their less favorable characteristics.

As a result of the field visit, several intake locations were shifted slightly to avoid existing easements, riparian habitat restoration activities, towns/communities, established monitoring locations, and high-value land uses. Understanding the iterative nature of the intake siting process, alternate intake locations were also recommended in the event that, based on follow-up engineering investigations, one of the other recommended intake locations was determined to be less favorable.

3F.4.2 Consideration of Intake Locations Downstream of Sutter and Steamboat Sloughs

Additional modeling was conducted in late 2009 to simulate operation of the proposed five intake locations. This effort further informed the DHCCP team and the EIR/EIS consulting team on how the intakes might be operated (e.g., comparing an operational scenario where all intakes would be pumping simultaneously with a scenario where intakes would be activated using top to bottom – that is, north to south – sequencing and how the Delta hydraulics would be affected). The modeling effort also raised questions related to fish exposure to the intakes and possible scenarios to provide additional biological protection through avoidance.

In 2009 and 2010, the fish agencies requested additional hydrologic and operational information to determine (i) whether biological protection could be increased by locating all of the intakes upstream of the confluence of the Sacramento River with Sutter and Steamboat sloughs or (ii) whether two intakes located downstream of the sloughs would provide additional protection under certain operating conditions. The rationale for identifying potential intake locations downstream of Sutter and Steamboat sloughs was based on the assumption that some proportion of the population of emigrating juvenile salmonids and smelt that emigrate through or generally use the distributaries during regular seasonal movements would avoid exposure to the intakes downstream of the distributaries. Current information suggests that roughly 25–30% of the Sacramento River flow may enter Steamboat and Sutter sloughs. If fish are diverted at the same ratio, then 25–30% of the migrating anadromous salmonids could experience exposure to only 3 screens, as opposed to 5. Fish that avoid exposure to intakes are not subjected to "take" associated with increased predation related to the presence of intake structures, and entrainment or impingement related to operations. However, increased tidal influence of downstream intake locations could result in multiple exposures to the same intake with tidal reverse flows. Likewise, intakes located downstream of the sloughs and thus deeper into the tidally influenced reaches of the Delta could result in reduced water quality for diversions, a condition that could worsen in the future with climate change and sea level rise. Additionally, there is a potential for reduced water diversions due to diversion operation sweeping velocity constraints from increased tidal influence of the farther downstream intake locations.

The BDCP consulting team also conducted investigations on intake locations below the sloughs and their respective effects on these distributaries' tidal reverse flow/emigration durations. The intent was to determine, if possible, what effect intakes located downstream of the sloughs would have on 1) the absolute flows and relative proportion of flows entering Sutter Slough, Steamboat Slough, and mainstem Sacramento River, 2) increased tidal influence at these locations, 3) hydrologic interactions between downstream intakes and Georgiana Slough or the Delta Cross Channel, and 4) the potential for any such interactions to result in adverse effects on covered fish species, habitat quality, and water quality.

Between 2009 and 2011 several meetings between the Lead Agency group and the DHCCP team resulted in recommended adjustments to the proposed intake locations. Due to community opposition expressed during scoping meetings, construction impacts in an overly constrained conveyance corridor, historic building conflicts, and the precedent set by the Freeport Diversion EIR (a 300 cfs intake across the river from the Pocket Area was determined not a reasonable and prudent alternative), the Lead Agency group recommended relocation of the northernmost intakes. Locations downstream of Sutter and Steamboat Sloughs were discussed, and additional analysis was conducted by the BDCP consulting team that discouraged downstream locations to minimize tidal influence effects on operation, maximize positive outbound sweeping velocities, minimize encroachment on Delta smelt habitat, and avoid producing reverse flows in the sloughs. General recommendations from the FFTT to provide approximately 1-mile separation between intakes, to locate intakes on straight reaches of the river as far north as possible, and to locate the furthest north intake a few miles downstream of the Sacramento regional effluent discharge remained intact. However, the process did result in adjusting physical locations of intake sites between Sacramento and Walnut Grove from those identified in the FFTT study, including the elimination of one particular site due to prohibitive existing features and conditions.

The BDCP consulting team presented its recommendations regarding the upstream versus downstream intake locations to the BDCP Steering Committee on January 20, 2010. In support of

locating all five intakes upstream of Sutter Slough, the team cited reduced probability of bi-directional tidal flows and improved sweeping velocities with greater river flows further upstream (less flow diverted to sloughs), which could reduce exposure time to intake screens. The team also suggested that locating intakes further upstream would reduce the future effects of sea level rise and salinity intrusion on export operations and protection of fish. Intakes located further upstream would be less likely to entrain organic material and food produced in the Cache Slough region.

Locating intakes downstream of Sutter Slough could result in reduced exposure of juvenile salmonids and other covered fish produced upstream because some proportion of the fish would migrate downstream through the sloughs and thus not be exposed to the two downstream intake structures. However, downstream locations could increase delta smelt and longfin smelt exposure to the screens, an increase that could be exacerbated over time by sea level rise. Locating two intakes downstream would also lengthen the distance the intakes are spread along the Sacramento River, providing increased refuge areas between structures, but the increased probability of bi-directional tidal flows would increase exposure duration for the two downstream intakes. The BDCP consulting team also pointed out that revisions to the bypass criteria would be needed to account for flows entering Sutter and Steamboat sloughs; and these bypass flows and diversion rates would be complex to model. Based on a consideration of the pros and cons of the two alternative intake location configurations, the BDCP consulting team recommended that all five intake structures be located in the Sacramento River in the reach upstream of the confluence with Sutter Slough.

