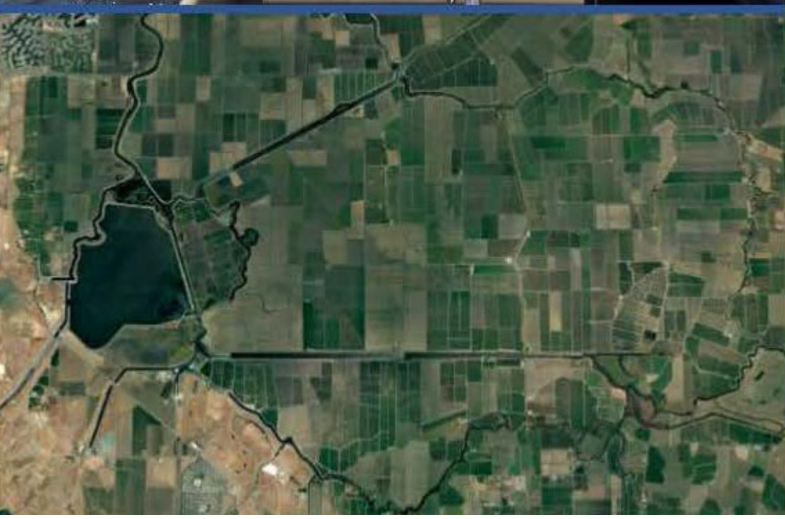

November 2021
South Delta Channels Planning Guide

Planning Guide for the Channel Depth Restoration Program for the South Delta Channels

Prepared for the Delta Channel Maintenance Group under contract administered by the State Water Contractors

November 2021

Planning Guide for the Channel Depth Restoration Program for the South Delta Channels

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Executive Summary

Introduction

This Planning Guide (Guide) presents a strategy for implementing a channel depth restoration program (Program) in the Sacramento-San Joaquin River Delta (Delta) channels, with initial emphasis on eight of the South Delta channels. This Guide outlines the framework for developing and managing dredging projects to address sedimentation that has been impacting channel conveyance and water quality. Development of the Guide was a collaborative effort of the Delta Dredging Work Group (Work Group) and Anchor QEA, LLC. The Work Group provided historical literature and data, including historical and current site condition information, during development of this Guide (see Appendix A).

Dredging Methodology

Applicable dredging methodologies are presented, including hydraulic cutter suction and mechanical. Additionally, methods for dewatering dredged sediment are presented, including settling ponds, mechanical working and disking, and confined space dewatering by using amendments, geotextile tubes, and rapid dewatering systems.

Interim maintenance is recommended after a large dredging project. The methods presented for interim maintenance include routine maintenance dredging using conventional dredging equipment, knockdown dredging, diver-assisted suction dredging, and long-term concepts, including sediment traps, deepening, and use of on-call contracting mechanisms.

Protection of the existing water diversion should be considered when planning a dredging project as protective measures or temporary removal may impact costs.

A list is provided of regional dredgers and their current equipment that would be suitable for this type of dredging.

Conceptual Dredging Design

For this Guide, conceptual dredging templates were developed to provide order-of-magnitude dredging volumes for the eight primary channels (Figure 4-1). The Work Group members from DWR and the South Delta Water Agency collaborated with Anchor QEA to identify target channel dredging elevations (for the purpose of this Guide only) that would meet Program objectives for water flow to allow full agricultural diversions. These elevations are listed in Table 4-1. range of horizonal extents (channel widths) was established with a minimum value to accommodate dredging equipment and a maximum value based on current bank locations. Pending a geotechnical assessment, a dredging offset from the existing banks and levees may be recommended during design of a dredging project.

Conceptual dredging quantities are included in Table 4-3. These will be refined during design of a dredging project, but are included in this Guide to present conceptual quantities and costs.

A work plan to produce a final dredging design and long-term maintenance program is included for future use. Successful implementation would require an understanding of the general accretion rates to properly budget and plan a long-term maintenance program. The data provided for this Guide was not sufficient to provide a robust accretion rate estimate, however an example maintenance methodology and long-term maintenance schedule are provided in Table 4-5.

Additional methodologies and recommendations for future hydrodynamic modeling, geotechnical investigations, and sediment characterization investigations are presented with order of magnitude costs. These tasks are recommended, and in some cases required, during the development of a dredging project.

Real Estate Plan

Potentially viable permanents placement and reuse sites for dredged sediment as well as potential temporary processing sites are discussed, which include Fabian Tract, Roberts island, Montezuma Wetland Restoration Project (MWRP), Big Break, and numerous opportunities to use private land. An extensive land use investigation was not conducted for this Guide due to the conceptual nature of the Program planning. These sites may not be available at the time of dredging, or conversely, additional viable placement sites may emerge.

Environmental Compliance and Permitting

A general overview is presented of the types of environmental investigations, documents, and authorizations that would be required to implement Program or individual channel dredging projects. During the environmental review process, it may be determined by the agencies that additional measures or requirements are needed or that particular requirements may be waived due to specific site conditions. Discussion is included for California Environmental Quality Act (CEQA) compliance, as well as for federal, state, and local regulatory permitting requirements.

Additional information is included for common site-specific avoidance, minimization measure and mitigation.

A list of environmental implementation steps is presented, including task and deliverables with conceptual costs and timelines.

Conceptual Costs

A summary of all conceptual design and permitting costs is presented in Table 7-1. The table represents a single project of 100,000 cy yards (or one channel mile). The costs are estimated between $1.1 and $1.9 million for planning and design, however some of the elements could (hence costs) could be applied to additional dredging projects.

A summary of conceptual construction costs are presented in Tables 7-2 through 7-4. These tables represent a single project of 100,000 cy yards (or one channel mile) using various dredging methods and placement sites. The costs are estimated to range from $6.8 million (hydraulic cutter suction with placement upland using geotube dewatering) to $11.5 mllion (mechanical with placement at MWRP).

Next Steps and Recommendation

The Guide concludes with a summary of next steps for planning and implementation of a dredging project within the Program area, including recommendations.

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ABBREVIATIONS

2018 DEM	Department of Water Resources Digital Elevation Model
AB	Assembly Bill
APE	Area of Potential Effects
BMP	best management practice
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CHRIS	California Historical Resources Information System
Council	Delta Stewardship Council
CPT	cone penetration testing
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DASIP	Draft Action Specific Implementation Plan
Delta	Sacramento-San Joaquin River Delta
DI-WET	deionized water waste extraction test
DO	dissolved oxygen
DPS	Distinct Population Segment
DTSC-SL	Department of Toxic Substances Control Screening Level
DWR	Department of Water Resources
EA	Environmental Assessment
ECCCHC	East Contra Costa County Habitat Conservancy
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESL	Environmental Screening Levels
ESU	Evolutionarily Significant Unit
Guide	Planning Guide
H:V	horizontal to vertical (ratio)
HCP	habitat conservation plan
IS	Initial Study
ITP	Incidental Take Permit
km	kilometer
LiDAR	light detection and ranging
LWD	Low Water Datum

Abbreviations (continued)

MBTA	Migratory Bird Treaty Act
mitigation rule	*Compensatory Mitigation for Losses of Aquatic Resources; Final Rule*
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MMRP	mitigation monitoring and reporting plan
MND	Mitigated Negative Declaration
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
MWRP	Montezuma Wetlands Restoration Project
NAHC	Native American Heritage Commission
NAVD88	North American Vertical Datum of 1988
NCCP	Natural Community Conservation Plan
ND	Negative Declaration
NEPA	National Environmental Policy Act
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Completion
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	Probable Effect Levels
Port	Port of Stockton
Program	Delta Dredging Work Group's channel depth restoration program
RHA	Rivers and Harbors Act
SAA	Streambed Alteration Agreement
SAP	sampling and analysis plan
SCH	State Clearinghouse
SDIP	South Delta Improvements Program
SHPO	California State Historic Preservation Officer
SJCOG	San Joaquin Council of Governments
SJMSCP	San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

Abbreviations (continued)

SPT	standard penetration testing
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TEL	Threshold Effect Levels
TSS	total suspended solids
TTLC	Total Threshold Limit Concentration
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDR	waste discharge requirement
Work Group	Delta Dredge Work Group

1 Introduction

1.1 Planning Guide Introduction and Purpose

This Planning Guide (Guide) presents a strategy for implementing a channel depth restoration program (Program) in the Sacramento-San Joaquin River Delta (Delta) channels, with initial emphasis on the South Delta channels. This Guide outlines the framework for developing and managing dredging projects to address sedimentation that has been impacting channel conveyance and water quality. Development of the Guide was a collaborative effort of the Delta Dredging Work Group (Work Group) and Anchor QEA, LLC. The Work Group is made up of the following entities:

U.S. Bureau of Reclamation (USBR)	San Luis & Delta-Mendota Water Authority
Central Delta Water Agency	South Delta Water Agency
Delta Water Master	State Water Contractors
Department of Water Resources (DWR)	State Water Resources Control Board

The purpose of the Program is to address sediment deposition in the channels that have the potential to affect water conveyance, diversion limitations, and flood-carrying capacity. Additional services that would improve from dredging include navigation and water quality, which has been negatively impacted by increased water temperature, invasive species, salinity, toxic algae blooms, and decreased dissolved oxygen.

1.2 Site History and Purpose of the South Delta Channels Restoration Program

Prior to the mid-nineteenth century, the Delta consisted largely of natural channels that ran through marshland and were subject to tidal action from San Francisco Bay. In the mid-1800s, levees were built to contain Delta lands to protect them from flooding. The contained lands were then drained, cleared, and planted for agricultural use (USGS 2016).

There are currently about 75 miles of channels in the southern Delta that are used as regional water supply sources for irrigation, drainage canals, fish habitat and migration routes, waterways for commercial shipping and recreational boating, and avenues for the passage of flood water. These channels also convey water from the San Joaquin and Sacramento rivers and tributaries to the State Water Project and Central Valley Project export facilities within the South Delta, which provide water for agriculture, industry, and approximately 27 million people south of the Delta in other parts of the state.

1.3 Intended Use of the Planning Guide

Throughout the Guide, the following terms are used to describe the scope of work:

- The **Program** refers to the channel depth restoration program, which includes the overall area of concern and all channels under investigation for depth restoration. Under the Program, the Work Group will monitor channel sediment accretion, decide where and when to plan project(s) to remove sediment, and determine funding mechanisms for the project(s). Management of the Program will be an ongoing multi-stakeholder effort.
- A **project** refers to the dredging of a portion of the Program area. A project could include dredging one segment of one channel, dredging multiple channels, or dredging all the channels in the Program area. The Program may include multiple projects.

This Planning Guide has been prepared to provide the Work Group with the following planning components to conceptually develop and manage the Program, with recommended next steps:

- An assessment of known site conditions and identification of missing site condition information
- A description of applicable dredging methods
- An inventory of potential dredging contractors
- An order-of-magnitude assessment of dredging volumes and site capacity needs
- A framework for completing the environmental compliance and permitting process

The information listed as follows is not within the scope of this Guide; however, it will be required for the design phase. Where possible, steps are provided to determine this information.

- Hydrodynamic and water quality modeling to determine actual flood and water supply conveyance and diversion needs and to develop resulting dredging templates; Additionally modeling can support predictions of sediment accretion rates and patterns to support planning of a long-term sediment management program
- Updated bathymetric data (in some reaches)
- Finalized upland site use agreements with landowners for placement of dredged sediment
- Confirmation of final regulatory requirements as they apply to specific sites. These include, but are not limited to, the following:
  - California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) documentation and determinations
  - Environmental investigation and survey results, including site-specific sediment characterization analysis, special status species and habitats, jurisdictional wetlands and water delineations, and cultural and historic resources
  - Regulatory permits and avoidance, minimization, and mitigation requirements of the permitting agencies

1.4 Channels within the Program Area

The South Delta channels addressed in this Planning Guide were identified by the Work Group as having siltation issues. These channels and their associated side channels are located east of Antioch, in the south and central sections of the Delta, south of Bouldin Island, and north of the Pescadero Reclamation District (Figure 1-1). They include the following channels:

- Middle River
- Old River (West)
- Old River (South)
- Old River (East)
- Old River Side Channel
- Fabian & Bell[1]
- Paradise Cut
- Tom Paine Slough

1.5 Historical Literature and Data Review

The Work Group provided historical literature and data for use in preparing this Guide. Additional information was obtained from dredging contractors, landowners, and regulatory agencies (with communication approved by the Work Group). The literature and data were organized into the following categories:

- Hydraulics (including bathymetric survey files and historical studies of South Delta channels and nearby basins)
- Dredging methodology (applicable dredging and placement methods, regional contractors, and available equipment)
- Real estate (potentially available placement sites, beneficial reuse sites, and interim dewatering and processing sites)
- Regulatory requirements and guidance, including the following:
  - CEQA/NEPA documentation
  - Agency permits
  - Anticipated investigations or surveys (sediment characterization; special-status species and habitats; wetlands and waters; and tribal, cultural, and historic assessments)

Appendix A includes a detailed list of documents and data that were provided, including date, author/source, and specific information used in the development of the Guide. Full citations are included in Section 9.

[1] Grant Line Canal and Fabian Bell Canal run parallel to each other, with Fabian and Bell canal to the south. The Work Group only identified a segment of the Fabian & Bell Canal for inclusion in this Guide.

2 Site Conditions

2.1 Vertical Datum and Tidal Information

Much of the historic bathymetric survey information in the South Delta referenced the Low Water Datum (LWD). In 2005, survey data was converted from LWD to North American Vertical Datum of 1988 (NAVD88) and tied to new and more reliable benchmarks in the area.[2]

Dredging design is typically performed using the tidal datum Mean Lower Low Water (MLLW) datum at the locality to correspond with navigation charts. However, the MLLW level has not been determined in enough locations in the Program area to provide reliable conversions from NAVD88 to MLLW at all locations since tidal datums should not be extended more than a few hundred feet from the defining gage without substantiating measurements or models. The correct conversion in each location is important because it may range up to 0.75 feet throughout the Program area (USWPRS and SDWA 1980). However, as a broad reference, MLLW levels in some areas of the Program were provided by the South Delta Water Agency, as shown in Figure 2-1 (Hydrologic Systems, date unknown).

This Program encompasses a large area, and it is anticipated that dredging will occur as a series of independent projects. Therefore, it will be important to use a common datum for the dredging work that to allow for an integrated system of channel modifications. NAVD88 is the datum used for this Guide and is the recommended datum for dredging improvements, although it should be coordinated with the agencies in advance.

Table 2-1 provides descriptions and applicability of vertical datums mentioned in this Guide.

Table 2-1
Summary of Vertical Datums

Datum	Description	Applicability
LWD	Low Water Datum; The lowest water level that should be encountered the majority of the time. Typically used in isolated non-tidal coastal areas.	Datum originally used for 1934 historic hydrographic surveys of the Program area.
NAVD88	North American Vertical Datum of 1988; Superseded NGVD29 datum; Based on the new International Great Lakes Datum of 1985 local mean sea level height benchmark.	The official vertical datum in the National Spatial Reference System. Project elevation data for the region is in NAVD88.

[2] Most of the regional water gages were converted from a LWD to the North American Vertical Datum of 1929 (NGVD29) in the 1970's. In 2005, many of the gages were again converted from NGVD29 to the North American Vertical Datum of 1988 (NAVD88) datum. Although, for unknown reasons, the change has never been fully implemented, so some gages still use the LWD (Information provided by HIS Hydrologic Systems, October 2021).

Datum	Description	Applicability
NGVD29	National Geodetic Vertical Datum of 1929. Based on historical mean sea level measurements taken at tide gauges around the United States and Canada.	USGS survey control points in the region were historically measured in NGVD29. These points were superseded by NAVD88 in the 1990s.
MLLW	The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch (19-year period).*	Commonly used as a datum for dredging since it is used on National Oceanographic and Atmospheric Administration (NOAA) nautical charts as a water level reference for vessels. May be required by permitting agencies.
MSL	The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch (19-year period).*	Not applicable for the purposes of the Program.
MWL	The mean surface elevation as determined by averaging the heights of the water at equal intervals of time, usually hourly. Mean water level is used in areas of little or no range in tide	Not applicable for the purposes of the Program, however referenced in Figure 2-1.

*As defined by NOAA.

2.2 Historical Channel Bathymetry

Historical bathymetric data were provided by the DWR South Delta Branch for this Guide. These data included the following, in NAVD88 datum:

- National Oceanic and Atmospheric Administration (NOAA) 1934 soundings (assumed to have been collected by the plumb bob method)
- DWR bathymetric data (collected by multibeam method):
  - Fabian & Bell Canal: 2012, 2013, and 2014
  - Grant Line Canal: 2012
  - Middle River: 2017
  - Old River at San Joaquin River: 2011, 2012, 2017, and 2018
  - Old River at Salmon Slough: 2013
  - Victoria Canal (not part of the Program): 2011
  - West Canal: 2011

DWR also provided a Digital Elevation Model (2018 DEM)[3] of the Delta (Wang et al. 2018), which was a compilation of the data collected between 2011 and 2018.

2.3 Sediment Quality

Sediment collection and laboratory analysis is required for the regulatory agencies to determine suitability for the proposed placement or disposal location. The sediment analysis usually includes

[3] Digital Elevation Model Version 4.2.

physical testing (grain size) as well as chemical analysis, and if in-water placement is proposed, biological analysis. The testing approach is tailored to the proposed placement or disposal locations, with variances between the tests performed for in-water placement, upland placement, and landfill disposal. If historical sediment quality is unknown or if the disposal site is not defined at the time of sampling and analysis, it is not uncommon to perform analysis for multiple placement and disposal locations to allow flexibility during design and construction.

Sediment sampling and analysis to support a dredging project typically takes place after preliminary design, when the horizontal and vertical extents of the dredging prism have been established and placement site options have been identified. However, in 2021 the South Delta Water Agency implemented investigative testing to determine general sediment characteristics and inform future decisions (CLS 2021). Samples from 10 locations in Middle River and Old River were analyzed for grain size and chemical properties, as described below. The sample locations are shown in Figure 2-2.

2.3.1 Sediment Grain Size Analysis (Old River and Middle River)

In 2021, sediment physical property testing was conducted at 10 sites along Old River and Middle River (Gulf Shore, 2021). This information is summarized in Table 2-3. The grain size varies between sampling locations from 98.5% sand to 98.5% fines. This variation in grain size between sampling locations indicates a diverse range of geotechnical conditions within the Program area.

Table 2-2
Summary of Grain Size Along Old River[4]

Sample Location	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
OR1	0.0	0.0	0.3	54.8	43.7	1.2
OR2	0.0	0.1	0.5	44.8	52.7	1.9
OR3	0.0	0.0	0.0	4.9	24.6	70.5
OR4	0.0	0.0	0.0	10.3	71.1	18.6
OR5	0.0	0.0	0.0	12.8	35.9	51.3
OR6	0.0	0.0	0.0	0.2	1.3	98.5
OR7	Not Sampled					
OR8	0.0	0.0	0.1	22.7	28.0	49.2
OR9	0.0	0.0	0.0	5.3	20.6	74.1
OR10	0.0	0.9	0.1	3.4	8.9	86.7
OR11	0.0	0.0	0.0	5.7	47.8	46.5
OR12	Not Sampled					

[4] Atterberg limits were not included in the reporting.

2.3.2 Sediment Chemistry Analysis (Old River and Middle River)

The collected sediment was tested for trace metals, sulfide, pesticides, polychlorinated biphenyl (PCB) cogeners, polycyclic aromatic hydrocarbons (PAHs), and methyl mercury. For the purpose of this Guide, the results were compared to common regional thresholds for upland placement and reuse, landfill disposal, and placement in or adjacent to water (including wetland cover). The thresholds are defined as follows:

- Upland placement suitability is measured by California Department of Toxic Substances Control (DTSC) modified screening levels (DTSC-SLs). DTSC-SLs were developed based on USEPA Regional Screening Levels to evaluate human health risk at California sites.
- Landfill disposal suitability is measured by the following thresholds:
  - Total Threshold Limit Concentration (TTLC): Bulk concentration test to determine whether the sediment is a California hazardous waste
  - Soluble Threshold Limit Concentration (STLC): Leachate testing required to determine whether the sediment is a California hazardous waste; the sample is diluted at a 10:1 ratio for analysis. Bulk sediment concentrations may be compared to STLC trigger levels (STLCx10) to determine if leachate testing is required.
  - Toxicity Characteristic Leaching Procedure (TCLP): Leachate testing required to determine whether the sediment is a federal hazardous waste; the sample is diluted at a 20:1 ratio for analysis. Bulk sediment concentrations may be compared to TCLP trigger levels (TCLPx20) to determine if leachate testing is required.
- In or near water (or wetland cover) placement suitability is measured using the following thresholds:
  - Threshold Effect Levels (TELs): Indication that adverse effects may occur due to exposure, but the sediment is not necessarily toxic
  - Probable Effect Levels (PELs): Indication that adverse effects are more likely to occur due to exposure.

The 2021 test results indicated that the sampled sediment was relatively free of contaminants with some minor exceedances. Assessment of test results against the common regional thresholds listed previously are summarized in Table 2-3.

Table 2-3
Preliminary Sediment Testing vs. Common Thresholds

Placement or Disposal Option	Comparison to Common Regional Thresholds	Preliminary Assessment of Results
Upland Placement	• DTSC-SLs = no exceedances, except for arsenic (however still consistent with background concentrations)	No level of concern. DI-WET will likely be required to evaluate leachate that could migrate and contaminate groundwater or adjacent surface water (assumed for levee improvement, too).[1] Modified elutriate chemistry and bioassay testing will likely be required if decant water is anticipated.
Landfill Disposal	• TTLC = no exceedances • STLCx10 = no exceedances • TCLPx20 = no exceedances	Not considered California or federal hazardous waste. Additional testing will likely be required for landfill acceptance.
In or Near Water Placement	• TELs = Nickel exceedance in six samples • PELs = 4,4'-DDD exceedance in one sample • Some exceedances above TELs and PELs for cadmium, some pesticides, and Aroclor 1254.	These results do not necessarily preclude placement in or near water; however, additional testing may be required.

Notes:
1. DI-WET as described in the General Order for Sacramento-San Joaquin Delta.
Source: CLS 2021

If the sediment proposed for dredging as part of the Program is accurately represented from this preliminary testing data, it would likely be suitable for landfill disposal and upland reuse, and potentially for reuse in the water.

Section 4.3.3 includes a description of sediment characterization guidelines and procedures required by regional agencies prior to dredging project approval. New sediment testing may be required for a future dredging project, in which case the available information could be used to create a site history or estimate the probability of contamination either directly or by inference from other sites.

2.4 Levees and Berms

To avoid impacting the earthen features in the South Delta region during dredging activities, it is important to understand the general bank and levee stability conditions. Dredging design will need to take this into account as well as determine a levee reuse opportunity for the dredged sediment.

There are eight primary channels in the Program area, and each has a levee on either one or both sides of the channel. These levees are classified as project or non-project levees. Project levees are Federal Flood Control Project levees that are designed to meet U.S. Army Corps of Engineers (USACE) standards. Non-project levees are built by local reclamation districts or landowners and are usually built to an agricultural standard. Non-project levees can be assumed to be less stable than project levees (Water Education Foundation 2021). Levees within the Program area may be built to various standards such as Short-Term Hazard Mitigation Plan Geometry, PL 84-99, and Bulletin 192-82 standards for agricultural levees or Federal Emergency Management Agency and Bulletin 192-82 standards for urban levees. The levees found at each of the eight primary channels are summarized in Table 2-4.

Table 2-4
Channel Levee Classifications

Channel	Levee Classification
Middle River	Non-project levees
Old River (West)	Non-project levees
Old River (South)	Mostly non-project levees, some project levees on eastern span
Old River (East)	Mostly project levees, some non-project levees on western span
Old River Side Channel	Non-project levees
Fabian & Bell	Non-project levees
Paradise Cut	Project levees
Tom Paine Slough	Non-project levees

As shown in Table 2-2, the sediment within the channels primarily consists of fines (clay and silt) to fine to medium grain sand. The reuse of this sediment to build levees may be limited because levees typically are built with various layers of gravel, rock, and sand to provide long-term stability. However, dredged sediment could be used to increase upland elevations of dry land and marshes to protect against sea level rise and flooding.

3 Dredging Methodology

3.1 Dredging Method Overview and Applicability to Shallow Channels

The two most applicable methods for conducting dredging in shallow channels, such as those in the Program area, are hydraulic cutterhead and mechanical dredging. The selection of a dredging method is typically determined by construction logistics such as design elevations and volumes, site access, environmental quality of the dredged sediment and effluent water, and availability of sediment temporary dewatering and stockpiling sites, and permanent placement sites or landfill disposal sites. Regulatory permit conditions, cost, and contractor equipment availability may also play major roles in the decision.

The equipment could be mobilized to the site using existing waterways, or, if the particular dredging location has limited water access and elevations, portable equipment could be trucked to the site and be assembled and launched from an adjacent upland location.

Table 3-1 summarizes the most feasible dredging equipment anticipated for each primary channel in the Program area based on the physical properties of the channels, the available placement sites, and access routes for vessels and equipment. The equipment is discussed in greater detail in the subsequent sub-sections.

Table 3-1
Feasible Dredging Equipment for Each Primary Channel

Channel	Hydraulic and/or Mechanical	Why
Middle River	Hydraulic (cutter suction) likely preferable; Mechanical may be complicated due to channel characteristics	There are bridges and other obstructions in the channel. Scows are limited by narrow channels.
Old River (West)	Hydraulic (cutter suction) or mechanical suitable.	Scows and dredges can reach these channels under sail. There is space available for scows and pipelines.
Old River (South)		
Old River (East)		
Old River Side Channel		
Paradise Cut		
Fabian & Bell		
Tom Paine Slough		

3.1.1 Hydraulic Cutter-Suction Dredging

Hydraulic dredging involves removing sediment through a slurry-and-suction mechanism. A cutter suction dredge would be the ideal hydraulic dredge for the Program area since they exist as both large and small equipment, whereas a hydraulic hopper dredge, for example, is a very large vessel that requires deep drafts. For a cutter suction dredge, a cutterhead at the end of the intake of the dredge loosens sediment in situ, and water is entrained to create a sediment slurry of approximately 85% water and 15% solids. The slurry is pumped directly from the dredging area to the dewatering area. The cutterhead and intake often swing in an arc to dredge an area, and the whole dredge is advanced to the next location using self-propulsion, a small powered boat, or winches or anchors.

A small cutter suction dredge with a discharge pipeline ranging from 10 to 16 inches in diameter, such as the dredge shown in Figure 3-1, would be well suited for the shallow South Delta channels. A larger dredge may require more underkeel depth or overwhelm the system with a pumping rate that is too high, causing unmanageable water effluent if the sediment management or placement area is space-constrained. Small hydraulic dredges can typically pump approximately 4,000 to 10,000 feet without a booster pump. If dredged slurry needs to be pumped to a site at a higher elevation, a booster pump may be necessary. Some sediment management or placement areas may be large enough to allow the hydraulically pumped slurry to settle naturally. It may be possible to enhance these areas by constructing earthen berms or plastic-lined modular concrete barriers (k-rail) to create settling pond systems within the sediment management or placement sites. Sites with less available area for settling may require water from the dredged slurry to be decanted from the sediment management or placement site (further described in Section 3.1.3). Other sites may require the use of more aggressive dewatering methods, such as adding amendments, geotextile tubes, collections tanks, or rapid dewatering systems.

A significant advantage of cutter suction dredging is that it can operate continuously and transport sediment directly to the sediment management or placement area without the need for scows or double handling; therefore, it is more time-efficient than mechanical dredging. If the ultimate placement area is within reach of the discharge pipeline, cutter suction dredging is also typically more cost-effective than mechanical dredging. An additional advantage is that a hydraulic dredge does not require ancillary equipment such as scow or tow boats, so can work more effectively in dredging areas with a smaller channel width. The primary disadvantage of cutter suction dredging is the large volume of water effluent that requires management. In addition, there can be regulatory restrictions on the use of hydraulic dredges due to the risk of fish entrainment. The sediment management or placement area may need infrastructure (berms, ponds, pipes, outfalls, etc.) to be prepared prior to sediment dewatering. Depending on the sediment management or placement area location, the cost to construct the infrastructure needed to support the dredged slurry dewatering process could counteract any cost savings associated with hydraulic dredging.

The equipment anticipated to be used in cutter suction dredging operations in the Program area includes the following:

- Required equipment:
  - Small cutter suction dredge (10-inch to 16-inch discharge pipe size)
  - Pipeline for pumping slurry to sediment management or placement area
  - Skiffs (crewed work boats)
- Additional equipment that may be required pending placement area logistics:
  - Earth-moving equipment to create ponds and to stockpile and dry sediment
  - Water tanks and processing equipment if effluent is collected from the stockpile
  - Loader and trucks if sediment will be trucked from the sediment management area to the ultimate placement area

3.1.2 Mechanical Dredging

The most common mechanical dredging method used in shallow waterbodies is an excavator mounted on a shallow-draft barge. A crane mounted on a barge can also be used. Depending on the upland site conditions, a land-based long-reach excavator can be used as well. Sediment dredged from the waterbody is usually loaded on a transport vessel, such as haul barge (often called a scow), or directly placed on a temporary rehandling area if it is within reach of the dredge. Sediment loaded onto a scow is either transported and placed in water at a designated deep water location or removed from the vessel and placed in an upland location for dewatering. Typically, mechanical dredging operations are most effective in dredging areas with at least 60 to 70 feet of width to allow the dredge and scow to work side by side.

One or more small mechanical dredges assembled with modular floating pontoons, like that shown in Figure 3-2, would be well suited for the shallow South Delta channels. Dredged sediment placed in an upland sediment management or placement area would need to be handled twice: it would be placed in a scow first and then moved to an area where an offloading system would transfer the dredged sediment to the sediment management or placement area for processing. Using a scow to move sediment from the dredge area may require construction of a temporary pier to access the vessel from the shore.

A significant advantage of mechanical dredging is that it requires much less water management compared to hydraulic dredging (unless the contractor uses a pump out station). It is also typically more environmentally sensitive because it does not have a suction mechanism that has the potential to entrain fish. Mechanical dredging can also have less of an impact on vessel traffic given the absence of a fully or partially submerged pipeline.

The primary disadvantage of mechanical dredging is that is typically slower than hydraulic dredging and, aside from water management, transporting the sediment from the point of dredging to the sediment management or placement area is more logistically complicated.

The equipment anticipated to be used in mechanical dredging operations in the Program area includes the following:

- Required equipment:
  - Excavator or crane mounted on shallow draft barges
  - Shallow-draft scows (estimated 300-cubic-yard capacity or less)
  - Skiffs (crewed work boats)
  - Tugboat to move scows to offloading site at the sediment management or placement area
- Additional equipment that may be required pending placement area logistics:
  - Hydraulic pump out station with crane and pump to mix water into scows and hydraulically pump sediment to placement site
  - Excavator or cranes for offloading sediment from the scows
  - Earth-moving equipment to stockpile and dry sediment
  - Water tanks and processing equipment if effluent is collected from the stockpile
  - Loader and trucks if sediment will be trucked from the sediment management area to ultimate placement area

3.1.3 Dewatering Hydraulically and Mechanically Dredged Sediment

Similar to selection of the dredging method, selection of a particular dewatering method is typically determined by construction logistics, such as the dredging method, dredge volume, site access, and available upland space. Regulatory conditions, cost, and contractor equipment availability also play a major role in the selection. Potentially applicable dewatering methods are described in the following sections.

CVRWQCB typically restricts suspended sediment particle concentration in effluent discharges, so it is critical to provide adequate particle and water separation during dewatering. For mechanical dredging and excavation, dewatering may require a few days or weeks. However, for hydraulic dredging, dewatering becomes an important and complicated process because if the dewatering operations cannot meet or exceed the production rate of the dredge, the dredge will have to stop operations until the dewatering process catches up.

3.1.3.1 Settling Pond Dewatering

If sediment is mechanically dredged and placed upland for dewatering, it could be placed in a containment pond supported by modular concrete barriers (k-rail) and lined with plastic. The effluent water could be left to evaporate or be released back into the channels. The sediment may also require some working using land-based equipment after the initial effluent water drains.

However, if material is hydraulically dredged and placed upland for dewatering, the settling pond would require a much larger surface area to allow proper residence time for settlement of suspended particles and to manage the amount of water associated with hydraulic dredged slurry. The settling pond would be constructed with earthen berms and include a weir system for releasing effluent.

Sandy sediment would settle relatively quickly, possibly within several days. However, fine silts and clays have a much slower settling rate and can require weeks or months to settle. In the absence of laboratory column settling tests, it is approximated that proper settling of the fine silts and clays would require at least 1 acre of settling pond area for every 5,000 cubic yards of sediment dredged, with containment berms between 5 and 8 feet tall.

Sediment sampled from Old River shown in Table 2-2 shows that the sediment fines, fine sand and medium sand, with percentages ranging throughout the Program area. This means that the extent of the smaller project's dredging area will be a critical factor for determining the specific settling rate of the dredged slurry within that project.

The settling process could be enhanced by adding inert flocculants, further discussed in Section 3.1.3.3.1, pending CVRWQCB approval. The settling pond area could also include a cell system or internal berm feature to create a longer slurry travel distance, increasing residence time.

3.1.3.2 Mechanical Working or Disking

If sediment removal occurs using mechanical dredging or land-based construction equipment, it may require working (spreading and drying by dozers) or disking (rotating and drying by harrowing disks). This would limit the thickness of the dredged material at the processing area to just a few feet thick at a time to allow for effective drying. Using this method, mechanically dredged or excavated sediment could be dry within days during warmer weather or within weeks or months if dewatering is attempted during rainy weather.

Mechanical working or disking alone is not sufficient to dewater hydraulically dredged slurry but could be implemented after another more aggressive dewatering method is performed.

3.1.3.3 Dewatering Methods in Confined Areas

There are additional dewatering methods that could be considered if a sediment management area has limited space to accommodate the volume of dredged sediment. These methods are not typically applied to dredging projects in the Delta due to the general availability of open space.

3.1.3.3.1 Addition of Amendments

If dredged sediment is fine grained, the dewatering process can be enhanced by the addition of amendments to bind the sediment into flocs and increase the rate of settlement. Some amendments also act as a stabilization agent for certain chemical constituents and can reduce leachability. Portland cement or lime are most often used as additives because they are historically have been readily available and have predictable reactive characteristics. Fly ash is also used as an additive, usually in conjunction with cement or lime to reduce the overall additive cost. This system is best applied to mechanically dredged or excavated sediment but could be used as a supplementary dewatering method for hydraulically dredged slurry. Amendments are typically used to supplement other dewatering methods.

3.1.3.3.2 Geotextile Tube Dewatering

Geotextile tubes may also be used to dewater hydraulically dredged material. Geotextile tubes are constructed from high-strength, woven, permeable geotextiles, and can reach sizes of up to several hundred feet long by up to 60 feet in circumference when filled. Dredged slurry is pumped directly upland into the tubes at the processing area, and sediment is retained within the tubes while the water drains through the permeable walls. If implemented properly, use of geotextile tubes can be cost effective and time efficient. Depending on the sediment quality, the decanted water is often suitable to be returned to the native waterways without additional treatment, if permitted by the agencies. If additional decant water filtration is required, it could be routed to a treatment area and filtered through a system such as Baker tanks. Additionally, additives can be applied to fine-grain sediment to encourage dewatering, enhance chemical stabilization, and reduce leachability.

3.1.3.3.3 Rapid Dewatering System

If the channels are mechanically dredged, the dredged slurry could be manually pumped to a portable rapid dewatering system. This type of system typically consists of debris removal, coarse-grain separation by hydrocyclone or centrifuges, and separation of fine sediments by polymer flocculation or other methods. Water is usually clarified to the extent that it can be released directly back into the native waterbody, if permitted by the agencies, or hauled off site. The resulting sediment is usually sufficiently dried for immediate trucking; therefore, this system eliminates the need for additional active dewatering methods such as mechanical working, disking, settling, or geotextile tubes. Benefits of this system include the compact work area in comparison to settling ponds and geotextile tubes. Additionally, this system provides separation of sediment by grain size, allowing sand to be segregated from fines and routed to targeted beneficial uses. However, it is difficult to maintain a steady intake of solids content in the dredged slurry needed to keep this system working at optimal levels.

3.2 Interim Dredging Maintenance Considerations and Recommendations

After target dredging elevations in the channels have been achieved, they will require ongoing maintenance dredging. A successful long-term sediment management plan may include a combination of a large initial dredging event, moderate to large maintenance dredging events, and interim isolated shoal management.

The key factor in developing a successful long-term sediment management plan is understanding the sediment accretion, or shoaling, rates for each channel or reach. Shoaling rates can be estimated by comparing historical and current bathymetric surveys and calculating the amount of sediment that accumulates over time. It is preferable to compare numerous surveys spanning many years because comparing only two or three surveys performed within a relatively short period might provide only a snapshot in time that could reflect atypical conditions such as El Niño years or drought years. Any dredging or sediment management activity between surveys must also be considered.