However, the potential intake locations downstream of the sloughs continued to interest the fisheries agencies. An interagency conceptual discussion of the relationship of the intake locations to smelt and salmonid distribution and exposure to the intakes resulted in a calculation of smelt and salmonid exposures under the two configurations. The primary concern of the location of the intakes respective to the smelt population distribution in the diversion planning reach is to avoid smelt egg and larval life stage exposure to the intakes in which entrainment or impingement could occur. Presumably, since the egg and larva are free floating, the smelt losses would be proportionate to the rate of exposure and the proportion of diversion flows to the tributary flows at the time of exposure. The rationale for placing the intakes as far upstream as feasible for smelt distribution is that the portions of the smelt population in this reach that reproduce downstream of the intake locations would not be exposed to the intakes, or in cases of fish produced from the middle portion of the reach, smelt egg and larva would be exposed to a reduced number of intakes. Using collected fish/station data from the planning reach, the downstream configuration resulted in a calculated 23% increase in smelt screen exposures while the downstream configuration resulted in a calculated 16% decrease in salmonid screen exposures.

3F.5 Refinement of Intake Locations for EIR/EIS Analysis

Previously the FFTT identified 12 sites as possible intake locations extending from north of Freeport to Sutter Slough. Further effort refined the intake sites proposed by the FFTT. Site visits, scoping comments, and land use considerations prompted the EIR/EIS consulting team to adjust its original five proposed sites. In developing proposed sites for the intakes, the following general considerations were used:

- Position them as far upstream as practical to best avoid encroachment on potential Delta smelt habitat and to minimize probability of smelt exposure;
- Position them as far upstream as practical to best avoid tidal influence and to achieve the greatest opportunity for positive outbound flows with ambient sweeping velocities minimizing fish exposure duration;
- Site intakes to avoid highest concentration of fish in the water column, found to be toward the outside radius of a bend per United States Geological Survey "Clarksburg Bend" pilot experiment conducted in 2005–2006;
- Locate intakes upstream of Steamboat and Sutter Sloughs to avoid producing unnatural reverse flows in the sloughs, prolonging emigration of salmonids entering these waterways, and increasing exposure to predation by circulating young fish back and forth past aquatic and avian predators;
- Maintain a one-mile buffer distance between intake facilities to provide for fish resting and redistribution within the river section;
- Minimize visual and noise disturbance, as well as construction-related impacts, to land owners, residents, and commercial areas;
- Avoid/Minimize displacing land owners and residents;
- Avoid known areas with high concentration of cultural and historic resources;
- Preserve riparian habitat whenever possible and minimize impacts to special status terrestrial species and high value habitats;
- Avoid placing intakes where hydraulic conflicts with existing facilities could occur; and
- When possible, use sites were levee stability is compromised and requires eventual repair even without new intakes (the thought being that, because intake construction requires movement of existing levees, long-term cost savings could be achieved by using intake construction as an opportunity to strengthen levees already in need of strengthening).

The proposed five intake structure locations were reviewed by the Lead Agency group and its Anadromous Fisheries Mini-Effects Team, the BDCP Steering Committee, and the National Marine Fisheries Service. The Anadromous Fisheries Mini-Effects Team analyzed the proposed locations and identified a concern that the intake structures would potentially attract predatory fish and increase the vulnerability to predation mortality of juvenile salmonids and other covered fish species. To offer alternate pathways to migrating salmonids and other fish, it was again proposed to locate one or more intakes downstream of the junctions with Sutter and Steamboat sloughs. The EIR/EIS consulting team recognized the need to include downstream intakes in the range of alternatives evaluated in the EIR/EIS.

3F.6 Lead Agency Suggested Locations

In May 2010, the Lead Agency group guiding development of the EIR/EIS suggested that five specific site locations north of Sutter and Steamboat sloughs and two site locations south of the sloughs be moved forward for analysis, with each site capable of diverting 3,000 cfs from the Sacramento River. Meanwhile, the DWR engineering team obtained bathymetric data for the entire river reach and

began evaluating the proposed site locations for appropriate river geometry, resulting in suggested alternative sites for several of the intake locations.

In July 2010, the BDCP Steering Committee received a presentation entitled, "Evaluation of North Delta Intake Locations," which addressed potential optional intake locations, including intakes both upstream and downstream from the five proposed intake locations suggested by the EIR/EIS consulting team. Key findings from the presentation were:

- All configurations analyzed, within the reach upstream of the Sacramento-American River confluence to downstream of Sutter and Steamboat Slough, appear to have similar salinity levels at the intakes.
- Diversion capability appears insensitive to the intake configurations analyzed.
- Operations and operational preference are more important than location of the intakes for effects on tidal dynamics.
- Intake locations primarily influence exposure risk and to a lesser extent migration pathways.

This presentation indicated that locating two intakes south of Sutter and Steamboat Sloughs may provide a significant benefit to out-migrating smolts. This benefit was based in part on the results of a one dimensional particle tracking model that indicated that about half the particles moved down Sutter and Steamboat Sloughs and the other half moved past Walnut Grove. Since smelt larvae are much more likely than salmonids to be entrained through a screen, the possible benefits associated with avoiding the lower intakes might provide an overall greater benefit for these alternative intake locations. However, it was noted that fish do not necessarily behave like particles and the actual percentage of downstream migrants entering these sloughs is uncertain. Assumptions may also be affected by where the fish are during low versus high flows in the river. For example, fish may be more bank-oriented during low flows, while they may be more center-oriented with higher flows or with changes in turbidity. Juvenile salmonid emigration behavior and habitat preference may in turn be a function of whether fish are wild or are produced by a hatchery, as hatchery fish may be more bank-oriented due to feeding patterns at the hatcheries.