Once a shoaling rate is estimated, it can be applied to the development of a long-term sediment management plan that suits the Work Group's preferences and budget. The following sections discuss considerations for maintenance dredging and small, interim methods for controlling isolated shoals or small volumes of sediment between larger dredging projects.

3.2.1 Maintenance Dredging

Maintenance dredging is dredging an existing dredging template to no more than the originally permitted and dredged horizontal and vertical extents. The term "maintenance dredging" is a formal term in the dredging industry and the regulatory fields. It indicates that the sediment within the dredging template is not consolidated with the potential for debris, but rather is sediment that is softer and easier to dig because it has accreted since the last dredging event. This is important to note because several of the dredging contractors contacted during development of this Guide said that they have encountered consolidated sediment and solid debris while dredging in the Delta, which could create issues with construction schedule and costs.

Maintenance dredging differs from initial dredging in the following ways:

- The project may be exempt from CEQA or covered by the initial project's CEQA document if ongoing maintenance activities were included in the assessment of long-term impacts (See Section 4.1.1. for further discussion of appropriate CEQA documentation).
- The sediment characterization process is more predictable because a site history has been established for the agencies to consider during any subsequent sediment characterization efforts.

- Contractor bid prices are typically lower because dredging contractors anticipate softer sediment and very little to no debris or obstructions within the dredging template. Due to the anticipation of softer sediment, the dredging contractors can potentially use less powerful cutterheads or smaller buckets.

Maintenance dredging is similar to initial dredging in the following ways:

- Permit requirements are typically similar in terms of the required avoidance and minimization measures.
- Design costs are similar.
- In the Delta, the initial dredging project (often called new work dredging) and maintenance dredging are commonly regarded similarly by the agencies in terms of placement site approvals (whereas in the San Francisco Bay, placement and disposal of new work dredging is highly regulated).

3.2.2 Knockdown Dredging

Knockdown dredging, sometimes called bed-levelling, is a method of sediment control that involves knocking down or grading sediment high spots into adjacent lower spots in the same authorized dredging footprint. This method of interim sediment control would be best suited for the Program channels in the following situations:

- There are small, isolated shoals that can be scraped into an adjacent low-lying area or depression to level out the channel bottom.
- There are small amounts of sediment in a difficult to access area that can be relocated to a more accessible area a short distance away for future dredging.

This method involves scraping only several inches of sediment at a time; it is not typically suitable for managing large volumes of sediment or sediment distributed over a large area. Although this method is common throughout various parts of the country, knockdowns in the greater Bay Area and Delta regions have historically been applied only to very small shoals, generally between a few hundred to a few thousand cubic yards, due to concerns with sediment plumes resulting from large amounts of sediment disturbance.

Knockdown equipment commonly consists of a heavy beam dragged across the channel bottom by a barge or tug (see Figure 3-3) or a mechanical dredge bucket swept across the channel bottom.

A significant benefit of knockdowns in lieu of dredging is that no off-site placement of the sediment is necessary. Placement costs associated with hydraulic dredging (pipeline, booster pumps, upland site preparation, and water management) or mechanical dredging (tugboats, scows, placement fees, offloading equipment, sediment management, and placement crews) are eliminated, resulting in a considerable cost savings. Another potential cost savings would be realized if sediment testing requirements were reduced or eliminated, which would be determined by CVRWQCB.

Based on a recent knockdown effort in Stockton, California, it is anticipated that a knockdown project in the Program area could have the following regulatory restrictions and conditions:

- Knockdown operation may be required to occur during an annual in-water construction window (likely August 1 through November 30, although it may vary by location).
- A knockdown event may have a permitted volume limit per instance, such as 5,000 cubic yards or less. Further, the knockdown volume could not be increased beyond the depression capacity. It is possible that any knockdown that exceeds the volume limit may require a plume monitoring report until sufficient information confirms that knockdowns have environmental impacts less than or equal to those of a dredging episode.
- Pre- and post-project surveys may be required, including calculations of the volume of sediment relocated.
- Either a mechanical bucket or towed I-beam may be permitted to knock the shoal into the depression.
- The knockdown episode would likely be required to minimize the potential resuspension of sediment; if an I-beam is used, it would likely be required to be towed no faster than 4 knots.
- The knockdown material may have to meet chemical and biological criteria specified by the agencies.

3.2.3 Diver Suction Dredging

Diver-assisted suction dredging involves one or more SCUBA divers equipped with a hose attached to a small dredging device mounted either on land or on a floating barge. An example of diver-assisted dredging is shown in Figure 3-4. This method allows for precise sediment removal and would be best suited for low-volume dredging between structures such as diversions, docks, or riprap slopes, or for addressing small, localized shoals within a channel. Dredged material could be placed either in a scow for transport and off-site placement or directly upland for dewatering and drying. Like hydraulic dredging, upland placement would involve sediment dewatering, drying, and effluent management. Benefits of diver-assisted suction dredging include very low impacts to diversion operations or vessel movement and very low mobilization and operational costs compared to a larger dredging operation. Diver-assisted dredging is not a viable method for dredging projects with larger volumes.

This method is most cost-effective if slurry is pumped upland, either to a mobile treatment and dewatering system or to a contained settling area similar to those used for hydraulic dredging. Because of the high water content, pumping to a scow and transporting to an off-site placement location may be cost prohibitive. Dredging production rates are expected to be very low compared to hydraulic dredging, at approximately 50 to 100 cubic yards per day; however, production rates could be increased by adding additional divers.

This method is not expected to impact special-status species because it can be conducted in a very precise manner and would only be used in limited circumstances. It is not known to frequently occur in the Delta; however, based on agency discussions at candidate sites throughout the San Francisco Bay and on the San Joaquin River, it is anticipated that diver-assisted suction dredging within the Program area could have the following restrictions and conditions:

- Each diver-assisted dredging effort would be permitted to remove a limited volume, on the order of 2,500 cubic yards per event.
- The equipment intake and discharge lines would not be permitted to exceed 6 inches in diameter.
- The equipment pump would not be permitted to start until the suction nozzle is in contact with the channel bottom (at mudline), and the equipment would not be permitted to be on and suctioning while the nozzle is within the water column.
- Diver-assisted dredge material could be discharged to scows and transported to an off-site location, or it could be pumped upland for dewatering and processing.

3.2.4 Additional Sediment Management Concepts

Additional sediment management concepts that might provide long-term cost savings in areas with high shoaling rates include the following:

- Sediment traps
- Advanced maintenance
- Annual dredging projects with an on-call contractor

These methods have proved successful at various other dredging sites, such as ports, refineries, and marinas; however, they also could be more costly and logistically challenging to implement than standard maintenance dredging, knockdown dredging, and diver suction dredging. The following sections contain brief descriptions of each additional concept and how it could be applied to a long-term sediment management plan.

3.2.4.1 Sediment Traps

Creating a sediment trap involves dredging a pit near to and deeper than the dredging area. The intent is for incoming sediment to settle in the trap before spreading to the rest of the channel. In theory, suspended sediment is transported into the channels by rising tides, and the tidal velocity would slow down over the trap so that some of the coarser suspended sediment would settle out into the trap. Dredging of the sediment trap would be completed in the same manner as maintenance dredging, but it would be less expensive because theoretically the sediment is contained in one area rather than distributed to larger areas or difficult-to-access locations. If a sediment trap works effectively and has enough capacity, it could also potentially reduce the frequency of routine maintenance dredging intervals.

If a sediment trap is constructed in the wrong place, suspended sediment may pass over the trap during rising tides and settle in the channel. Hydrodynamic modeling could be completed to predict the performance of the sediment trap and the maximum elevation that would balance between reducing dredging frequency and accreting sediment so rapidly that there is no benefit to the sediment trap.

The steps to develop this concept include:

1. Identify locations where sediment seems to be accreting naturally and rapidly.
2. Prepare conceptual designs of sediment trap options.
3. Create a model to test the potential effectiveness of the sediment trap in collecting sediment before it enters the channel.
4. If the sediment trap is found to be effective, estimate the frequency of maintenance dredging with and without the sediment trap.
5. Compare the estimated costs and benefits of maintenance dredging with and without the sediment trap.

3.2.4.2 Deepening

Deepening is dredging an existing dredging template to wider horizontal extents or deeper elevations than originally permitted or historically dredged. For the purposes of this Guide, the term could also apply to deepening beyond operational requirements. The purpose of deepening would be to increase the interval between maintenance dredging events, which in turn could reduce costs associated with repeat design and contractor mobilizations. However, the initial costs for a deepening event may negate any cost savings due to the amount of regulatory oversight and the volume of dredged material. Further, risks involve the potential to encounter debris, obstructions, or consolidated sediment at previously undisturbed elevations.

An additional consideration is that deepening may require a more formal CEQA process than maintenance of a channel to historic elevations.

3.2.4.3 On-Call Dredging Contract

This concept includes contracting with an on-call dredging contractor for a multi-year duration. The total number of dredging episodes and associated dredging volumes within this multi-year period would be based on the varying needs of the channels included in the overall contract, which would likely be determined by routine bathymetric condition surveys, operational needs, and funding availability. Bidders could be asked to either provide a price that holds for the duration of the contract or commit to unit prices for each year of the contract.

Multi-year contracts commonly run between 2 and 5 years and sometimes include a shorter base contract duration that allows add-on years at the Owner's discretion. This approach includes preparing a multi-year master specification that is applicable to all dredging areas under the contract umbrella. After the first year, a much less design-intensive process would be applied because the project limits, technical requirements, and contractual conditions would already be in place. These interim years would only require preparation of a new plan sheet showing revised bathymetric data and identification of the targeted dredging area that can be covered by the available annual dredging budget. Because dredging would occur every year, both a pre-dredge and a post-dredge survey would be required each year.

If long-term dredging permits are in place, this option would not require additional regulatory efforts beyond maintaining the active status of the permits and completing the annual agency notifications with some interim approvals.

This type of contract could benefit both the Owner and the contractor because the Owner would know the dredging unit prices for the duration of the contract and could budget accordingly, and the contractor would be incentivized to bid lower because they would be guaranteed consistent work. Generally, the most successful multi-year contracts provide the dredger assurance of a minimum annual dredging volume to make it worth their effort to bid, although the Owner could increase the volume as needed.

Successful implementation would require an understanding of the general accretion rates to properly budget and plan each annual dredging episode. This option would increase the frequency of dredging, however, the dredging would be scheduled well in advance rather than reactive.

The steps to develop this concept include the following:

1. Prepare an assessment of dredging needs over a set number of years to develop the minimum annual dredging guarantee and approximate dredging area per year.
2. Obtain long-term dredging permits.
3. Prepare and bid a master specification and plan set that applies to all channels within the overall contract.
4. Award base year(s) to the selected contractor.
5. Implement Year 1 dredging in accordance with the master specification and plan set.
6. Perform annual site condition surveys in Year 2 through the end of the base year to confirm dredging locations and volumes, then issue a task order to the dredging contractor.
7. Provide agencies notification (or ask for episode approvals) each year.
8. If satisfied with the dredging contractor, award optional add-on years to the contract.

3.3 Protection of Diversions

There are approximately 160 diversion systems located throughout the Program area that may need protection during dredging. These diversions should be clearly marked on the dredging design plans so the Contractor will know to dredge with caution in the vicinity, or if feasible, temporarily remove the intake piping during dredging operations. If the intake piping cannot be temporarily removed and sediment has built up around a diversion system such that sediment removal is necessary, diver suction would be the most appropriate method as it can be managed by hand using visual guides by the operator. It is anticipated that temporary removal would be more cost effective than diver suction dredging, however diver suction could be considered if being used for dredging under nearby infrastructure.

3.4 Availability of Suitable Regional Equipment and Contractors

Dredging in the Program area introduces some challenges compared to nearby regions, such as shallow water depths, some unverified tidal monuments, and lack of in-water dredged sediment placement options. Therefore, it is recommended that either a regionally based dredging contractor or a dredging contractor with experience in the Delta be considered to perform the work.

Table 3-2 contains a list of dredging contractors that were contacted for this Planning Guide. They confirmed they have Delta dredging experience and access to suitable equipment to dredge the channels in the Program area. The information in Table 3-2 was provided by contractor websites or personal communications, and was not independently verified. This information is understood to be current at the time of the report but may vary by the time dredging is implemented.

Table 3-2
Dredging Contractors with Delta Experience and Suitable Equipment

Company	Small Hydraulic Equipment	Small Mechanical Equipment	Summary of Delta Experience
Camenzind Dredging, Inc.	12-inch portable cutter suction	Equipment for any sized projects, including excavators and cranes	Delta, Sacramento, and San Joaquin rivers
Curtin Maritime	12-inch portable cutter suction	Derrick Barge Ben Weston: 110’ x 48’ x 10.5’	Delta, Sacramento, and San Joaquin rivers
Dixon Marine Services, Inc.	8-inch and 12-inch portable cutter suction	Derrick Barge Columbia: 140’ x 40’, 5-cubic-yard digging bucket	Delta, Sacramento, and San Joaquin rivers
The Dutra Group	12-inch portable cutter suction	Derrick Barge #24: 150’ x 54’ x 13’	Delta, Sacramento, and San Joaquin rivers
JND Thomas Co., Inc.	8-inch and 10-inch portable cutter suction	Unknown	Confirmed inland marine experience
Lind Marine	unknown	Sonnee Delight: 120’ x 40’ excavator barge, 5-cubic-	Delta, Sacramento, and San Joaquin rivers

Company	Small Hydraulic Equipment	Small Mechanical Equipment	Summary of Delta Experience
		yard bucket; Gretajean Lind (also offloader): 120′ x 53′, 8-cubic-yard bucket	
Orion Marine Group	12-inch portable cutter suction	Liebherr 895 HD; Lima 2400B (barge mounted cranes)	unknown
Pacific Maritime Group	Sandpiper: 74′ x 26′ x 6′ cutter suction	Horton: 110′ x 34′ x 8′ excavator barge	unknown
Ross Island Sand & Gravel	12-inch and 16-inch portable cutter suction	unknown	Delta, Sacramento, and San Joaquin rivers
Vortex Marine Construction, Inc.	16-inch portable cutter suction	Derrick Barge Vigor: 30′ x 70′ x 6′	unknown

Note:
Manson Construction Co. was also contacted. They confirmed they do not have equipment suitable for this work.

4 Conceptual Dredging Design

For this Guide, conceptual dredging templates were developed to provide order-of-magnitude dredging volumes for the eight primary channels summarized in Section 1.3 and shown in Figure 4-1. Note that some of the secondary channels from Figure 1-1 are not included in this assessment.

The following sections describe the development of conceptual dredging templates a work plan that includes studies and analysis to support the development of a formal dredging design.

4.1 Dredging Template

Conceptual dredging templates were developed to meet anticipated Program objectives and accommodate existing site conditions. These templates were developed using basic design components that include target dredging elevation, channel width (at toe of slope and top of slope), and side slopes. These design components are described below in their application to development of the conceptual dredging templates. Figure 4-2 provides a schematic cross section of the relationship between these components.

4.1.1 Vertical Extents (Target Dredging Elevations)

Work Group members from DWR and the South Delta Water Agency collaborated with Anchor QEA in a focus meeting to identify target channel dredging elevations (for the purpose of this Guide only) that would meet Program objectives for water flow to allow full agricultural diversions.

Although it is not possible to unequivocally identify a singular or consistent historical channel elevation, the focus meeting participants agreed that generally using the deepest historical elevations as a design reference may provide benefits during the environmental review and approval process to classify a project as "restoration to historical elevations." Using the following process, dredging target elevations were determined by using both the current 2018 DEM and historic 1934 NOAA survey data. During this process, it was found that the channels were generally deeper in 1934 than they are currently. The process consisted of the following steps for each channel:

1. The current thalweg (deepest part of the channel) elevations were charted using the 2018 DEM.
2. After eliminating any apparent data anomalies in the 2018 DEM thalweg, an average current thalweg elevation was determined over the entire channel.
3. The historical thalweg elevations were charted using 1934 NOAA survey data. This data was assessed in 250-meter "bins," with the average of each bin then being applied as an average 1934 maximum elevation for the channel. It is important to note that the thalweg identified by the historical data was not always in alignment with the thalweg from the 2018 DEM, therefore restoring the thalweg will likely be similar to new work deepening in some areas in terms of the potential to encounter consolidated sediment (see Section 3.2.4.2 for more information about deepening).

4. The maximum historical elevation along each 250-meter bin was used to calculate a historical maximum elevation average over the entire channel.
5. The target dredging elevation was then established as follows:
   a. The historical maximum elevation average was used in for Old River (West), Old River (East), Old River (South), Old River (Side Channel), Fabian & Bell, and Paradise Cut.
   b. In Tom Paine Slough, the average historic elevations were shallower than the southern segment of Old River, so the Work Group suggested that the historical elevation for Old River (South) be applied.
   c. In Middle River, the historical elevations were noticeably shallower at the south end of Middle River near the head of Old River than they were near South Tracy Boulevard, so Middle River was subdivided into two reaches with a transition reach in between. The average elevation was calculated over the first 12 kilometers (km) measured from South Tracy Boulevard, and then over 14 km from South Tracy Boulevard to the junction with Old River. Between 12 km and 14 km from South Tracy Boulevard, the target dredging elevation would transition between the elevation of these two segments.

Figure 4-3 provides the channel profile comparison of the historic and current elevations used to determine the target dredging elevations. A summary of the average historic elevations and proposed target dredging elevations is included in Table 4-1.

Table 4-1
Target Dredging Elevations (for Purposes of the Planning Guide)

Channel	Average Historic (1934) Elevation (meters NAVD88)	Proposed Target Dredging Elevation (meters NAVD88)	Proposed Target Dredging Elevation (feet NAVD88)
Middle River	-2.1 to -0.8	-2.1 to -0.8	-6.9 to -2.6
Old River (West)	-5.5	-5.5	-18.0
Old River (South)	-3.0	-3.0	-9.8
Old River (East)	-3.9	-3.9	-12.8
Old River (Side Channel)[1]	-1.8	-1.0	-3.3
Fabian & Bell	-3.4	-3.4	-11.2
Paradise Cut	-3.3	-3.3	-10.8
Tom Paine Slough	-2.7	-3.0	-9.8

Note:
1. The Proposed Target Dredging Elevation is shallower than the Approximate Existing Elevation.

4.1.2 Horizontal Extents (Channel Width)

A minimum and a maximum conceptual channel width was applied to develop a lower and upper bound of dredging volumes for each channel.