An acoustic tracking study conducted by David Vogel (2008) monitored large (107 mm to 181 mm smolt sized) juvenile Chinook salmon as they emigrated through this region of the Delta. Vogel reported that 26% of tagged smolts entered Sutter and Steamboat Sloughs during a series of releases in December, and 37% entered the sloughs during January releases. It is problematic to try to interpret these data to estimate how smaller fish such as larval delta smelt or fry sized salmonids might behave at these channel junctions, as these smaller fish would have much weaker swimming abilities than the larger fish used in Vogel's study.

3F.7 Further DWR Studies

In late 2010 DWR contributed two reports summarizing studies and analysis relevant to selection of intake locations. The first, *Two Dimensional Hydraulic Modeling Studies of DHCCP Intakes*[8], summarized preliminary two dimensional hydraulic modeling results of the Sacramento River section covering the proposed intake sites for the DHCCP. The objective of these modeling studies was to quantify the near-field impacts of the proposed intake technologies on Sacramento River

[8] *Proposed North Delta Intake Facilities for the Draft EIR/S*, Appendix G (DWR 11-30-2010).

hydraulics. This study concluded that based on the two dimensional modeling runs, both in-river type intakes (with and without setback levees) would have severe adverse impacts on channel hydraulics. The on-bank intakes, however, were found to have minimal impacts on the river hydraulics and were viable alternatives for the DHCCP program.

In response to the bathymetric study, DWR Division of Engineering (DOE) prepared a report entitled *Evaluation of DHCCP Proposed Intake Locations* to reevaluate the locations of the proposed DHCCP intakes. A total of 17 locations along the Sacramento River between Freeport and Steamboat Slough were included in DOE's study: five sites recommended by the DHCCP Conceptual Engineering Reports from November 2009 (California Department of Water Resources 2009b), five sites recommended by the DHCCP from *Technical Memorandum* 3 *Recommended Delta Intake Facilities for the Draft EIR/S (Draft*) (California Department of Water Resources 2010c), and seven sites chosen by DOE based on the new bathymetric study data. The sites were named Intake Site 1 (IS-1) through IS-17, from the most northern site to the most southern site. All of these sites also satisfied recommendations made by the FFTT's first report for proposed intake locations. All seventeen of the sites were evaluated using aerial maps, land use maps, recently collected bathymetry data, river cross-sections, and water surface elevations at the 99% exceedance level. The sites were then analyzed and compared based on the following criteria:

- Location on the east or the west bank of the Sacramento River
- Impact to existing structures, businesses, historical interests and current use of the land,
- The potential for deposit of sediments at the face of the intake fish screens, and
- Potential encroachment into the river cross-section and corresponding water depth, and preliminary screen height and intake facility length estimates.

After evaluating all seventeen potential sites, the report identified two preferred combinations of five intake locations. One set of five was all on the east bank of the river and north of Courtland. A second set allowed for flexibility in locating the intakes on the east or west bank.

3F.8 Reconvening the Fish Facilities Technical Team

Based on new information produced and gathered during the efforts described above, as well as discussions occurring in various other working groups (such as the Bypass Subgroup, the Habitat and Restoration Technical Team, and the Anadromous Fish Team), the FFTT was reconvened to revisit its initial recommendations. In January 2011, a formal charge was given to the FFTT by the EIR/EIS five agency group, made up of representatives from DWR, California Department of Fish and Game (CDFG), Reclamation, USFWS, and the National Marine Fisheries Service (NMFS). A series of meetings were conducted to address the issues as assigned in the formal charge and to draft a technical memorandum of the team's recommendations and rationale (BDCP Fish Facilities Technical Team 2011).

Among other tasks, the FFTT was charged with:

- Reviewing new information developed since the last FFTT meetings held in 2008, including the Separate Analysis presented to the BDCP Steering Committee in January 2010 and any construction cost estimations for the separate configurations provided in the Separate Analysis conducted by the BDCP consulting team;

- Reviewing additional information and studies generated since the FFTT last convened; and
- Based on those reviews, to consider any adjustments to its previous recommendations regarding locations, individual size, and configuration of intakes for the benefit of listed and unlisted fish or for water quality.

In considering any options for intakes, the FFTT was instructed to consider changes in flood potential (both local and regional), preliminary costs, and constructability for a total 15,000 cfs diversion capacity. To aid in the analysis of additional intake locations south of Sutter/Steamboat Sloughs, the FFTT asked DWR to provide Sacramento River bathymetric plots between the sloughs and Walnut Grove. The team looked at the bathymetric plots as well as some cross sections of two locations in the reach that were more than a mile apart and had a river bottom of about -22 feet mean sea level (MSL). The FFTT agreed that optional intake locations south of Sutter/Steamboat Sloughs should be reviewed.

Additional recommendations from the FFTT in 2011 include:

- Locate diversion structures up against the bank of the river rather than out in the channel.
- Locate intakes downstream of the town of Freeport due to public scoping comments received in March 2009 citing construction impacts in an overly constrained conveyance corridor, historic building conflicts, and the precedent set by the Freeport Regional Water Project EIR indicating that intakes in the Pocket area would produce significant impacts.
- Target approximately 1-mile of separation between intakes, though closer spacing may be acceptable to assure that each location meets the critical siting conditions (e.g., adequate river depth and bank geometry).
- Locate intakes within straight reaches of the river or mild outside bends to avoid complex flow patterns, sedimentation, and excessive scour.
- Locate the furthest upstream intake downstream of where complete mixing is reported to occur with effluent discharge from the Sacramento Regional Wastewater Treatment Facility.