The minimum conceptual channel width was developed with the following approach:

- A 20-foot channel width was selected as a minimum width to accommodate the proposed dredging methodologies discussed in Section 3. This defines the channel footprint.
- A side slope (see Section 4.1.3) from the toe of the channel up to the sediment surface was applied to capture the volume of potentially sloughed sediment, as well as to prevent potential undermining of existing banks or levees.

The maximum conceptual channel width was developed with the following approach:

- The thickness of the dredge cut was estimated based on existing channel mudline elevations compared to target dredging elevations, as identified in Section 4.1.1.
- A side slope (see Section 4.1.3) was projected down from the shoreline at the MLLW level until it intersected with the target dredging elevation. The resulting distance between the point of intersection of both slopes (toe of slope) was defined as the maximum channel width.

The resulting minimum and maximum channel widths are summarized in Table 4-2. Figure 4-4 provides an example of how the minimum and maximum channel widths can impact to the dredging template at Tom Paine Slough. No dredging offset from the levees or banks was applied during the development of the minimum widths, however a geotechnical investigation should be performed during design to determine if an offset is needed (see Section 4.3.2).

Table 4-2
Conceptual Channel Dredging Template Width Calculations

Channels	Proposed Target Dredging Elevation (feet NAVD88)	Cut Thickness (feet)	Channel Width at Toe of Slope (feet)	
			Minimum	Predominant Maximum
Middle River	-6.9 to -2.6	3.6	20	155 or greater
Old River (West)	-18.0	3.9	20	155
Old River (South)[1]	-9.8	3.2	20	160 or greater
Old River (East)	-12.8	N/A[3]	20	180 or greater
Old River (Side Channel)	-3.3	3.3	20	160
Fabian & Bell[2]	-11.2	6.3	20	140
Paradise Cut	-10.8	6.5	20	140
Tom Paine Slough	-9.8	8.2	20	130

Notes:

1. Old River (South) is predominately wider than 100 feet, except where interior channel islands are present.
2. Fabian & Bell is split by an interior land mass and is predominately more than 100 feet wide to the north of it, and ; southern portion is predominately less than 100 feet wide to the south.

4.1.3 Side Slopes

A side slope is defined as the area between the outer edge of the limit of dredging at the target dredging elevation (toe of cut) and the intersection point at the existing grade. Assessment of the sediment grain size and properties can inform the estimation of the natural angle of repose, but not all side slopes will settle as expected. Depending on the project, the volume of sediment within the side slope area may be included in the required dredging template, or it may be only designated as an optional part of the dredging template. Regardless, sediment from the side slopes that sloughs into the required dredging width should be removed. Typically, the contractor is allowed payment up to a maximum slope for either required side slope dredging or removal of side slope sediment that sloughs in.

As is discussed in Section 2.3 and shown in Table 2-2, the Program area ranges from silty to sandy material. With the diverse geotechnical properties present, a reasonable estimate for the natural angle of repose of side slopes would range from 3 horizontal to 1 vertical (3H:1V) to 2H:1V. A side slope of 2H:1V was predominately applied to the dredging templates to estimate dredging volumes, except where noted at Middle River in Table 4-3.

4.1.4 Allowable Overdredge

It is customary (though not required) to allow dredging contractors to dig a prescribed distance below the target dredging elevations, which is called an overdredge allowance. Typically, at least 1 foot (approximately 0.3 meter) of allowable overdredge is permitted to allow for surveying and equipment inaccuracies and to incentivize the dredger to remove all sediment above the target elevations. Sometimes a second foot of allowable overdredge is permitted to allow for equipment inaccuracies and to minimize the risk of the contractor over-digging in a manner that violates the permit conditions. The first foot of allowable overdredge should be counted as payable volume to the contractor. The second foot is not commonly payable. In many instances, designing with a full 2 feet of overdredge is preferable to maximize channel depth; however, site conditions need to be taken into consideration. For example, in many of the channels, overdredge could potentially lead to additional side sloughing and thus impact bank stability.

In bidding, the owner commonly reports the required dredging volume (to target elevation) and the potential maximum payable volume in the bid form. However, in permitting and sediment characterization documents, the owner must report all potential maximum payable and non-payable volumes as one lump overdredge volume. The overdredge elevation and volume is thus incorporated into the permit authorizations. If the dredging contractor exceeds the maximum overdredge allowance elevation, it may be considered a permit violation for dredging sediment that was not characterized or permitted to be removed.

For the purposes of this Planning Guide, 1 foot of allowable and payable overdredge beyond the target dredging elevation is assumed. If future modeling shows that adding a second foot of overdredge is unlikely to undermine the perimeter levees, it can be considered as part of the design.

4.2 Dredging Quantities (Reconnaissance-Level Estimates)

Dredging volumes were calculated by comparing the 2018 DEM to the lower and upper bound dredging templates described in Section 4.1 for each channel. Volume calculations were performed using AutoCAD Civil 3D software. The volumes are listed in Table 4-3. As is described in Section 4.1.2, a minimum and maximum channel width were selected to show a range of possible dredged material volume required to be removed to reach the target elevations identified in Section 4.1.1. These are estimations based on preliminary information and may be adjusted when during the design phase of a specific channel.

Table 4-3
Dredging Volumes by Channel (for Purposes of the Planning Guide)

Channel	Target Dredging Elevation (feet NAVD88)	Side Slopes	Dredging Volume (cubic yards)			
			Lower Bound		Upper Bound	
			20-Foot Width Channel Template	1-foot Overdredge Allowance	Average Maximum Width Channel Template	1-foot Overdredge Allowance
Middle River	-6.9 to -2.6	2H:1V[1]	265,000	80,000	707,000	214,000
Old River (West)	-18.0	2H:1V	200,000	45,000	1,504,000	333,000
Old River (South)	-9.8	2H:1V	338,000	95,000	1,495,000	417,000
Old River (East)	-12.8	2H:1V	119,000	36,000	594,000	180,000
Old River (Side Channel)	-3.3	2H:1V	28,000	11,000	86,000	32,000
Fabian & Bell	-11.2	2H:1V	73,000	19,000	288,000	73,000
Paradise Cut	-10.8	2H:1V	131,000	16,000	333,000	39,000
Tom Paine Slough	-9.8	2H:1V	56,000	8,000	188,000	24,000

Note:
1. Due to narrow channels, slopes in Middle River range from 1H:1V to 2H:1V. Slopes at

4.3 Work Plan to Produce Final Design

This section outlines the anticipated investigations and steps to prepare final dredging design.

4.3.1 Hydrographic Surveys

The first step in planning a dredging project is to perform a hydrographic survey of the dredging area. The information from the survey is used to determine existing bathymetric conditions and potential dredging volumes, which informed all other aspects of the planning work. The age of the survey can be depending on how rapidly the dredging site accretes sediment, however surveys should generally be no more than a year old if being used for design and planning purposes.

Multibeam hydrographic surveying equipment typically produces the best site coverage and accuracy and is not much more expensive than other methods. Using multibeam, approximately 1 mile of channel can be surveyed in one day for a daily rate of $8,000 to $10,000. This rate would include collection of site elevation by vessel and processing of the data.

Table 3-3 provides rough costs for surveying each of the channels in the Program.

Table 4-4
Approximate Hydrographic Surveying Costs

Channel	Approximate Channel Length (miles)	Approximate Survey Days	Approximate Cost Range
Middle River	9.5	10	$80,000 to $100,000
Old River (West)	5	5	$40,000 to $50,000
Old River (South)	10.5	11	$88,000 to $110,000
Old River (East)	4	4	$32,000 to $40,000
Old River Side Channel	1	1	$8,000 to $10,000
Paradise Cut	2	2	$16,000 to $20,000
Fabian & Bell	1	1	$8,000 to $10,000
Tom Paine Slough	1	1	$8,000 to $10,000
		Total:	**$280,000 to $350,000**

Multibeam technology works best with three or more feet of water depth, so manual bathymetric surveying may be required in some shallow areas of Middle River, Old River and Tom Paine Slough (such as lead line surveying). Additionally, aquatic and terrestrial vegetation in the Program area may impede sonar and LiDAR collection of data. For these reasons, it is recommended that the surveyor perform a site reconnaissance prior to performing the survey so that they can adequately plan for using the most appropriate and cost-effective surveying methods. The surveyor may elect to use alternative methods to supplement multibeam data, such as lead line or single beam frequency.

4.3.1.1 Sediment Accretion Monitoring Through Routine Surveys

To effectively plan an ongoing dredging program after the initial dredging event, it is prudent to monitor the accretion of sediment in the dredging areas by performing routine hydrographic surveys. This data would support estimation of historic sediment accretion rates and patterns, as well as monitoring and predicting future dredging needs. After the data from at least three routine surveying efforts has been collected (ideally a year or more apart) the data can be analyzed to find an approximate rate of sediment accumulation per a period of time. The more routine surveys that are included in the analysis, the better the estimate of the accretion rate because annual fluctuations in weather patterns (droughts or floods) would be averaged out.

The accretion rate analysis could be performed by hand calculation methods to determine an order-of-magnitude estimate, however a much more useful and accurate analysis would be to create a hydrodynamic model (see Section 4.3.1). As more survey data is added to the model, long-term accretion rates and patterns can be better evaluated, allowing a much more efficient dredging design and long-term management approach.

Unfortunately, the provided bathymetric data for the Program area is not sufficient to determine accretion rates throughout the channels. This is because the data does not entirely overlap in many areas, which is assumed to be due to migrating or moved channel thalwegs over many decades. Furthermore, data is not available showing interim dredging or channel modifications over the years, which would impact accretion analysis.

Below are some guidelines for implementing a routine surveying effort:

- Perform up to three surveys one or two years apart; This interval can be more than two years of the site is known to have low sediment accretion.
- Assess the first three surveys for an immediate accretion rate and patterns; if necessary, increase or decrease the frequency of routine surveys in certain areas to accommodate accretion rates and budget.
- Take note of any occurrences that might impact accretion patterns, such as dredging events, major erosion events, and extreme weather patterns.
- If possible, use the same surveying method (ideally multibeam) and coverage area for each survey, and confirm consistency in the horizontal and vertical datums.

4.3.1.2 Maintenance Action Elevation Triggers

The immediate application of the information provided by routine hydrographic surveys would be to identify when accretion is nearing a pre-determined critical elevation. The critical elevation represents an elevation of sediment where the channel would no longer operate at optimum functionality. The critical elevation should be shallower than the target dredging elevation to provide allowance for shoaling between dredging events.

A trigger elevation would be used to indicate when accretion is nearing the critical elevation. A trigger elevation would be established by approximating how much time is needed to implement a dredging project as compared to the average accretion rate. As an example, if a project area has an estimated accretion rate of 1 foot per year and implementation of a dredging project takes two years, then the established trigger elevation should be a minimum of 2 feet below the critical elevation to allow dredging to occur before the critical elevation is exceeded. This example is shown in Table 3-4 as a 20-year dredging plan. This is not based on the channels within the Program area.

Table 4-5
Example Maintenance Long-Term Plan

Example Project Parameters: Target Dredging Elevation = -12.0 feet Trigger Elevation = -8.0 feet Critical Elevation = -6.0 feet		
Year	**Mudline Elevation (feet)**	**Action**
1	-12.0	Dredging Event
2	-11.0	No Action
3	-10.0	No Action
4	-9.0	No Action
5	-8.0	Trigger Elevation Reached: Initiate Dredging Project Planning
6	-7.0	Planning
7	-12.0	Dredging Event
8	-11.0	No Action
9	-10.0	No Action
10	-9.0	No Action
11	-8.0	Trigger Elevation Reached: Initiate Dredging Project Planning
12	-7.0	Planning
13	-12.0	Dredging Event
14	-11.0	No Action
15	-10.0	No Action
16	-9.0	No Action
17	-8.0	Trigger Elevation Reached: Initiate Dredging Project Planning
18	-7.0	Planning
19	-12.0	Dredging Event
20	-11.0	No Action

Development of a similar plan for the channels in the Program area would require developing an annual (or similar interval) accretion rate. The accretion rate is not required for the initial dredging project, however. It is likely that there will be variation in accretion rates throughout various segments of the channels, which a long-term dredging plan may take into account for interim maintenance (see Section 3.2).

4.3.2 Hydrodynamic and Water Quality Modeling

Implementation of the Program will affect net flows and water quality in the South Delta. For this Guide, initial target dredging elevations were estimated based on the 1934 NOAA soundings. However, no modeling or analysis has been conducted to evaluate how the restoration of these historical channel depths would influence net flows, water quality, fish migration, or conditions during floods. The final design will need to consider these processes to quantify the Program's effects on hydrodynamics and water quality and to evaluate whether deepening the channels to their full historical depths will result in any unwanted or unanticipated changes in hydrodynamics, flooding, fish movement, or water quality in the Delta. This modeling work may also be required as part of the environmental review and regulatory permitting processes to support CEQA/NEPA compliance and regulatory permitting for the Program. Estimates of the approximate costs to conduct the hydrodynamic and water quality modeling described below are included in Section 4.3.5.

Hydrodynamic modeling for a majority of the Program area could be performed using one-dimensional (1-D) models such as DSM (by DWR) or HEC-RAS (by USACE). The channel junctions may require two-dimensional modeling (2-D). Advanced analysis, such as water quality modeling, could require a more elaborate three-dimensional (3-D) model such as UnTRIM (MacWilliams et al. 2015) or SCHISM (Ateljevich et al.

To evaluate the effects of the Program, predicted hydrodynamics and water quality conditions after implementing dredging associated with the Program should be compared to predicted hydrodynamics and water quality under existing conditions. The existing conditions for the South Delta are already well-represented by the models listed. If necessary, these models can be updated to include the most recent existing bathymetry in the Program area at the time the analysis is conducted. These models will be used to predict hydrodynamic and water quality under existing conditions. Predicted hydrodynamic and water quality variables for the existing conditions simulated should be validated using available data collected in the South Delta for the periods simulated.

A separate model grid will be developed that retains the same horizontal grid structure as the existing conditions model but uses revised model bathymetry that incorporates the design depths for the Program. A series of model simulations should be conducted on both the existing conditions grid and the with-Program grid, which includes the deeper depths in Program channels. Predicted tidal flows, water surface elevation, and water quality variables can be compared between these two simulations to evaluate the potential effects of the Program on tidal flows, net flows, flow splits at junctions, salinity, temperature, or other variables of interest.

It is recommended that the simulations used to evaluate the effects of the Program span a range of hydrodynamic conditions in the Delta, including a wet water year with high inflows from the San Joaquin River, a dry or critical water year with higher salinity intrusion into the West Delta, summer conditions that include the installation of the South Delta temporary barriers, and conditions with and without the Head of Old River Barrier. The analysis of the differences between predicted tidal flows, net flows, flow splits at junctions, salinity, temperature, or other water quality variables will provide the information needed to make a determination of the significance of impacts of the Program as part of the environmental review process.

If the initial evaluation of the effect of the Program is determined to be significant, the hydrodynamic model can be used to refine the design depths for the Program to reduce or minimize effects. The with-Program bathymetry can be modified to reflect changes to the design depths, and the with-Program simulations can be repeated using the revised bathymetry. These scenarios can be compared to the existing conditions and the original design depths to evaluate how modifying the design depths reduces or changes the Program's effects on hydrodynamics and water quality.

The described modeling may cost between $75,000 for a 1-D model and $300,000 for a 3-D model If additional assessments of the effect of the Program on sediment transport are needed, either to evaluate future sedimentation rates or to understand the effect of the Program on sedimentation in the South Delta, coupled hydrodynamic, wind wave, and sediment transport models of the Delta are also available (e.g., Bever and MacWilliams 2013; Bever et al. 2018). This cost estimate does not included these additional analyses.

4.3.3 Geotechnical Investigations

Prior to engineering design, an analysis of the sediment engineering characteristics should be performed to evaluate the sediment behavior for dredging and dewatering, slope stability, and post-construction uses. The collection of samples of the sediment to be dredged for geotechnical index characteristics can be combined with the sediment sampling work required for sediment characterization, thus incurring a nominal additional field work cost for sediments within the dredging footprint.

A more robust geotechnical evaluation may be required to assess potential impacts of dredging to the adjacent levees and banks, as well as the potential for levee soils to support equipment loads if landside access is required during mobilization or dredging operations. This more robust evaluation would be supported by a specific geotechnical subsurface investigation and supporting engineering analyses.

Typically, geotechnical subsurface investigations for the levee system would be spaced between 200 to 1,000 feet apart along the levee alignment, being spaced closer together in expected problem areas or near inlet or outlet structures and spaced wider in nonproblem or uniform condition areas (EM 1110-2-1913). Geotechnical subsurface investigations should extend from the top of the levee to a depth of at least 5 to 10 feet below the proposed dredge elevation. Additionally, a 100-foot-deep investigation would potentially be needed approximately every 1 to 3 levee miles for seismic site classification.

There are two types of geotechnical investigation methods that could be used. The first method advances geotechnical borings using a rotosonic, mud rotary, or hollow-stem auger drill rig. These borings should include sampling using split spoons and standard penetration testing (SPT) at maximum 5-foot-depth intervals, with collection of soil samples throughout for laboratory testing; it may be appropriate in the near surface to include additional samples (e.g. 2.5-foot-depth intervals, or continuous sampling). Laboratory testing should include, but is not limited to, index properties such as moisture content, organic content, Atterberg limits, grain size, and specific gravity, along with strength testing using direct shear or triaxial shear strength tests and consolidation testing.

The second subsurface investigation method advances a cone penetration testing (CPT) probe with pore pressures measurements. The CPT provides a continuous digital record of subsurface conditions and complements the information collected using traditional geotechnical boring soil sampling and laboratory testing. The CPT data can be correlated to a variety of geotechnical engineering design parameters and indicates changes in lithology in greater detail compared to geotechnical borings.

Following the field investigation and receipt of laboratory data (if applicable), slope stability analyses are recommended to evaluate the maximum dredge depth, stable side slopes, and/or necessary dredge offset to maintain levee stability. Both static and pseudo-static (seismic) conditions should be assessed for the current stability of the levees and the anticipated stability following dredging. The results of the slope stability evaluations should be presented alongside the subsurface conditions and field collection data in a geotechnical report.

The cost of a geotechnical investigation is assumed to be around $5,000 per day of drilling, and it is anticipated that it would take 4 to 5 days of drilling per channel mile given the anticipated spacing and depth of investigations for each adjacent levee. This assumes no access restrictions for a drill rig along the crest of the levee, along with minimal problematic areas and structures to investigate. If significant subsurface variability is encountered, the geotechnical engineer may recommend targeted supplemental investigation work to better define and evaluate problematic areas. Additional costs would include laboratory analysis of the samples and engineering analysis, which combined $10,000 to $15,000 per river mile.

4.3.4 Sediment Characterization

Sediment sampling and analysis of the dredged sediment is required by the regulatory agencies and often by the placement or landfill disposal site owner or manager to determine suitability for placement. For dredging work in the Program area, testing would follow guidelines provided in the General Waste Discharge Requirements for Maintenance Dredging Operations in the Sacramento-San Joaquin Delta (Order No. R5-2009-0085) for upland placement. Sediment is not commonly placed or disposed in-water in the Delta; however, if strategic land-mass creation is proposed, sediment testing criteria could be coordinated on a case-by-case basis. If sediment is proposed for landfill placement, additional testing may be required to meet individual landfill acceptance criteria.

The regional sediment sampling and analysis program has been designed based on 100,000 cubic yard increments of dredged sediment. The process for sediment characterization typically follows the steps listed as follows and can cost between $150,000 and $250,000 for testing of 100,000 cubic yards; however, cost and other factors are impacted by the volume of sediment tested as well as site-specific features:

1. Prepare a sampling and analysis plan (SAP) for sample collection and analytical testing. It is recommended to carefully consider the dredging area and volumes included in the SAP because including too much could incur unnecessary costs; however, including too little could prohibit future dredging in untested areas. The SAP would include procedures for sediment sample collection and handling, physical and chemical analysis, quality assurance and quality control, and data analysis. A project map with existing bathymetry, sampling locations, and composite areas would be included. Latitude and longitude coordinates, mudline elevations, and target core lengths would be provided for each sampling location. In accordance with Order No. R5-2009-0085, one core sample is required per 5,000 cubic yards of dredged material and one composite sample is required per 10,000 cubic yards of material (consisting of two core samples each). Historical data from previous sediment characterizations, if available, would be summarized.
2. Prior to sampling, the SAP would be submitted to CVRWQCB for approval. See Section 6 for more information about CVRWQCB.
3. Once the SAP is approved, sediment cores would be collected using a vibracore (or other equipment depending on core lengths and consolidation of sediment) to the proposed dredge elevation, plus overdredge elevation if applicable. Additional samples may be collected and archived from each core if further testing is required after the first round of results are reviewed.
4. In accordance with Order No. R5-2009-0085, pre-dredge testing would include sediment chemistry and leachate testing for upland placement. Sediment chemistry would include grain size, total solids, total organic carbon, metals, and potentially any constituent of concern in the dredging area that may be present from past incidents, such as spills, or that was detected in previous testing efforts. Leachate from dredge materials may contain soluble pollutants that

could migrate and contaminate groundwater or adjacent surface water. Leachate would be extracted using the deionized water waste extraction test (DI-WET) and analyzed for metals specified in Order No. R5-2009-0085. If decant water would be discharged from the placement site, modified elutriate testing would also be included.

5. Perform data validation before preparing a summary of the results.
6. Prepare a Notice of Intent (NOI) compliant with the requirements of Order No. R5-2009-0085 that describes test results with a comparison to appropriate screening levels, final sampling locations, and conclusions regarding the suitability of dredged sediment. The NOI should also include sediment core logs, core photographs, laboratory reports, and data validation reports. The NOI must be submitted to CVRWQCB for review and approval.

4.3.5 Design Steps

The design steps in this section are assumed to occur for project level work, not for the overall Program, because it not anticipated that all channels within the Program will be funded and dredged together. However, if a Program level CEQA document is prepared (refer to Section xxx), then all channels will need preliminary design. Preliminary and final project design steps are listed as follows in accordance with the general order of operations; however, the actual timing and details involved with each step will vary for each individual project:

1. Identify, to the extent possible, project objectives, such as a net flow, seasonal capacity, or minimal parameters to support diversions, navigation, and water quality improvements.
2. Refine the conceptual dredging template with hydrodynamic and water quality modeling. A new survey can be performed for this work; however, if existing survey data is assumed generally similar to existing conditions, it may be suitable for modeling purposes.
3. Prepare the project description.
4. Run a preliminary cost evaluation to see if the preliminary dredging volumes, preferred dredging and dewatering methods, and placement sites and project mitigation are within budged range. If not, determine if the project objectives need to be modified or if the project description needs to be revised to scale down the project before advancing to the next step.
5. Refine existing or collect new data to support 30% design, with the understanding that there may be additional data requirements during the CEQA/NEPA review and regulatory permitting processes. For example, if the sediment characteristics are unknown, a relatively low-cost sediment sampling effort could be performed to gage general sediment characterization. A more thorough sediment characterization effort could be performed once the regulatory agencies review the general characterization data and confirm permitting requirements. Some information that may be needed for this step includes the following:
   a. Survey data, if not already collected for modeling
   b. Geotechnical evaluations to determine levee stability and make recommendations for levees and in-water structure dredging offsets and dredge slope angles

c. Sediment characterization
d. Other surveys, such as for waters, special-status species, and habitats, as required for environmental review or permitting (see Section 6.3)

6. Prepare CEQA/NEPA documentation using the information and data collected as well as the project description. Note, if a Program level CEQA/NEPA document was prepared, this step may include preparing a subsequent document only (see Section 6.1.1.1).
7. Prepare permit applications. If required by agencies for permits, collected additional data or perform additional investigations. For flexibility, include multiple potential dredged sediment placement (and landfill disposal sites, if applicable) in the permit applications to allow for backup options if the preferred site becomes unavailable as well as to provide flexibility for the contractor bids.
8. When the CEQA/NEPA review and permitting processes are near complete, evaluate the anticipated regulatory requirements that could impact design or construction. These may include, but are not limited to, equipment restrictions, restrictions on seasonal construction work windows, and avoidance and minimization measures that may add significant cost or impact production rates.
9. Identify the most feasible placement sites (and if applicable, landfill disposal sites) included in the CEQA/NEPA document and permits, and confirm availability. Incorporate the site(s) into the design if site improvements are required to accommodate dredged sediment.
10. Prepare draft design documents and investigation design criteria such and placement area acceptance criteria for sediment quality. Incorporate findings and determinations from the CEQA/NEPA document and permits, as applicable.
11. Revaluate estimate of cost to determine if further project refinement is required to meet both project objective and budget. For example, if dredging volume is an issue, a base volume can be established as the required dredging to achieve minimum objectives, and the remaining volume to achieve ideal objectives could be applied as a bid option, only to be incorporated if bid costs are lower than expected.
12. Prepare final design, allowing flexibility from bidders where possible. For example, consider allowing multiple sediment placement or landfill disposal options at the contractor's choice to incentivize competition and better pricing.

5 Real Estate Plan

This section identifies potentially viable permanents placement and reuse sites for dredged sediment as well as potential temporary processing sites. An extensive land use investigation was not conducted for this Guide due to the conceptual nature of the Program planning. These sites may not be available at the time of dredging, or conversely, additional viable placement sites may emerge.

5.1.1 Potential Permanent Placement Sites (Active and Planned)

This section lists known sites that may be accepting dredged sediment for permanent placement, including sites that use sediment for beneficial uses, such as habitat restoration. These sites either actively accept sediment or are in the planning stages to accept sediment. These sites and their proximity to the Program area are shown in Figure 5-1.

5.1.1.1 Fabian Tract

Fabian Tract is a parcel of land located between Old River and Fabian & Bell Canal. It is owned by the USBR, who has leased it to DWR under a license extension through 2024. The site is approximately 34.5 acres and has been used for dredged material placement at least three times, including the following:

- 31,000 cubic yards placed in 2004 from mechanical dredging
- 7,000 cubic yards placed in 2005 from mechanical dredging
- 70,0000 cubic yards placed in 2000 from hydraulic dredging

The site required several commitments from DWR, including establishing a work buffer from elderberry shrubs, performing preconstruction biological surveys, assuring monitoring of a qualified biologist if work occurs between February 1 and August 31 for bird protections, and possibly performing a wetland delineation.

5.1.1.2 Roberts Island Placement Site

Roberts Island is an approximately 400-acre upland area located along the northern margin of Roberts Island opposite Buckley Cove. It is owned and operated by the Port of Stockton (Port) and has functioned as a Port placement site since 1982. As of 2018, it was known to have an approximate capacity for 4,000,000 cubic yards of dredged sediment. The site slopes gently westward away from the Stockton Deep Water Ship Channel and is surrounded by 8-foot-high berms. In compliance with permitting requirements, when using the site, the Port maintains 2 feet of freeboard below the top of the berm; as such, the site is never filled with more than 6 feet of dredged slurry. Dredged material has historically been placed throughout the site boundaries. The Port maintains a series of internal berms and dikes within the placement site to contain slurry and allow for sediments to settle in specific portions of the site; the locations of these features can vary over time and are ultimately dependent on annual dredged material placement needs. The Port excavates sediment from Roberts

Island throughout the year for beneficial reuse purposes (e.g., levee maintenance, construction projects, etc.), so the precise placement capacity of the site varies on a regular basis. If the Port allows other users at the site, they will charge a tipping fee for site use. It is anticipated that the dredging contractor would have to place and manage the sediment themselves.

5.1.1.3 Montezuma Wetland Restoration Project

Montezuma Wetlands Restoration Project (MWRP) is a beneficial reuse site created to restore approximately 630 acres of diked baylands to tidal and seasonal wetlands along Montezuma Slough. This project additionally enhances adjacent uplands in Suisun Marsh. The project is using dredged material from regional dredging projects to raise the site elevation, followed by additional construction activities, and ultimately with breaching the existing dikes to enable tidal action on the site. This is the most commonly used beneficial reuse site in the region at this time, and it is located over 30 nautical miles to the northwest of the Program. The site owners charge a tipping fee of approximately $15 a cubic yard for clean, cover-quality sediment and $30 per cubic yard for contaminated sediment that is used to fill foundation cells.

MWRP only accepts sediment in scows of approximately 1,000-cubic-yard capacity or larger due to the configuration of the permanent hydraulic offloading equipment at the site. Therefore, if sediment was placed at MWRP, the most efficient dredging method would be mechanical dredging into small scows, navigating the small scows to deeper water, then moving the sediment from multiple small scows into one larger scow that would be transported to MWRP.

5.1.1.4 Big Break

USACE is implementing a Delta Islands and Levees Feasibility Study to implement ecosystem restoration opportunities at various locations within the Delta through beneficial reuse of dredged material from the Stockton Deep Water Ship Channel (USACE 2018). The recommended plan proposed to restore 340 acres of intertidal marsh at Big Break, a historical marsh area previously converted into farmland until a levee break in 1928 inundated the island. Since that time, Big Break has remained unvegetated open water. It is possible that the ecosystem restoration efforts could accept dredged sediment from other sources.

The Feasibility Study EIR includes the assumption that dredged sediment from the Ship Channel will be directly pumped to Big Break using a hydraulic dredge. However, this would not be a feasible means of placement for dredging from the Program area because it would require approximately between 18 to 35 miles of pipeline. If this site were used, the dredged sediment would be transported via scows navigating approximately 15 to 25 nautical miles, depending on the dredging location.

would require double handling of the sediment which would ultimately incur additional costs.

5.1.2 Potential Temporary Processing Sites (Private Land)

This section lists properties that are adjacent to the Program area, including islands within the channels, that may be candidates for temporary placement locations to dewatering and process dredged sediment prior to off haul to the final destination (landfill, inland site, or other). These sites were identified in concept through review of aerial maps and informal discussions with some private landowners.

The sites were selected based on their proximity to the channel shorelines, apparent lack of permanent structures or active use (such as active agricultural land), and presence of access roads for sediment off haul after processing (for the inland sites, not the island sites). These locations are especially valuable to hydraulic cutter suction operations since the permanent placement sites in the preceding section are located too far to be reasonably pumped from the dredge. As a cutter suction dredge progresses through the project area or as capacity of an interim site is reached, the dredge's discharge pipe could be rerouted to the next closest interim site.

The general location of these sites and their proximity to the Program area are shown in Figure 5-2. Although some of the private landowners of these sites have expressed interest in leasing their land for temporary dredging processing, the particular land parcels are not identified in this Guide due to the conceptual status of this assessment More formalized planning and discussions would be appropriate once planning for a specific a dredging project is underway.

6 Environmental Compliance and Permitting

This section provides a general overview of the types of environmental investigations, documents, and authorizations that would be required for the Program and/or South Delta channel dredging projects implemented as part of the Program. During the environmental review process, it may be determined by the agencies that additional measures or requirements are needed or that particular requirements may be waived due to specific site conditions.

6.1 State and Federal Environmental Documentation Requirements

6.1.1 California Environmental Quality Act Compliance

CEQA requires state and local government agencies to inform decision-makers and the public about the potential environmental impacts of proposed projects and to reduce those environmental impacts to the extent feasible. The requirement for compliance with CEQA is triggered by a state or local agency taking a discretionary action for a project, such as issuing a permit or funding a project, and by a project occurring on state or local jurisdiction-owned lands. Although a given project may require discretionary approvals from more than one state or local agency, only one agency acts as the lead for preparing CEQA documentation. It is anticipated that the CEQA lead agency for the Program or associated South Delta channel dredging projects would be one of the Work Group agencies. The other agencies with discretionary approval are CEQA-responsible agencies. For the Program, which will require a number of state permits, state agencies issuing permits will be CEQA-responsible agencies.

The appropriate CEQA compliance process is determined by the scope of the project and its potential impacts on the environment. CEQA compliance is completed by the following: 1) filing a statutory or categorical exemption for classes of projects that are considered not to have potential impacts on the environment (14 California Code of Regulations Section 15300–15331); 2) preparing an Initial Study (IS) and Negative Declaration (ND) or Mitigated Negative Declaration (MND) for projects that would have less than significant impacts on the environment after incorporation of mitigation (if needed); or 3) preparing a Notice of Preparation (NOP) and Draft and Final Environmental Impact Report (EIR) for projects that have the potential to result in significant unavoidable impacts.

For IS/MNDs and EIRs, a mitigation monitoring and reporting plan (MMRP) must be prepared as part of the CEQA document and adopted as part of the lead agency's findings. An MMRP includes details, timing considerations, and implementation and verification requirements specific to the mitigation measures outlined in the CEQA document.

CEQA requires that EIRs include an evaluation of a reasonable range of alternatives to a project that could attain most of the project objectives but potentially result in reduced environmental impacts.

An EIR must also include an evaluation of a no-project alternative, which would represent conditions in the project area absent implementation of the proposed project. The feasibility of other alternatives (e.g., a reduced project) to achieve the project objectives should also be considered.

CEQA requires the lead agency to provide project notification to members of the public, agency staff, and responsible agencies. Projects that are not exempt from CEQA are subject to one or more public comment periods as part of the review process; public meetings or hearings may be held during the public comment periods.

6.1.1.1 Project-Level Versus Program-Level CEQA Documentation

The most common type of EIR examines the environmental impacts of a specific project, such as a development or maintenance activity, and for purposes of this document is referred to as a project-level EIR. A project-level EIR focuses primarily on the changes in the environment that would result from planning, constructing, and operating a specific development or maintenance project. Project-level EIRs require the CEQA lead agency to have sufficient project description information at the time the EIR is prepared to fully analyze all potential direct, indirect, and cumulative environmental impacts resulting from the project and to identify required mitigation measures so that this information can be disclosed to the public.

For geographically expansive or sequenced projects, projects whose design elements are not yet complete, or for a program of connected projects, sufficient detail may not be available to fully evaluate all the project elements at the time the EIR is prepared. In such cases, it may be more appropriate to prepare a program EIR. A program EIR is prepared on a series of actions that can be characterized as one large project and that are related in one of these ways: geographically; as logical parts in the chain of contemplated actions; in connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program; or as individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects that can be mitigated in similar ways (CEQA Guidelines 15168[a]). Program EIRs include all of the same contents as project-level EIRs but are generally more broad and less defined in terms of pinpointing specific impacts and mitigation measures. It is also possible to develop a program EIR with project-level elements for which sufficient information is available to evaluate specific project impacts and assess mitigation requirements. Such a document would likely be organized to include both the program and project-level analyses in different sections because the level of detail would be different between the two assessments.

It is important to note that a project-level EIR can accommodate more broadly defined elements of a project description; in such cases, the EIR can include a programmatic evaluation of those elements. The EIR impact analyses can be prepared to bracket a range of potential activities that may be implemented under the CEQA compliance umbrella of the project. This approach can allow for future flexibility in the project description while still producing a project-level EIR. As long as the range of potential activities evaluated in the project-level EIR covers all activities undertaken by the lead agency in the future, no further CEQA documentation is required.

After a program EIR is certified and future projects broadly covered in the program EIR are ready for implementation, the lead agency must review the later project in light of the program EIR to determine whether an additional environmental document is required. If the later project would have impacts not disclosed in the program EIR, a new IS should be prepared to determine whether a tiered EIR, ND, or MND is the appropriate subsequent CEQA documentation. If the lead agency finds that subsequent to CEQA Guidelines Section 15162, the later project is within the scope of the project (consistent with all program EIR impact determinations and compliant with all program EIR mitigation measures) covered by the program EIR, no subsequent CEQA documentation is needed.

A program EIR can enable a lead agency to more comprehensively consider potential effects (including cumulative impacts) and alternatives than would be practical in a project-level EIR—and at an early time when there is greater flexibility to address impacts and identify mitigation measures. A program EIR also allows for early agency consultations that could help identify agency concerns and provide programmatic responses. A program EIR will be most helpful for providing comprehensive CEQA coverage for future projects if it addresses the effects of the program as specifically and comprehensively as possible. With a thorough and detailed analysis of the program, many future activities may be found to be within the scope of the project described in the program EIR, and no further environmental documents may be required. If additional CEQA documentation is determined to be required for a later project, tiering off the prior program EIR offers the benefit of allowing the subsequent EIR or ND/MND to focus solely on the new effects that were not considered in the program EIR and, in the case of a subsequent EIR, avoid the NOP process which streamlines the later process.

To make a specific recommendation on the appropriate type of CEQA document type the Program, it is important to understand when project description details are anticipated to be better defined and when the CEQA lead agency anticipates commencing the CEQA review. If project description details for all the channels within the Program's geographic study area are unlikely to be available at one time, preparation of a program EIR may be the best CEQA approach for the Program. If details on certain channels within the Program area are more defined than others, a combined program and project-level EIR could be prepared. This approach would provide both programmatic CEQA clearance for the larger Program (which may require subsequent documentation when later projects are implemented) and project-level CEQA clearance for the more defined project activities likely to occur sooner. If more details are known about the project description for the Program by the time the lead agency is ready to complete the CEQA process, or if the project description includes programmatic elements wherein a range of potential activities that may be implemented are bracketed and analyzed in the EIR, it may also be possible to prepare a project-level EIR for the entirety of the Program. Table 6-1 provides a summary of the potential benefits and constraints of the different approaches to completing CEQA compliance for the Program and associated projects.