The FFTT reviewed bathymetric data for both the EIR/EIS locations and the several additional locations identified by the DWR engineering team which were potentially better suited for a diversion facility due to water depth and river curvature. The additional intake locations evaluated by the FFTT included the original EIR/EIS Sites 1 through 5, the Alternate Sites 1 through 5 as refined by DWR for the FFTT, and the two sites below Steamboat Slough, FFTT Sites 6 and 7.

During the process, it was discovered that conflicting coordinates and facility footprints existed for intakes 1-5. An initial set of GPS coordinates had been developed for the 2010 DHCCP Conceptual Engineering Reports (CER). After the release of the CER, DWR developed revised coordinates largely reflecting the change from “in-river” to “on-bank” intake fish screen technologies and data from the new bathymetric survey. The differences between the two efforts can be seen on Table 1. For the two locations furthest upstream, intakes 1 and 2, the alterations were minimal in comparison to the initial coordinates identified in the CER process. However, the locations for intakes 3, 4, and 5 differed appreciably, which prompted the FFTT to recommend a field visit to those alterative intake sites with agency and consultant staff knowledgeable in the biology, engineering, botany, community/land use, and hydrology for the area.

Table 1. Potential North Delta Intake Site Location Coordinates Comparison

Site	Location	EIR/EIS Sites	DWR/DHCCP Alternative Sites	Offset from EIR/EIS Site
1	Latitude	38.43411	38.434058	270' Downstream
	Longitude	-121.51855	-121.519510	
2	Latitude	38.405342	38.405542	70' Upstream
	Longitude	-121.514319	-121.514390	
3	Latitude	38.374924	38.383023	3,730' Upstream
	Longitude	-121.523036	-121.517813	
4	Latitude	38.355213	38.362588	3,650' Upstream
	Longitude	-121.527962	-121.519945	
5	Latitude	38.345037	38.349777	4,780' Upstream
	Longitude	-121.548789	-121.533840	
6	Latitude	38.296029		
	Longitude	-121.565009		
7	Latitude	38.281036		
	Longitude	-121.546916		

All of the intake sites are located on the left bank looking down stream with a near-bank bed elevation of approximately -15 feet or greater. Sites on or just below an outside bend in the river are preferable. It is anticipated that these sites will be deeper, have higher sweeping flow velocities, and be less subject to sedimentation. Conversely, it is anticipated that sites on or just below the inside of a river bend will be shallower, have slower sweeping flow velocities, and be more susceptible to sedimentation.

As part of its charge, the FFTT revisited accumulated information relative to locating intakes south of Steamboat and Sutter sloughs. These continued discussions centered around the potential effects on Sacramento River spawning delta smelt from having intakes further south. The FFTT was also uncertain of the potential effects to salmonids from placing intakes below Steamboat and Sutter Sloughs. As previously described, the use of particle tracking modeling indicates about half the particles move down the sloughs; however, fish do not necessarily behave like particles and the actual percentage of downstream migrants entering these sloughs is uncertain. The FFTT echoed previous concerns about slower flow velocities past these lower intakes as fish traveling past these intakes could be negatively affected by slower velocities. However, the proposed operational criteria under development by the DHCCP would have these lower intakes operating only during relatively high flow periods, and they would be required to shut down any time sweeping velocities were not meeting the minimum deemed to be safe for juvenile salmonids and adult delta smelt.

Concern was also raised for green sturgeon at all of the intakes, regardless of their location relative to the sloughs. Juvenile sturgeon (along with the other covered fish species) may face higher predation due to the presence of the structures alone (regardless of their operations). The interface between the fish screen facility and the river bottom will need to be evaluated to minimize impacts to sturgeon. The FFTT agreed that more information was needed to determine the potential effects for each of the covered species from placing structures below the sloughs, and recommended that the EIR/EIS evaluate the option to site intakes below Steamboat and Sutter Sloughs.

3F.9 Five-Agency Recommendations for BDCP Intakes 1–7

In December of 2011, technical staff representing the five lead agencies, along with consultant staff, participated in an additional site visit to the proposed intake locations and met to review selection criteria. This meeting resulted in recommendations to management for the siting of intakes 1–7 for the BDCP effects analysis (Figure 3F-3) (California Department of Water Resources 2011a). This group used the following criteria in determining their recommendations:

- Minimize impacts to aquatic and terrestrial species,
- Maintain a diversion structure's functionality,
- Provide adequate river depth (bed elevations from LIDAR and bathymetry data),
- Provide adequate sweeping flows (positioning along the river),
- Maintain flood neutrality, and
- Minimize impacts to land use and community.

Their final recommendations were as follows:

- Intake 1 – Use of CER 1 (or EIR 1)
- Intake 2 – Use of CER 2 (or EIR 2)
- Intake 3 – Use of Alt 3
- Intake 4 – Locate intake in between Alt 4 and CER 4
- Intake 5 – Use of Alt 5
- Intakes 6 and 7 – Use locations for 6 and 7 developed by the FFTT

3F.10 Phased Construction

Based on potential impacts to salmonids from large screened diversions, such as those considered in the BDCP, the National Marine Fisheries Services (NMFS) proposed phased construction of the intakes to reduce uncertainty surrounding the impacts of simultaneous construction. In response DWR, prepared a white paper evaluating the impacts to the costs, schedule and deliveries if phased construction was implemented. This paper concluded that phased construction as proposed by NMFS would increase the construction duration from 7.25 years to about 17.5–20.5 years. The construction cost would increase from approximately $12.068 billion to $13.29–14.236 billion (California Department of Water Resources 2011b).