Table 6-1
Benefits and Constraints of Different CEQA Approaches

Type of CEQA Document	Benefit	Constraint
Program EIR	• Allows for preparation of a CEQA document without having specific project description details available for the Program channels • Provides programmatic CEQA clearance for the contemplated Program activities	• Subsequent CEQA documentation (e.g., addenda or supplemental EIRs or ND/MNDs) may be required for the Program activities in the future when more details are known
Combined Program and Project-Level EIR	• Allows for preparation of a CEQA document when specific project description details are known for certain channels within the Program but not others • Provides project-level CEQA clearance for the more defined project activities likely to occur sooner • Provides programmatic CEQA clearance for less defined Program activities	• Subsequent CEQA documentation (e.g., addenda or supplemental EIRs or ND/MNDs) may be required for the less defined Program activities in the future when more details are known
Project-Level EIR or IS/MND[1]	• Allows for preparation of a CEQA document when specific project description details are known or when a range of potential activities that may be implemented can be fully evaluated • Provides project-level CEQA clearance for the whole of the project (which could be a portion of or the entirety of the Program)	• It may take longer to develop the project description for a project-level document that includes all or most of the Program area; accordingly, it could delay starting the CEQA process and lead to a longer timeline • If a narrower project description is used for specific channels (not the whole Program) in a project-level document, then additional CEQA review (project or program-level) will be needed before restoration of other Program channels can be completed

Note:

1. An IS/MND is not anticipated to be the appropriate CEQA document type for the Program; however, if a small channel dredging project is proposed on its own, it is possible that preparation of an IS/MND may be appropriate.

6.1.1.2 Tribal Consultation

Assembly Bill (AB) 52, which became effective on July 1, 2015, requires CEQA lead agencies to consider the effects of projects on tribal cultural resources and to conduct early notification and consultation with federally and non-federally recognized Native American tribes and with the Native American Heritage Commission (NAHC). AB 52 applies to any project for which a NOP, IS/ND, or IS/MND is filed on or after July 1, 2015. The purpose of AB 52 is to ensure that CEQA lead agencies get the information needed to preserve options to avoid cultural resources early in the planning process, build working relationships with tribes that are traditionally and culturally affiliated with the program area, and avoid inadvertent discovery of tribal burials and work with tribes in advance to determine treatment and disposition if burials are inadvertently discovered.

As part of the AB 52 consultation process, the CEQA lead agency must reach out to NAHC for a list of tribes with which to consult. Tribal consultation must be initiated within 14 days of determining that an application for a project is complete or of a decision by a public agency to undertake a project. It is recommended that tribal consultation commence when a complete project description is available for a CEQA document (or at the NOP phase) to ensure sufficient time for the consultation to be completed. Depending on responses received, tribal consultations (potentially involving review of project documents, meetings, construction monitoring, etc.) may be required.

6.1.2 National Environmental Policy Act

NEPA requires federal agencies to evaluate the environmental effects of their proposed actions prior to making decisions. Compliance with NEPA is required for any federal approval/permit, federally funded project, or project on federal lands. NEPA also requires opportunities for public review and comment. The federal agency with discretionary authority acts as the NEPA lead agency; similar to the CEQA process, only one federal agency acts as the lead agency for a project. For a lead federal agency to comply with NEPA, compliance with the National Historic Preservation Act (NHPA), Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act (MSA), Clean Air Act, and other potentially applicable federal regulations must also be documented.

Similar to the CEQA process, the appropriate NEPA compliance process is determined by the scope of the project and its potential impacts on the environment. NEPA compliance is completed by 1) filing a categorical exclusion for classes of projects that are considered not to have potential impacts on the environment; 2) preparing an Environmental Assessment (EA) and a Finding of No Significant Impact for projects that would have less than significant impacts on the environment after incorporation of mitigation (if needed); or 3) preparing an Environmental Impact Statement (EIS) and Record of Decision for projects that have the potential to result in significant unavoidable impacts.

Like the CEQA requirement for EIRs, NEPA also requires that EAs and EISs consider alternatives to a project, including a No Action alternative, that would represent conditions in the study area absent implementation of the project. NEPA also requires the lead agency to provide project notification and comment opportunities to members of the public, agency staff, and cooperating agencies.

If a project requires review under both CEQA and NEPA, the respective lead agencies can agree to prepare a joint CEQA/NEPA document that meets CEQA and NEPA requirements. This approach was undertaken for the South Delta Improvements Program (SDIP) EIS/EIR (DWR and USBR 2006) by DWR and USBR.

6.2 Regulatory Permitting Requirements

6.2.1 U.S. Army Corps of Engineers Permits

USACE, Sacramento District, issues Clean Water Act (CWA) Section 404 and Rivers and Harbors Act (RHA) Section 10 permits for work in jurisdictional waters in the Program area. The purpose of the CWA is to restore and maintain the chemical, physical, and biological integrity of waters of the United States, including wetlands. The RHA prohibits the obstruction or alteration of navigable waters of the United States without USACE approval. CWA Section 404 permits are required to discharge dredged or fill material into waters of the United States, and RHA Section 10 permits are required for any work in navigable waters. Applications for CWA Section 404 and RHA Section 10 permits must be submitted to USACE for project approval, generally consisting of a project description, impact area and volume calculations and summaries, and accompanying illustrations.

For all projects for which it is the lead federal agency, USACE leads other federal consultations required for projects subject to CWA Section 404 or RHA Section 10 review, including NEPA compliance and special-status species and habitat consultations (ESA Section 7, MSA, Marine Mammal Protection Act [MMPA], and Migratory Bird Treaty Act [MBTA]) with the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), or both depending on the special-status species potentially present and affected. USACE would also initiate consultation with the California State Historic Preservation Officer (SHPO) under NHPA Section 106 as part of its permitting process. These federal regulations and consultations are discussed further under their respective headings in the following sections.

If another agency (such as USBR) is identified as the NEPA lead agency for a project because the project would occur on its land or receive funds from this agency, the consultations described previously would be completed by the lead federal agency—and not by USACE—as part of NEPA compliance. USACE would reference the consultations completed by the other lead federal agency to document compliance for its CWA and RHA permitting requirements.

ESA consultations may also be completed by non-federal agencies under Section 10 of the ESA. Because ESA Section 10 consultations have no time limits and have historically taken long periods of time to be completed, local, state, and federal agencies have worked together to approve habitat conservations plans (HCPs) that allow for streamlined compliance with Section 10 of the ESA (and state equivalents) while providing species-specific habitat mitigation. Two HCPs are in effect in the Program area: the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP), administered by the San Joaquin Council of Governments (SJCOG), and the Contra Costa County HCP/Natural Community Conservation Plan (NCCP), administered by the East Contra Costa County Habitat Conservancy (ECCCHC). Opting into these HCPs generally also fulfills consultation requirements for other special-status species or habitats, such as MBTA-protected birds. The SJCOG and ECCCHC and their HCPs are discussed further in Section 6.4.2.1.1.

6.2.2 U.S. Fish and Wildlife Service Approvals

As noted previously, the lead federal agency (USACE or otherwise) would initiate consultation with USFWS under Section 7 of the ESA for projects that have the potential to affect ESA-listed species and habitats managed by USFWS (all terrestrial species and certain aquatic species and associated critical habitats). The ESA provides protection for imperiled species and the ecosystems upon which they depend, which includes designating threatened or endangered species and associated critical habitats. Under the ESA, USFWS has primary responsibility for terrestrial and freshwater organisms.

USFWS reviews documentation submitted by the lead federal agency (typically a Biological Assessment) and completes consultation by issuing either a Biological Opinion for projects that may affect and would likely adversely affect USFWS-managed ESA-listed species or a concurrence letter for projects that may affect but would not likely adversely affect such species and habitats. As described previously, consultations with USFWS may also occur under Section 10 of the ESA; this would be accomplished by obtaining coverage from the HCP administrator.

USFWS also administers the MBTA, which makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations.

6.2.3 National Marine Fisheries Service Approvals

As noted previously, the lead federal agency (USACE or otherwise) would initiate consultation with NMFS under Section 7 of the ESA for projects that have the potential to affect ESA-listed species and associated critical habitat managed by NMFS, mainly marine wildlife such as anadromous fish and whales. The lead agency would also consult with NMFS for effects to Essential Fish Habitat (EFH) as designated through fishery management plans in accordance with the MSA, the primary law that governs fishery management in United States federal waters. NMFS reviews documentation submitted by the lead federal agency (typically a Biological Assessment and EFH Assessment) and completes consultation by issuing either a Biological Opinion for projects that may affect and would likely adversely affect NMFS-managed ESA-listed species and habitat or an EFH or concurrence letter for projects that may affect but would not likely adversely affect such species and habitat.

In coordination with USFWS, NMFS also administers the MMPA. The MMPA prohibits, with certain exceptions, the take of marine mammals. The MMPA implementing regulations allow NMFS to issue "take authorizations" for construction or other projects that would have no more than negligible impacts on marine mammals or stocks. Authorizations are provided in the form of an Incidental Harassment Authorization or Letter of Authorization.

6.2.4 State Historic Preservation Office Approvals

As noted, the lead federal agency (USACE or otherwise) would initiate consultation with the SHPO under Section 106 of the NHPA for projects that have the potential to affect historic properties or cultural resources. Under Section 106 and its implementing regulations at 36 Code of Federal Regulations (CFR) 800, federal agencies are required to consider the effects of the proposed activity on historic properties. A historic property is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places" (36 CFR 800.16[l][1]). Traditional Cultural Properties may also be historic properties. Under the Section 106 process, federal agencies must consult with interested and affected Native American tribes and with the SHPO on potential impacts to cultural and historic resources.

6.2.5 Central Valley Regional Water Quality Control Board Permits

Consistent with the goals of maintaining the integrity of waters of the United States, the CWA gives states and authorized tribes the authority to grant, deny, or waive certification of proposed federal permits that may discharge into waters of the United States. CVRWQCB issues CWA Section 401 Water Quality Certifications for federal (USACE) permits for dredging activities in the Program area. The CVRWQCB also ensures compliance with the Porter-Cologne Water Quality Control Act, which governs water quality regulation in California. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater and to both point and nonpoint sources of pollution, which includes but is not limited to those waters that qualify as waters of the United States. For dredging projects, CVRWQCB typically regulates discharges under the Porter-Cologne Act primarily through waste discharge requirements (WDRs). In WDRs, the CVRWQCB requires that sediment be tested prior to dredging to determine its suitability for upland placement or potential beneficial reuse (relevant to the Program, these requirements are summarized in Section 4.3.3).

6.2.6 California Department of Fish and Wildlife Permits

The California Department of Fish and Wildlife (CDFW), Bay Delta Region, issues California Fish and Game Code Section 1600 Lake and Streambed Alteration Agreements (SAAs) and California Endangered Species Act (CESA) Incidental Take Permits (ITPs) in the Program area. Section 1600 regulations were enacted to conserve fish and wildlife resources of the state. SAAs are required for dredging projects in streams or reservoirs. CDFW also has jurisdiction over stream-dependent riparian areas, as defined by Section 2785 of the California Fish and Game Code. Impacts to these features are also permitted through the SAA process.

CDFW also administers Fish and Game Code Section 2081, which prohibits take of CESA-protected species without CDFW approval. CDFW can issue an ITP for projects that are anticipated to result in harm or injury to CESA-protected species. ITP permittees must implement species-specific minimization and avoidance measures and must fully mitigate the impacts of the project. Applicants apply directly to CDFW for ITPs. Obtaining coverage under an HCP also provides take coverage and the required mitigation under CESA in lieu of a project-specific ITP.

Following the 2015 *Siskiyou County Farm Bureau v. California CDFW of Fish and Game* decision (Case No. SCSCCV11-00418), CDFW has started to require SAAs (and ITPs when deemed necessary) for water diversions that occur under existing water rights. Over time, CDFW has gradually and more commonly mandated that water rights holders obtain an SAA and/or an ITP when applying for other related approvals (such as maintenance dredging; Downey Brand 2015). As such, it is possible that if the existing diversions associated with the channels to be dredged do not have existing SAAs or ITPs, CDFW may require one or both to be issued for those diversions when the dredging project application(s) is submitted.

6.2.7 Delta Stewardship Council Approvals

The Delta Stewardship Council (Council) would review the Program for consistency with the Delta Plan in accordance with the Sacramento-San Joaquin Delta Reform Act of 2009. The Delta Plan is a comprehensive, long-term plan that guides how multiple federal, state, and local agencies manage the Delta's water and environmental resources. The Council oversees implementation of the Delta Plan through coordination and oversight of state and local agencies proposing to fund, carry out, and approve Delta-related activities. The Delta Plan's 14 regulatory policies and 95 policy recommendations address current and predicted challenges related to the Delta's ecology, flood management, land use, water quality, and water supply reliability.

6.3 Anticipated Investigations or Surveys

To obtain environmental approvals to complete dredging in the Program area, a number of investigations or surveys will be required, including but not limited to sediment sampling and analysis (see Section 4.3.3), special-status species and habitat evaluations or surveys, jurisdictional wetlands and waters delineations, and cultural and historic resource evaluations. These evaluations may be informed by information available from other studies completed in the Program area, including SDIP documents containing surveys, investigations, or studies of relevant existing conditions. The anticipated investigations or surveys and relevant SDIP documents are briefly described in the following sections.

6.3.1 Special-Status Species and Habitats

An analysis of the Program's or associated channel dredging project's potential effects on special-status species and habitats would be required during the CEQA/NEPA and regulatory permitting processes. State and federally listed special-status species, critical habitat, EFH, or other protected resources (e.g., migratory birds) with the potential to occur in the Program area would be identified from the following sources:

- Species observation records in the California Natural Diversity Database for the 7.5-minute USGS quadrangle for the Program or project area and adjacent quadrangles (CDFW 2021)
- USFWS's Environmental Conservation Online System species by county report for San Joaquin and Contra Costa counties (USFWS 2021)
- NMFS's EFH Mapper (NMFS 2021)
- CDFW Fall Midwater Trawl survey results (CDFW 2019)
- USACE entrainment and community monitoring performed during annual Stockton and Sacramento Deep Water Ship Channel operations and maintenance dredging since 2005 (USACE 2015; ICF 2019)
- South Delta Improvements Program Draft and Final EIS/EIR (DWR and USBR 2006) and Draft Action Specific Implementation Plan (DASIP; USBR and DWR 2005)
- SJMSCP (SJCOG 2000)
- Other applicable surveys, studies, or reports (e.g., general plans, rare bird surveys)

Table 6-2 identifies special-status species (ESA- or CESA-listed species, state species of special concern, and California Native Plant Society Rank 1B plant species) potentially present in the Program area, as identified through review of the previously listed sources.

Table 6-2
Special-Status Species Potentially Present in the Program Area

Species	Federal	State	Habitat Association
Invertebrates			
Lange's metalmark butterfly (*Apodemia mormo langei*)	E	-	Inhabits stabilized dunes along the San Joaquin River; endemic to Antioch Dunes, Contra Costa County
Crotch bumble bee (*Bombus crotchii*)	-	C	Associated with a variety of flowering plants
Western bumble bee (*Bombus crotchii*)	-	C	Associated with a variety of flowering plants
Conservancy fairy shrimp (*Branchinecta 50exicana50ion*)	E	-	Astatic pools located in swales formed by old, braided alluvium; filled by winter/spring rains
Longhorn fairy shrimp (*Branchinecta longiantenna*)	E	-	Inhabit small, clear-water depressions in sandstone and clear-to-turbid clay/grass-bottomed pools in shallow swales

Species	Federal	State	Habitat Association
Vernal pool fairy shrimp (*Branchinecta lynchi*)	T	-	Inhabit small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools
Longhorn fairy shrimp (*Branchinecta longiantenna*)	E		Valley and foothill grassland; vernal pool; wetland
San Bruno elfin butterfly (*Callophrys mossii bayensis*)	E	-	Coastal, mountainous areas with grassy ground cover, mainly in the vicinity of San Bruno Mountain, San Mateo County
Monarch butterfly (*Danaus plexippus*)	C	-	Closed-cone coniferous forest
Bay checkerspot butterfly (*Euphydryas editha bayensis*)	T	-	Coastal dunes; ultramafic; valley and foothill grassland
Vernal pool tadpole shrimp (*Lepidurus packardi*)	E	-	Vernal pools
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	T	-	Riparian scrub in association with blue elderberry (*Sambucus 51exicana*)
Vernal pool tadpole shrimp (*Lepidurus packardi*)	E	-	Valley and foothill grassland; vernal pool; wetland
Callippe silverspot butterfly (*Speyeria callippe callippe*)	E	-	Coastal scrub; restricted to the northern coastal scrub of the San Francisco peninsula
California freshwater shrimp (*Syncaris pacifica*)	E	E	Aquatic; Sacramento/San Joaquin flowing waters; endemic to Marin, Napa, and Sonoma counties
Amphibians			
California tiger salamander (*Ambystoma californiense*)	T	T	Cismontane woodland; meadow and seep; riparian woodland; valley and foothill grassland
California red-legged frog (*Rana draytonii*)	T	-	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation
Birds			
Tricolored blackbird (*Agelaius tricolor*)	-	T, SSC	Found in open waters of estuaries, mostly in middle or bottom of water column
Greater sandhill crane (*Antigone canadensis tabida*)	-	T	Marsh and swamp; meadow and seep; wetland

Species	Federal	State	Habitat Association
Northern harrier (*Circus hudsonius*)	-	SSC	Coastal scrub; Great Basin grassland; marsh and swamp; riparian scrub; valley and foothill grassland; wetland
Short-eared owl (*Asio flammeus*)	-	SSC	Great Basin grassland; marsh and swamp; meadow and seep; valley and foothill grassland; wetland
Western burrowing owl (*Athene cunicularia*)	-	SSC	Coastal prairie; coastal scrub; Great Basin grassland; Great Basin scrub; Mojavean desert scrub; Sonoran desert scrub; valley and foothill grassland
Marbled murrelet (*Brachyramphus marmoratus*)	E	E	Lower montane coniferous forest; old growth redwood
Swainson's hawk (*Buteo swainsoni*)	-	T	Great Basin grassland; riparian forest riparian woodland; valley and foothill grassland
Western snowy plover (*Charadrius nivosus nivosus*)	T	SSC	Sandy beaches, salt pond levees and shores of large alkali lakes
Yellow-billed cuckoo (*Coccyzus americanus*)	T	E	Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape
California black rail (*Laterallus jamaicensis coturniculus*)	-	T	Inhabits freshwater marshes, wet meadows and shallow margins of saltwater marshes bordering larger bays
California least tern (*Sterna antillarum browni*)	E	E	Alkali playa; wetland
Least Bell's vireo (*Vireo bellii pusillus*)	E	E	Riparian forest; riparian scrub; riparian woodland
California clapper rail (*Rallus obsoletus obsoletus*)	E	E	Saltwater and brackish marshes traversed by tidal sloughs in the vicinity of San Francisco Bay
Mammals			
Riparian woodrat (*Neotoma fuscipes riparia*)	E	-	Riparian areas along the San Joaquin, Stanislaus, and Tuolumne rivers
Salt-marsh harvest mouse (*Reithrodontomys raviventris*)	E	E	Dense pickleweed salt marsh in and west of Suisun Bay
Riparian brush rabbit (*Sylvilagus bachmani riparius*)	E	E	Riparian forest
San Joaquin kit fox (*Vulpes macrotis mutica*)	E	T	Annual grasslands or grassy open stages with scattered shrubby vegetation

Species	Federal	State	Habitat Association
Fish			
Green sturgeon – Southern DPS (*Acipenser medirostris*)	E	-	Aquatic; estuary
Tidewater goby (*Eucyclogobius newberryi*)	E	-	Aquatic; Klamath/north coast flowing waters; Sacramento/San Joaquin flowing waters; south coast flowing waters
Delta smelt (*Hypomesus transpacificus*)	T	E	Aquatic; estuary
Steelhead – Central Valley DPS (*Oncorhynchus mykiss irideus*)	T	-	Aquatic; Sacramento/San Joaquin flowing waters
Chinook salmon – Central Valley spring-run ESU (*Oncorhynchus tshawytscha*)	T	-	Aquatic; estuary
Chinook salmon – Central Valley fall/late fall-run ESU (*Oncorhynchus tshawytscha*)	-	SSC	Aquatic; Sacramento/San Joaquin flowing waters
Chinook salmon – Sacramento River winter-run ESU (*Oncorhynchus tshawytscha*)	E	E	Aquatic; Sacramento/San Joaquin flowing water
Splittail (*Pogonichthys macrolepidotus*)	-	SSC	Aquatic; estuary; freshwater marsh; Sacramento/San Joaquin flowing waters
Longfin smelt (*Spirinchus thaleichthys*)	C	T; SSC	Aquatic; estuary
Eulachon (*Thaleichthys pacificus*)	T	SSC	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation
Reptiles			
Western pond turtle (*Emys marmorata*)	-	SSC	Variety of aquatic habitats
Alameda whipsnake (*Masticophis lateral euryxanthus*)	T	T	Typically found in chaparral and scrub habitats but will also use adjacent grassland, oak savanna and woodland habitats
Giant garter snake (*Thamnophis gigas*)	T	T	Marsh and swamp; riparian scrub; wetland
Plants			

Species	Federal	State	Habitat Association
Large-flowered fiddleneck (*Amsinckia grandiflora*)	E	E; 1B.1	Cismontane woodland, valley and foothill grassland
Suisun Marsh aster (*Symphyotrichum lentum*)	-	1B.2	Brackish marsh; freshwater marsh; marsh and swamp; wetland
Slough thistle (*Cirsium crassicaule*)	-	1B.1	Chenopod scrub; freshwater marsh; marsh and swamp; riparian scrub; wetland
Delta button celery (*Eryngium racemosum*)	-	E; 1B.1	Riparian scrub; wetland
Rose-mallow (*Hibiscus lasiocarpos* var. *occidentalis*)	-	`1B.2	Freshwater marsh; marsh and swamp; wetland
Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)	-	1B.2	Freshwater marsh; marsh and swamp; wetland
Mason's lilaeopsis (*Lilaeopsis masonii*)	-	1B.1	Freshwater marsh; marsh and swamp; riparian scrub; wetland
Delta mudwort (*Limosella australis*)	-	2B.1	Brackish marsh; freshwater marsh; marsh and swamp; riparian scrub
Lone manzanita (*Arctostaphylos myrtifolia*)	E	1B.2	Chaparral, cismontane woodland
Pallid manzanita (*Arctostaphylos pallida*)	T	E; 1B.1	Broadleaved upland forest; chaparral cismontane woodland; closed-cone coniferous forest
Tiburon mariposa lily (*Calochortus tiburonensis*)	T	T; 1B.1	Ultramafic; valley and foothill grassland
Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*)	E	E; 1B.2	Ultramafic; valley and foothill grassland
Fleshy owl's-clover (*Castilleja campestris* ssp. *succulenta*)	T	E; 1B.2	Vernal pools
Palmate-bracted salty bird's-beak (*Chloropyron palmatum*)	E	E; 1B.1	Chenopod scrub; meadow and seep; valley and foothill grassland; wetland
Robust spineflower (*Chorizanthe robusta* var. *robusta*)	E	1B.1	Chaparral, cismontane woodland, coastal bluff scrub, coastal dunes
Presidio clarkia (*Clarkia franciscana*)	E	E, 1B.1	Coastal scrub, ultramafic, valley and foothill grassland

Species	Federal	State	Habitat Association
Soft bird's-beak (*Cordylanthus mollis mollis*)	E	-	Coastal saltmarsh and swamp areas
Palmate-bracted bird's beak (*Cordylanthus palmatus*)	E	E; 1B.1	Chenopod scrub, meadow and seep, valley & foothill grassland, wetland
Delta button-celery (*Eryngium racemosum*)	-	E: 1B.1	Riparian scrub
Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*)	E	E; 1B.1	Interior dunes
Marin dwarf-flax (*Hesperolinon congestum*)	T	T; 1B.1	Chaparral, ultramafic, valley and foothill grassland
Santa Cruz tarplant (*Holocarpha macradenia*)	T	E; 1B.1	Coastal prairie, coastal scrub, valley and foothill grassland
Contra Costa goldfields (*Lasthenia conjugens*)	E	1B.1	Alkali playa, cismontane woodland, valley and foothill grassland, vernal pool
Colusa grass (*Neostapfia colusana*)	T	E; 1B.1	Vernal pool, wetland
Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*)	E	E; 1B.1	Interior dunes
Sacramento Orcutt grass (*Orcuttia viscida*)	E	E; 1B.1	Vernal pools
White-rayed pentachaeta (*Pentachaeta bellidiflora*)	E	E; 1B.1	Ultramafic, valley and foothill grassland
California seablite (*Suaeda californica*)	E	1B.1	Freshwater marsh, marsh and swamp, wetland
Showy Indian clover (*Trifolium amoenum*)	E	1B.1	Coastal bluff scrub, ultramafic, valley and foothill grassland
Greene's tuctoria (*Tuctoria greenei*)	E	1B.1	Vernal pools
Keck's Checker-mallow (*Sidalcea keckii*)	E	1B.1	Cismontane woodland, ultramafic, valley and foothill grassland
Tiburon jewelflower (*Streptanthus niger*)	E	E; 1B.1	Ultramafic, valley and foothill grassland

Notes:
Sources: California Natural Diversity Database 2021 search of Program area quadrangles (Clifton Court Forebay, Woodward Island, Holt, Stockton West, Lathrop, Union Island); USFWS's Environmental Conservation Online System species by county report for San Joaquin and Contra Costa Counties; South Delta Improvements Program 2005 Draft Action Specific Implementation Plan.
Rare Plant Rank 1B.1 – rare, threatened, or endangered in California and elsewhere; seriously threatened in California (more than 80% of occurrences threatened/high degree and immediacy of threat)
Rare Plant Rank 1B.2 – rare, threatened, or endangered in California and elsewhere; fairly endangered in California.
C: candidate
E: endangered
FP: CDFW fully protected
SSC: state species of special concern
T: threatened

The Program area also includes critical habitat for the Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit (ESU) and delta smelt, and EFH for the Pacific Coast Salmon Plan Fisheries Management Plan. Per the DASIP, the Program area may also contain rookeries for black-crowned night heron, great blue heron, and snowy egret, and it may provide habitat for several MBTA-protected bird species without ESA or CESA designations.

The presence or potential presence of special-status species and habitats would be evaluated through the CEQA/NEPA and regulatory permitting processes. Presence would be evaluated based on a variety of factors, mainly the geographic extents of the Program or project area, habitats present, species habitat needs, and recorded species occurrences. Special-status species surveys may also be required to inform the biological resources documentation, or as required through CEQA/NEPA mitigation measures or permit conditions. This may include special-status plant surveys during bloom periods, or nesting bird surveys during the nesting season.

The SDIP Draft EIS/EIR and DASIP provide substantial background information related to special-status species and biological resources for that project's study area based on 2005 information, much of which overlaps with the Program area. Using many of the same sources previously identified, the SDIP Draft EIS/EIR and SDIP DSIP describe habitat types present in the SDIP project area, identify common species likely to be present, provide limited mapping of vegetation and special status species, and identify potential impacts from the SDIP. The following sections, figures, tables, and appendices from the SDIP Draft EIS/EIR may provide relevant special-status species information for the development of biological resources documentation for the Program:

- Chapter 6: Biological Environment
- Figures 6.1-16 through 6.1-32: Salvage, entrainment, and estuarine habitat tables for various special status fish species
- Figure 6.2-9: Salvage, entrainment, and estuarine habitat tables for various special status fish species
- Figure 6.2-10: California Natural Diversity Database occurrences near the study area
- Appendix K: Tables and figures supporting the impact assessment of the South Delta Improvements Program on fish

The following DASIP tables may be of particular relevance to the development of biological resources documentation for the Program:

- Table 1-1: Special-status species covered under the CALFED Programmatic Biological Opinions and NCCP determination with the potential to occur in the SDIP project area
- Table 1-2: Species covered under the Programmatic Biological Opinions and NCCP determination that are proposed for evaluation in DASIP
- Table 1-4: NCCP habitat types present in the SDIP project area
- Table 5-1: Existing land cover types in the SDIP project area
- Table 5-2: Fish species groups and associated NCCP habitat types

6.3.2 Jurisdictional Wetlands and Waters Delineations

The CEQA/NEPA compliance and federal and state regulatory permitting processes require identifying project impacts to wetlands or other federal or state jurisdictional waters and identifying the ordinary high water mark or similar elevation data for water conveyances proposed to be dredged. Some of this information may be available through previous prepared documentation, although identification of potentially jurisdictional features typically requires a field delineation and accompanying report (jurisdictional delineation).

Jurisdictional features should be identified based on federal and state regulations, including CWA Sections 404 and 401, the Porter-Cologne Water Quality Control Act, and Section 1600 of the California Fish and Game Code. Jurisdictional delineations should be prepared in accordance with the USACE's September 2008 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE 2008). The USACE manual, in conjunction with the previously listed regulations, serves as a guidance document for identifying waters and wetland features under the jurisdiction of USACE, CVRWQCB, and CDFW.

The SDIP Draft EIS/EIR provides limited background information on jurisdictional waters and wetlands in the SDIP project area; wetland delineations of the SDIP project area were conducted in 1994, 2001, 2003, and 2004. SDIP Draft EIS/EIR Appendix L includes the USACE Routine Wetland Delineation Data Forms from the 2001 delineation. The SDIP Draft EIS/EIR identifies the following land cover types in the study area that are considered waters of the United States:

- Tidal perennial aquatic
- Tule and cattail tidal emergent wetland
- Cottonwood-willow woodland wetland, riparian scrub wetland, and willow scrub wetland growing on in-channel islands

The SDIP Draft EIS/EIR provides wetland mapping for some areas overlapping with the Program area (mainly proposed gate areas), as shown in SDIP Draft EIS/EIR Figures 6.2-2 through 6.2-8. Based on the wetland delineation data collected, the SDIP EIS/EIR concludes there are minimal areas of jurisdictional wetlands along the leveed channels in the SDIP project area because these areas are generally covered with riprap. In-channel islands are described as more likely to contain jurisdictional wetlands because there are more areas appropriate to plant growth that have exposed soil and are regularly flooded.

The DASIP also provides limited information on jurisdictional water and wetland conditions in the SDIP project area, reflective of conditions in 2005. This includes a description of water and wetland habitats in the study area, including tidal perennial aquatic habitat (SDIP DSIP Section 5.5), tule and cattail tidal emergent wetland (SDIP DSIP Section 5.6), and riparian communities (SDIP DSIP Section 5.7).

Given the amount of time that has passed since these documents were developed, additional field reconnaissance is required to evaluate the presence of wetlands or other federal or state jurisdictional waters in the Program area.

6.3.3 Tribal, Cultural, and Historic Resources

The California Office of Historic Preservation's California Historical Resources Information System (CHRIS) maintains a wide range of documents and materials relating to historical resources (e.g., buildings, structures, objects, historic and archaeological sites, landscapes, and districts). For a given project area, a request can be filed with the CHRIS Central California or Northwest Information Centers (for San Joaquin or Contra Costa County project elements, respectively) for recorded cultural, historic, or archaeological resources in the study area. While CHRIS does not inherently replace the need for cultural or archaeological surveys, it is an important tool used for CEQA/NEPA documentation and NHPA Section 106 consultations.

The SDIP Draft EIS/EIR cultural resource analysis (SDIP Draft EIS/EIR Chapter 7.7) included a records search, a review of historical maps, and architectural and archaeological surveys, which identified five cultural resources in the SDIP Area of Potential Effects (APE). These five resources are the Grant Line/Fabian & Bell Canal, the West Canal, a levee system, a farm complex located near Middle River, and a building complex. The Grant Line/Fabian & Bell Canal and the West Canal are located in the southern portion of the SDIP APE; the levee system occurs throughout the SDIP area; the farm complex is located on the south bank of the Middle River; and the Grant Line/Fabian & Bell Canal Buildings are located on the island strip in the Grant Line/Fabian & Bell Canal.

6.4 Considerations Regarding Site-Specific Avoidance, Minimization, and Mitigation

6.4.1 Avoidance and Minimization Measures

Standard avoidance and minimization measures or best management practices (BMPs) required for the Program or associated channel dredging projects will be identified during the environmental compliance and permitting processes. Based on Anchor QEA's experience permitting dredging projects in the region, issued permits/consultation documents, and information from the SDIP EIS/EIR (DWR and USBR 2006) and DASIP (USBR and DWR 2005), these measures may include but would not be limited to the following:

- General Measures
  - The contractor would be responsible for preparing and submitting a spill prevention and response plan that identifies the location of sorbents or booms on site and provides emergency response contact information.
  - To ensure that contaminants are not accidently introduced into the waterway, the lead agency or its contractors would implement standard erosion and sediment controls and spill prevention and response measures in and around the project site. The contractor responsible for operating the dredging equipment would be responsible for ensuring compliance with such measures.
  - The contractor would be responsible for preparing a traffic and navigation control plan and an emergency access plan.
  - Proper notification and coordination would be completed with nearby marinas and other recreational facilities in advance of construction.
  - Dredging would be conducted in accordance with all state and federal permits.
  - Sediment sampling and analysis would be conducted in accordance with CVRWQCB requirements (see Section 4.3.3).
  - Dredging would be conducted during the agency-approved in-water work window (anticipated to be August 1 through November 30).
  - Work would be stopped if archaeological materials or human remains are discovered during construction or dredging.
- Clamshell Dredging Measures
  - All dredged sediment would be handled and transported such that it does not re-enter surface waters outside of the active dredging zone.
  - Dredging would be limited to the approved project depth plus overdredge.
  - Multiple horizontal dredge cuts would be taken where a thick horizontal volume needs to be dredged to avoid overfilling the bucket and causing spillage (if scows are used).
  - Before each scow is transported to a placement site, the dredging contractor and a site inspector must certify that it is filled correctly and not higher than the agency-approved pre-determined level.
  - The cycle time would be increased as needed to reduce the velocity of the ascending loaded bucket through the water column, thereby reducing the potential to wash sediment from the bucket.
- Hydraulic Dredging Measures

- The cutterhead rotation speed would be reduced as needed to reduce the potential for side casting the excavated sediment away from the suction entrance and resuspending sediment.
- The swing speed would be reduced as needed to ensure that the dredge head does not move through the cut faster than it can hydraulically pump the sediment. Reducing swing speed reduces the volume of resuspended sediment. The goal is to swing the dredge head at a speed that allows as much of the disturbed sediment as possible to be removed with the hydraulic flow. Typical swing speeds range from 5 to 30 feet per minute.
- Sediment would be removed in maximum lifts equal to 80% or less of the cutterhead diameter.
- The hydraulic dredge would operate on the bottom of the channel, and the velocity of water moving toward the dredge cutterhead would be less than 0.1 foot per second within 9 feet of the suction pipe opening.
- Draghead or pipeline pumps would only be turned on when the dragheads, cutterheads, or pipeline intakes are on the seafloor or within 3 feet of the seafloor when priming pumps.
- Dragheads, cutterheads, or pipeline intakes would be monitored so that they maintain positive contact with the seafloor during suction dredging.
- Temporary dredge pipelines would be positioned to avoid sensitive vegetation.

- Water Quality Monitoring Measures
  - Water quality monitoring would be conducted in accordance with the General Waste Discharge Requirements for Maintenance Dredging Operations, Sacramento-San Joaquin Delta (Order No. R5-2009-0085).
  - If monitoring data show that dredging or effluent from decanting operations are affecting turbidity, dissolved oxygen (DO), temperature, or pH levels in excess of the limits shown in Order No. R5-2009-0085, the monitoring equipment would be inspected and a second measurement would be taken to confirm the exceedance. If the second measurement confirms an exceedance has occurred, then the applicant would enact the following:
    - Implement controls in dredging operations to reduce sediment resuspension.
    - Implement controls in decanting operations to reduce flows discharging into the receiving water.
    - Conduct additional water quality measurements 1 hour after the additional controls are implemented.
    - If there is no longer an exceedance, regular monitoring in accordance with the frequency outlined in Order No. R5-2009-085 would resume.