In addition, on October 12, 2011, DWR held a Phased Construction Workshop held to address the uncertainties associated with the construction and operation of the five proposed intakes along the Sacramento River between Freeport and Courtland. The objective of this workshop was to better define the scope and schedule of a phased approach for construction to be included as a potential alternative in the EIR/S. Based on a series of assumptions regarding intake locations, intake capacity, size and location of the Forebay, six phasing scenarios were proposed. However, the EIR/S

evaluates construction of all intakes regardless of phasing in order to support the total impact in the analysis.

3F.11 Intake Locations Analyzed in the EIR/EIS

The intake locations evaluated in the EIR/EIS reflect the ongoing and iterative process between the environmental and the engineering teams and represent a reasonable range of alternative intake locations, including intake locations downstream of Sutter and Steamboat sloughs to evaluate potential effects on covered fish species. Figures 3-2, 3-4, and 3-6 in EIR/EIS Chapter 3, *Description of Alternatives,* show the seven intake locations for the tunnel, east, and west alignments respectively, as analyzed in the EIR/EIS.

At the June 20, 2012, BDCP public meeting, it was announced that the proposed project would consist of three 3,000 cfs (total of 9,000 cfs) diversion intakes along the eastern bank of the mainstem Sacramento River. The 7 intake locations under evaluation in the EIR/S could be located between Clarksburg and Walnut Grove. As the description for the proposed project was modified to reduce the maximum north Delta diversion capacity from 15,000 cfs to 9,000 cfs, the number of required intakes was reduced from five to three. In general, there has been a preference to locate sites as far north on the Sacramento River to reduce the area of overlap between delta smelt and direct exposure to the intake screens. However, salmonids emigrating along the mainstem Sacramento River would encounter some or all of the intakes proposed for construction, unless they travel downstream through the Yolo Bypass or Sutter and Steamboat Sloughs. Shorter screen lengths have been desirable to reduce the exposure time for fish swimming past the front of a screen. All intake locations would be located at least one mile apart as recommended by the FFTT to provide rests or breaks for fish passing multiple screens. Potential intake locations upstream of Scribner's bend were eliminated from consideration, due to the concern of proximity to a wastewater treatment plant located a few miles upstream.

Current Lead Agency discussions have narrowed down the locations of the three intakes to include intakes 2, 3, and 5 for analysis under the proposed project. Intake 2 is the second most northern intake location site of the seven sites under consideration and is located towards the middle of a gentle outside river bend with shallower depths than other intake locations under consideration. Therefore the shallower depths will require a longer screen length. However, intake 2 would have reduced costs when compared to the costs associated with Intake 1 due to its closer proximity to the intermediate forebay (IF) located near Hood. And, as discussed below, Intake 2 would create fewer potential impacts to nearby sandhill crane populations, compared with Intake 1. Intake 3 is located on the outer bend at the downstream end of a curve nearing the community of Hood. Deep bed elevations resulting in shorter screen lengths at Intake 3 make it a stronger candidate than Intake 4. Both intakes 3 and 5 bookend the community, but avoid many of the structures that Intake 4 would directly impact within the small community. For these reasons Intakes 2, 3, and 5 will move forward for analysis under the proposed project. The footprint for Intake 5 overlaps with the tip of Snodgrass Slough that serves as habitat for both aquatic and terrestrial species. There is also a natural gas field nearby that will need to be further examined in the process. However, the locations of Intakes 2, 3, and 5 being in close proximity for tunneling to the IF have made these locations a priority for consideration.

Intake locations not moving forward for analysis in the proposed project include Intakes 1, 4, 6, and 7, though they will be addressed in connection with other EIR/EIS alternatives. Those locations have

suitable attributes for placement of an intake; however, they did not make it as being the top three sites under analysis for the proposed project. Intake 1 is the most northern located site of the seven sites under consideration. Intake 1 is considered to have one of the shortest screen lengths of those under consideration, due to deep river bed elevations that occur along the toe of the bank, which have the potential to minimize impacts aquatic species. In contrast, project features such as transmission lines, borrow/spoil/reusable tunnel material areas, and intake facility footprints are in close proximity to an existing greater sandhill crane roost site located just east of the Intake 1 location. Although cranes have been known to adapt over time to loud noises and other disturbances, the potential for constant utility, maintenance, and operation of Intake 1 could result in nest abandonment by the cranes which could cause stress to an already limited overwintering population of cranes that use the central Delta. The EIR/S alternatives evaluation will provide a comparison of potential effects associated with each intake location which should identify related aquatic and terrestrial impacts. Intake 1 is also the furthest away from the IF, therefore being the most costly of the seven locations. The footprint for Intake 4 encroaches upon parts of the developed area, where it would be expected to have a greater impact to the community than the other surrounding intake locations. Also, a natural gas field is close to the footprint for Intake 4 that would require further examination if the site was chosen.

The alternate configuration of the North Delta intakes that includes intakes 6 and 7 was derived by the agencies as a way to potentially reduce exposure of outmigrants to increased entrainment, impingement, predation, and any other adverse effects associated with the intakes. The reduction in exposure was hypothesized to result from a portion of the downstream-migrating juvenile fish population entering Sutter and Steamboat sloughs (i.e., an alternative migration pathway) rather than staying in the mainstem Sacramento River. Because Intakes 6 and 7 would be located downstream of Sutter and Steamboat sloughs, the fish that migrate down Sutter and Steamboat sloughs would not pass these intakes and, therefore, would not be exposed to any adverse effects from these two intakes. Because intake location could influence the hydrodynamics of Delta channels, particle tracking was used to determine whether the configuration of intakes would potentially affect migration pathways for migratory species. This analysis assumed that outmigrating fish behaved as passive, neutrally buoyant particles, which is not likely true for most species, although fish generally follow flow patterns. For this analysis, particles were inserted just downstream of the American River confluence on the Sacramento River.

Results indicate that the percentage of particles that would travel into either Sutter and Steamboat sloughs or the Delta Cross Channel and Georgiana Slough differs very little between diversions from intakes 1, 2, 3, 4 and 5 and intakes 1, 2, 3, 6, and 7. Based on these results, it was concluded that the probability of fish migrating into these alternative pathways was independent of the location of proposed intakes between Intake Sites 4 and 5 and Intake Sites 6 and 7. It was further concluded, moreover, that the use of Intakes 6 and 7 could create a series of tradeoffs rather than just benefits for affected species. Moving the intakes would provide a benefit to those outmigrating species that would use Sutter and Steamboat sloughs as an alternative migration pathway because exposure to these two intakes would be reduced, although overall benefits are small (0% to 6% increase in overall survival). At times, survival of individuals in Sutter and Steamboat sloughs is lower than that in the mainstem Sacramento River. For those individuals that stay in the mainstem Sacramento River, increased effects of tidal conditions on river hydrodynamics near Intake Sites 6 and 7 (e.g., reduced downstream velocity under flood tide conditions that could contribute to increased duration of exposure or multiple exposures to intakes) would increase the exposure to these

intakes. Moving the intakes to Sites 6 and 7 would increase exposure risk of delta and longfin smelt to the intakes, particularly in the future with sea level rise.

3F.12 References

BDCP Fish Facilities Technical Team. 2008. *Conceptual Proposal for Screening Water Diversion Facilities along the Sacramento River*. August.

———. 2011. *Technical Memorandum*. July 15.

California Department of Water Resources. 2009a. *Value Planning Study for Diversion Facilities along the Sacramento River, Revision B*. Final Draft. January. Delta Habitat Conservation and Conveyance Program. Sacramento, CA.

———. 2009b. *Conceptual Engineering Report—Isolated Conveyance Facility—East Option*. November 18. Revision 1. Delta Habitat Conservation and Conveyance Program. Sacramento, CA. *Appendix B, Intake Facility Development and Selection Processes*.

———. 2010a. *Conceptual Engineering Report—Isolated Conveyance Facility—All Tunnel Option*. March 10. Revision 0. Design Document 500-05-05-100-03. Delta Habitat Conservation and Conveyance Program. Sacramento, CA.

———. 2010b. *Technical Memorandum 20-2: Proposed North Delta Intake Facilities for the Draft EIR/S*. Final Draft. November 30.

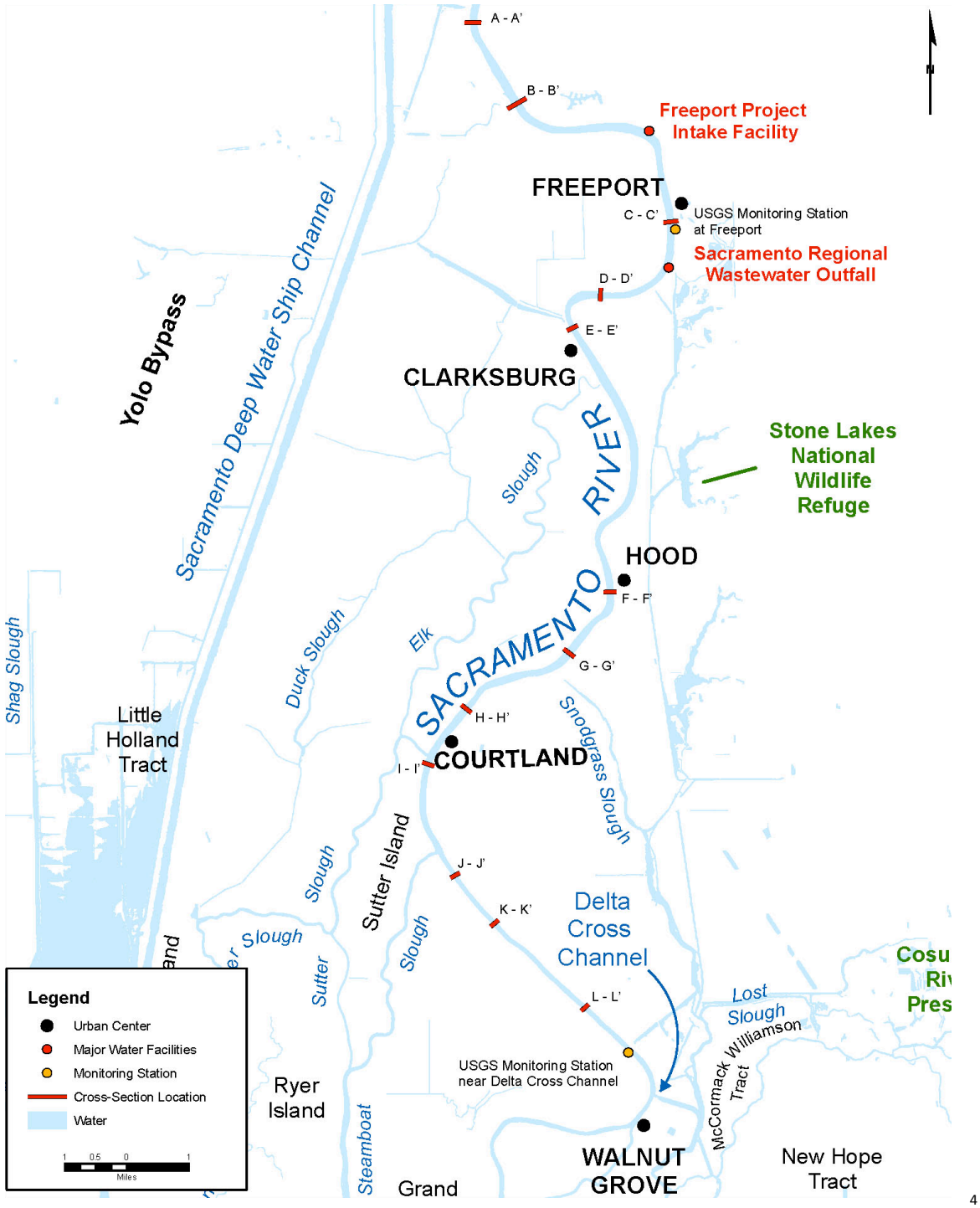
———. 2010c. *Technical Memo 3, Recommended Delta Intake Facilities for the Draft EIR/S (Draft)*. Delta Habitat Conservation and Conveyance Program. Program Document No. 009-07-05-100-003 Revision A. April 16. Prepared for the California Department of Water Resources, Division of Engineering.

———. 2010. *Evaluation of DHCCP Proposed Intake Locations*. September. Division of Engineering.

———. 2011a. *5-Agency Technical Recommendations for the Location of BDCP Intakes 1–7*. December 13.

———. 2011b*. Impacts to DHCCP Cost, Schedule and Delivery due to NMFS Proposal for a Phased Construction of North Delta Intake Facilities*. September 13. Prepared by the BDCP Program Management Team. Confidential Working Draft. Sacramento, CA.

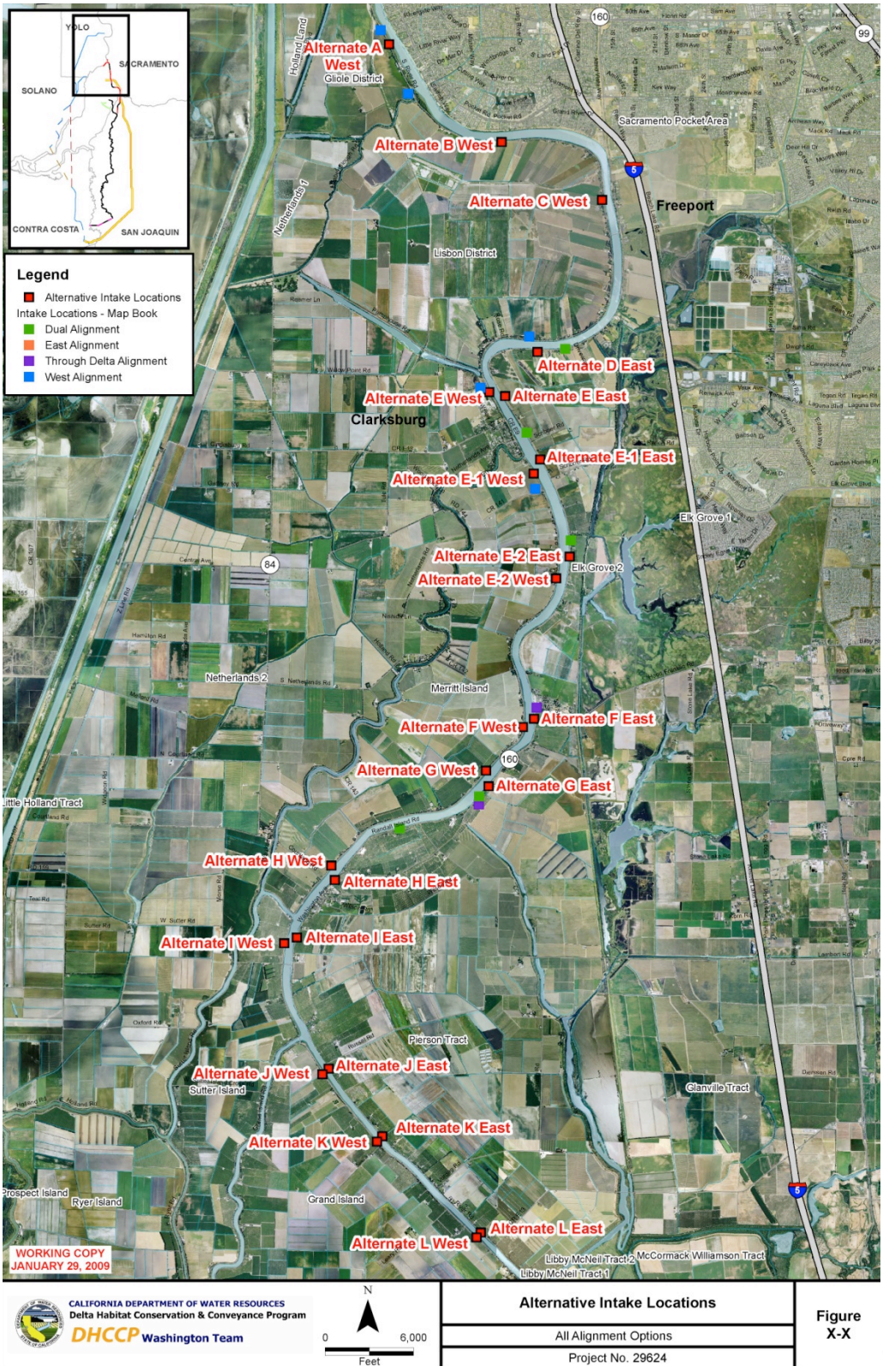
Vogel, D. A. 2008. *Pilot Study to Evaluate Acoustic-Tagged Juvenile Chinook Salmon Smolt Migration in the Northern Sacramento-San Joaquin Delta 2006–2007*. March. Prepared for the California Department of Water Resources, Bay-Delta Office, Sacramento, CA. Natural Resource Scientists, Inc., Red Bluff, CA.



Source: California Department of Water Resources 2010-3f4

4: Proposed North Delta Intake Facilities for the Draft EIR/S, Figure 3.1, p. 3-4 (DWR 11-30-2010).

Figure 3F-1
Sacramento River Cross-Section Analysis



Source: Figure 3.5, Proposed North Delta Intake Facilities for the Draft EIR/S, Figure 3.5, p. 3-18 (DWR 11-30-2010).

Figure 3F-2
Alternative Intake Locations

Potential North Delta Intake Locations Reviewed by the FFTT in 2011

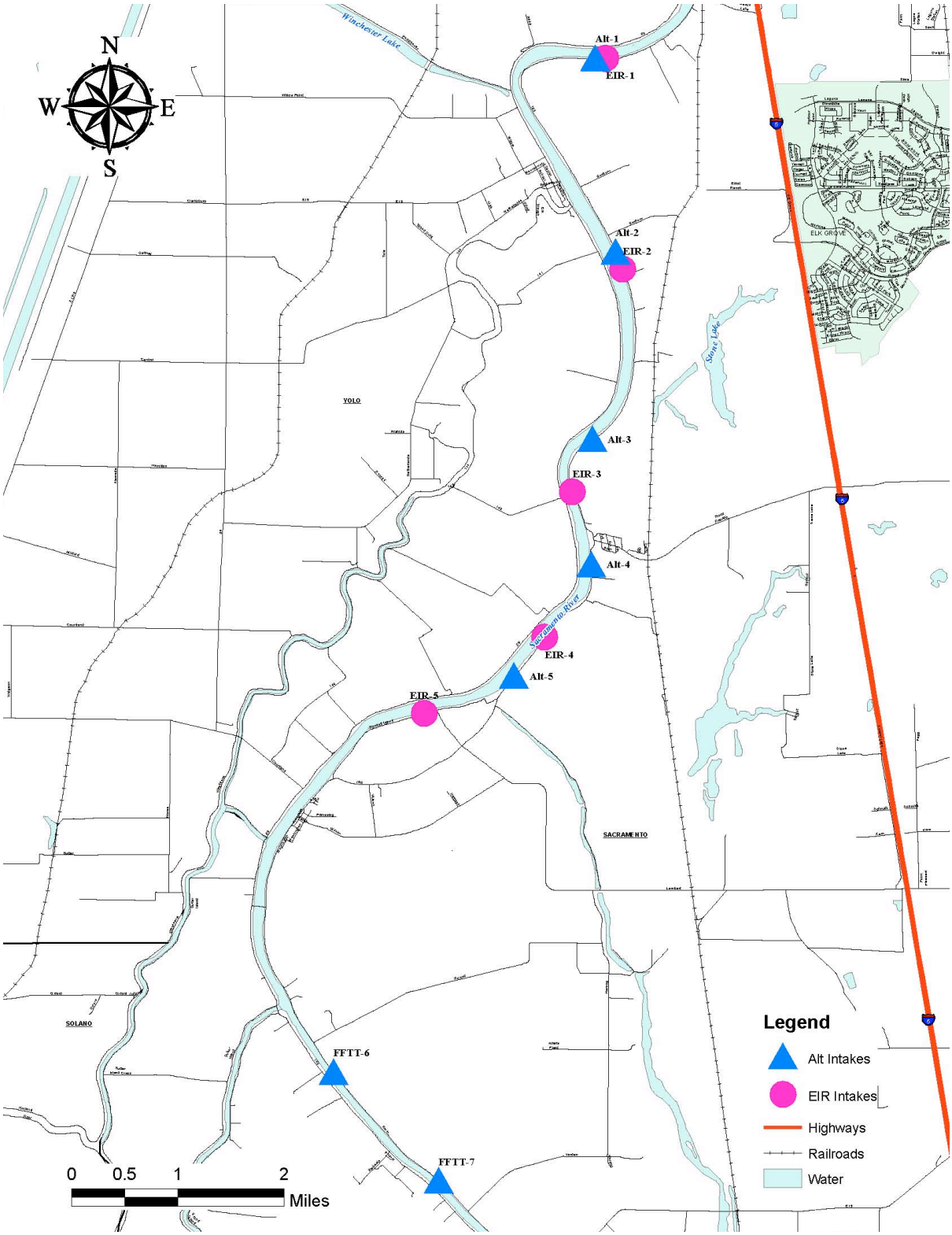


Figure 3F-3
Potential North Delta Intake Locations Reviewed by the FFTT in 2011