  - If exceedances persist, the applicant would notify CVRWQCB and operations would cease until the turbidity, DO, temperature, and pH levels are compliant with requirements. Once water quality returns to acceptable levels, dredging and decanting operations and water quality monitoring would recommence and each step outlined in this list would be repeated.
- Special-Status Species and Habitat-Related Measures
  - A worker education program would be implemented for special-status species that could be affected by construction or dredging activities. The program would include a presentation to all workers on biology, general behavior, distribution, habitat needs, sensitivity to human activities, legal protection status, and project-specific protective measures for each listed species. Workers would also be provided written materials containing this information.
  - Operators of construction equipment and all other project workers would not harass any waterfowl, fishes, or other wildlife.
  - Impacts on sensitive biological resources would be minimized through monitoring; identifying, field marking (flagging or otherwise), and avoiding sensitive habitats; avoiding unnecessary landing on in-channel islands; avoiding removal of woody vegetation to the extent possible; removing all trash and debris following construction; and implementing a revegetation plan for disturbed areas.
  - Introduction and spread of new noxious weeds would be avoided during construction and dredging.
  - Pre-construction surveys for sensitive species and habitats would be conducted.
  - Vegetation management would be completed during the nonbreeding season for birds.
  - Habitats occupied by special-status species would be avoided to the extent possible.
  - Compensation for loss of special-status species habitats would occur through measures such as obtaining HCP coverage, establishing conservation easements, or paying in lieu fees.
  - Additional avoidance and minimization measures for potentially present special-status species or habitats will be identified during the regulatory approval processes described in Section 6.2.

6.4.2 Typical Types of Compensatory Mitigation

Compensatory mitigation will be required to offset adverse impacts to special-status species and their habitats, wetlands/waters, and other environmental resources from the Program or associated channel dredging projects. Compensatory mitigation strategies can be identified during the CEQA/NEPA and regulatory permitting processes. As described in Section 6.1.1, CEQA documents are required to include an MMRP that includes details, timing considerations, implementation, and verification requirements specific to any mitigation measures outlined in the CEQA document. The regulatory permitting process further confirms the specifics of any compensatory mitigation commitments, such as mitigation ratios, specific mitigation plans, or appropriate mitigation banks from which credits would be purchased. Depending on the mitigation approach, development of a mitigation plan may also be required. The following sections describe different types of mitigation that may be required for environmental impacts associated with dredging and sediment management in the South Delta channels.

6.4.2.1 Mitigation for Impacts to Terrestrial Special-Status Species and Habitats

Mitigation is required to offset adverse impacts on terrestrial special-status species or their habitats from project construction and operations. If an ITP is required from CDFW, the applicant will need to pay for both the permit fee (currently $33,665.75 for projects that cost $500,000 or more) as well as for mitigation to offset impacts. Mitigation costs depend on the extent of the impact, the species or habitat impacted, and the mitigation strategy.

Costs for permittee-responsible special-status species and habitat mitigation vary widely; in general, the costs associated with acquiring land, permitting, constructing, and conducting long-term monitoring for this type of mitigation are higher than purchasing credits from a conservation bank. A number of conservation banks have enhanced, restored, or preserved habitat for special-status terrestrial species and have credits available for purchase. Updated information on conservation banks in the region is available on the USFWS's website at https://www.fws.gov/sacramento/es/Conservation-Banking/Banks/In-Area/. Based on current information on this website, the following conservation banks currently have credits available for certain special-status terrestrial species or their habitats in or very close to the Program area: Alkali Sink, Big Gun, Deadman Creek, Drayer Ranch, Dutchman Creek, Elsie Gridley, Fitzgerald Ranch, French Camp, Great Valley, Laguna Creek, Mussy Ranch, Nicolaus Ranch, Noonan Ranch, North Bay Highlands, Ohlone West, Oursan Ridge, Ridgetop Ranch, River Ranch, and Sparkling Ranch.

6.4.2.1.1 Habitat Conservation Plans

As described in Section 6.2.1, HCPs allow for streamlined compliance with Section 10 of the ESA (and state equivalents) while providing species-specific habitat mitigation. Two HCPs are in effect in the Program area: the SJCOG's SJMSCP and the ECCCHC's HCP/NCCP.

SJCOG is a joint-powers authority that administers regional programs, including the SJMSCP within San Joaquin County. A key purpose of the SJMSCP is to provide for the long-term management of plant, fish, and wildlife species including ESA- or CESA-protected species. The SJMSCP, in accordance with the ESA Section 10(a)(1)(B) consultation and the CESA Section 2081(b) ITP, can provide take coverage for species covered by the plan. Opting into the SJMSCP typically entails adhering to plan-approved avoidance and minimization measures during project construction and mitigating for potential species take or loss of habitat through the plan. This can include compensation for the conversion of open space, natural, or agricultural land to other project-oriented uses. The SJMSCP provides take coverage for many but not all ESA- or CESA-listed species; aquatic species are not covered, nor are some terrestrial species, such as the federally endangered riparian brush rabbit.

ECCCHC is a joint-powers authority formed to implement the HCP/NCCP. The HCP/NCCP provides a framework to protect natural resources in eastern Contra Costa County, while improving and streamlining the environmental permitting process for impacts on endangered species. This includes streamlined approvals from USFWS and CDFW for ESA- and CESA-listed species impacts. Applicants obtaining HCP/NCCPs are required to implement avoidance and minimization measures from the plan, such as preconstruction or construction monitoring. Like the SJMSCP, the HCP/NCCP does not cover all special status species or habitats, such as aquatic species.

Should the permittee elect to opt into the SJMSCP or HCP/NCCP (for projects in San Joaquin County or Contra Costa County, respectively) for impacts on terrestrial species and habitats instead of obtain a project-specific ITP, there would be a commitment to implement avoidance and minimization measures during project construction and mitigate for potential species take or loss of habitat through payment of SJMSCP or HCP/NCCP fees. Fees for each HCP are updated annually. Additional information about each plan is as follows:

- SJMSCP
  - Fees: https://www.sjcog.org/DocumentCenter/View/5455/HCP----2021-Fees-and-Endowment
  - Plan map: https://www.sjcog.org/DocumentCenter/View/12/SJMSCP-Zone-Mappdf?bidId=
  - Point of contact: Laurel Boyd, boyd@sjcog.org; Steve Mayo, mayo@sjcog.org
- HCP/NCCP
  - Fees: https://www.contracosta.ca.gov/depart/cd/water/HCP/project-permitting.html
  - Plan map: https://www.contracosta.ca.gov/depart/cd/water/HCP/permitting/Development_fee_zone_map_high_res.pdf
  - Point of contact: Allison Cloney, Allison.Cloney@dcd.cccounty.us; Joanne Chiu, Joanne.Chiu@dcd.cccounty.us

6.4.2.2 Mitigation for Impacts to Aquatic Special-Status Species/Habitats

Mitigation is required to offset adverse impacts on aquatic special-status species or their habitats from dredging projects. As noted previously, if an ITP is required from CDFW, the applicant will need to pay both the permit fee (currently $33,665.75 for projects that cost $500,000 or more) and for mitigation to offset impacts. There are few aquatic habitat conservation banks that offer credits for special-status aquatic species. Conservation bank updates are available on the USFWS website at https://www.fws.gov/sfbaydelta/EndangeredSpecies/ConservationBanking/index.htm.

The Fremont Landing Conservation Bank overlaps with the Project area and as of May 13, 2021, had 15 acre-credits available for salmon, steelhead, and green sturgeon mitigation. A new salmon and delta smelt conservation bank is anticipated to be online in approximately 2 years. Historically, the Liberty Island Conservation Bank and the North Delta Fish Conservation Bank have been the primary aquatic habitat conservation banks used in the region; however, both are currently sold out. Neither the SJMSCP nor the HCP/NCCP offer aquatic habitat take coverage/mitigation.

6.4.2.3 Mitigation for Fill Impacts to Wetlands or Other Jurisdictional Waters

Any fill in wetlands or waters must be mitigated to ensure there is no net loss of wetlands and waters. Per the USACE's 2008 *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* (mitigation rule), the following are acceptable compensatory mitigation options for impacts to waters of the United States, listed in order of environmental preference as described in the mitigation rule:

1. **Purchase of appropriate credits at an approved wetland or waters mitigation bank.** A mitigation bank is a wetland, stream, or other aquatic resource area that has been restored, established, enhanced, or (in certain circumstances) preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources permitted under federal and state regulations. Information on the wetland mitigation bank credits that are expected to be available for purchase over the next few years servicing the Program area is detailed in Table 6-3. Costs for mitigation bank credits generally range from between $120,000 to $1800,000 per acre-credit but will depend on the type of credit being purchased, market demand, and amount of credits purchased.
2. **Payment into an approved in lieu fee fund.** An in lieu fee program is an agreement between state, federal, and/or local regulatory agencies and a public agency or non-profit organization sponsor. Under an in lieu fee agreement, the mitigation sponsor collects funds from permittees in lieu of providing permittee-responsible compensatory mitigation. The sponsor uses the funds pooled from multiple permittees to create one or more sites under the authority of the agreement to compensate for aquatic resource functions lost as a result of the permits issued. The Program area is served by the Sacramento District California In Lieu Fee Program. Information on this in lieu fee program is detailed in Table 6-3. Costs for the in lieu fee program are currently $350,000 per acre-credit.
3. **Permittee-responsible on-site/off-site establishment, re-establishment, enhancement, rehabilitation, and/or preservation.** With permittee-responsible mitigation, the permittee retains responsibility for ensuring that required compensation activities are completed and successful. Permittee-responsible mitigation can be located at or adjacent to the impact site (i.e., on-site compensatory mitigation) or at another location generally within the same watershed as the impact site (i.e., off-site compensatory mitigation). The scope of permittee-responsible mitigation includes the design, permitting, construction, and post-construction monitoring and management of the mitigation project.

Table 6-3
Wetland Mitigation Bank and In Lieu Fee Program Information

Credit Bank	Credit Type	Timing	Point of Contact
Cosumnes Mitigation Bank Phase 2	Floodplain mosaic wetlands and riverine habitat	Credits anticipated to be available in 2024/2025	Amanda Dwyer adwyer@westervelt.com or Sarah Correa scorrea@westervelt.com
Grasslands Mitigation Bank	Seasonal wetland	Limited credits currently available	
Shin Kee Mitigation Bank	Deep and shallow subtidal, tule marsh, seasonal wetland, and upland (giant garter snake)	Credits anticipated to be available in 2022/2023	James Jimison jjimison@agspanos.com
Sacramento District California In Lieu Fee Program	Wetlands and other waters of the United States and state, including vernal pools	Credits currently available	Heather Hoyles heather.hoyles@nfwf.org

Note:
Availability as of April 20, 2021.

6.5 Implementation Steps

6.5.1 Tasks and Deliverables

Anticipated tasks and deliverables associated with the environmental compliance process are listed in the following sections in accordance with the general order of sequencing; however, the actual timing and details involved with each step will vary for each individual project.

6.5.1.1 CEQA/NEPA Compliance Tasks and Deliverables

1. To kick off this process, the lead agency should confirm at least the conceptual project description (see Section 4.3.4) to determine the appropriate type of environmental document. This would be either a program or project-level EIR (or joint EIS/EIR), assuming there would be potentially significant residual environmental impacts, or possibly an IS/MND (or joint MND/EA), assuming there would be no significant residual impacts. While it not anticipated that the appropriate CEQA document type for the Program would be an IS/MND, it is possible that smaller channel dredging project could be cleared through an IS/MND. A conceptual project description should include a summary of the proposed construction activities, equipment, anticipated sequencing and timing, and post-construction (operational) activities.
    a. The lead agency can either assume an EIR is needed for the Program/channel dredging project or prepare an IS to determine whether the Program/project would have potentially significant environmental impacts
    b. **Required deliverables:** Conceptual project description

c. **Potential deliverables:** IS (to ascertain potential impacts)

2. Assuming an EIR or joint EIS/EIR is determined to be the appropriate type of document to be prepared, the following tasks would be required (note that to avoid confusion, the following bullets refer to preparation of an EIR; if a joint document is prepared, the same steps would generally apply to a joint EIS/EIR):
   a. Prepare and publish the NOP (CEQA) and NOI (NEPA).
      i. Regardless of whether the EIR will be program or project-level, preparation of a NOP (and NOI for NEPA) is required to initiate scoping. This document must include a project description, project location, and the probable environmental effects of the project.
      ii. If an IS is prepared, it can be included with the NOP as a means for screening out resource topics from analysis in the Draft EIR that would not be affected by the Program or project (such as, for example, population and housing).
      iii. The NOP and Notice of Completion (NOC) must be filed with the State Clearinghouse (SCH) and the County clerk(s) in which the project is located to initiate the 30-day scoping process. Notification should also be provided to agencies of the NOP and scoping process.
      iv. While not specifically required at this point in the CEQA process, it is recommended that tribal consultation under AB 52 commence during scoping. Letters describing the project, project location, and any known tribal cultural resources must be sent to the NAHC and then to any tribes identified by the NAHC for the project.
      v. A public scoping meeting is not required but is an effective tool to facilitate public and agency input early on the development of the alternatives and prior to assessment of potential environmental impacts.
      vi. **Required deliverables:** NOP (CEQA); NOI (NEPA); NOC; notices to the public and agencies regarding the NOP, NOI, and scoping period; tribal consultation letters
      vii. **Potential deliverables:** IS; public scoping meeting materials
   b. Prepare the Draft EIR.
      i. The lead agency is not required to directly respond to scoping feedback but should review and consider the feedback in developing the Draft EIR.
      ii. The project description and alternatives descriptions should be fully complete for inclusion and analysis in the Draft EIR. Ideally, the project description would be reflective of 30% design; however, depending on the scope of the EIR (program or project-level) and design timelines, the project description may be less developed than 30% design. In this case, the project description in the EIR can be prepared to include a range of construction activities that would be evaluated in the EIR to provide flexibility in the future as design progresses.

iii. The lead agency should conduct the necessary investigations, studies, and technical analyses required to fully evaluate the potential environmental impacts of the project, including describing the mitigation measures to reduce or avoid impacts on the environment. Specific to the Program, this may include a formal wetlands and waters delineation, vegetation and special-status species habitat assessment, cultural resources assessment, sediment characterization, and air quality assessment, among other topics. It is possible that desktop analyses may provide sufficient information for CEQA review purposes and site-specific fieldwork can be completed when additional design information is confirms at a later time to save costs on repeat assessments.

iv. The Draft EIR must include a table of contents, an executive summary, a description of the project, a description of the environmental setting, an evaluation of potential environmental impacts anticipated to result from implementation of the project, mitigation measures proposed to reduce significant impacts, a description of irreversible changes resulting from project implementation, an assessment of potential cumulative impacts, a summary of scoping and outreach efforts, and a description and consideration of alternatives to the project.

v. The Draft EIR and NOC must be filed with the SCH and the county clerk(s) for the county in which the project is located to initiate the 45-day public review process. Notification should also be provided to agencies and interested members of the public of the availability of the Draft EIR and public review process.

vi. A public meeting on the Draft EIR is not required but is an effective tool to provide project information and facilitate public and agency comments on the document.

vii. **Required deliverables:** Complete project and alternatives descriptions; technical studies needed to prepare the Draft EIR; the Draft EIR document; NOC; notices to the public and agencies regarding the Draft EIR and public comment period

viii. **Potential deliverables:** Public scoping meeting materials; public and agency notices for the public meeting

c. Prepare the Final EIR.

i. The lead agency is required to prepare written responses to agency comments and to comments that raise significant environmental issues. Written agency responses must be provided to the agencies at least 10 days prior to certification of the Final EIR. The lead agency is required to evaluate all other public comments received on the Draft EIR.

ii. If it is determined that additional investigations, studies, or technical analyses are warranted based on comments, new information, or project updates, those steps need to be completed prior to preparing the Final EIR.

iii. If additional analyses, comments, or new information reveal that the project would result in new significant impacts not presented in the Draft EIR, the Draft EIR would require revision and recirculation.

iv. The Final EIR must include the Draft EIR or a revision of the Draft EIR, verbatim or summarized comments received on the Draft EIR, a list of Draft EIR commentors, and responses to significant environmental issues raised in comments.

v. The MMRP should also be prepared, including the final set of mitigation measures required for the project and implementation details, including persons responsible and timing.

vi. The Final EIR. MMRP, Notice of Determination (NOD), and NOC must be filed with the SCH and the county clerk(s) for the county in which the project is located within 5 days of the document being certified.

vii. Preparation of the Findings of Fact and Statement of Overriding Considerations is required for final approval of the Final EIR by the lead agency.

viii. **Required deliverables:** Response letters to agency comments on the Draft EIR; the Final EIR document; MMRP; Findings of Fact and Statement of Overriding Considerations; NOD; NOC

ix. **Potential deliverables:** Technical studies needed to address comments on the Draft EIR

3. Assuming an IS/MND or joint IS/MND and EA is determined to be the appropriate type of document for a channel dredging project, the following tasks would be required (note that to avoid confusion, the following bullets refer to preparation of an IS/MND; if a joint document is prepared, the same steps would generally apply to a joint IS/MND and EA):

    a. Prepare the Draft IS/MND.

        i. The project description should be fully complete for analysis in the Draft IS/MND. Ideally, the project description would be reflective of 30% design; however, depending on design timelines, the project description may be less developed than 30% design. In this case, the project description in the Draft IS/MND can be prepared to include a range of construction activities that would be evaluated in the Draft IS/MND to provide flexibility in the future as design progresses.

        ii. Tribal consultation under AB 52 should commence early as possible. Letters describing the project, project location, and any known tribal cultural resources must be sent to the NAHC and then to any tribes identified by the NAHC for the project.

        iii. The lead agency should conduct the necessary investigations, studies, and technical analyses required to fully evaluate the potential environmental impacts of the project, including describing the mitigation measures to reduce or avoid impacts on the environment. Specific to the Program, this may include a formal wetlands and waters delineation, vegetation and special-status species habitat assessment, cultural resources assessment, sediment characterization, and air quality assessment, among other topics. It is possible that desktop analyses may provide sufficient information for CEQA review purposes and site-specific fieldwork can be completed when additional design information is confirms at a later time to save costs on repeat assessments.

iv. The Draft IS/MND must include a description of the project and location; a description of the environmental setting; an evaluation of potential environmental impacts anticipated to result from implementation of the project; mitigation measures proposed to reduce significant impacts; an assessment of whether the project would be consistent with existing zoning, plans, and applicable land use controls; and the names of the document preparers.

v. The Draft IS/MND and NOC must be filed with the SCH and the county clerk(s) for the county in which the project is located to initiate the 30-day public review process. Notification should also be provided to agencies and interested members of the public of the availability of the Draft IS/MND and public review process.

vi. A public meeting on the Draft IS/MND is not required but is an effective tool to provide project information and facilitate public and agency comments on the document.

vii. **Required deliverables:** Complete project description; tribal consultation letters; technical studies needed to prepare the Draft IS/MND; the Draft IS/MND document; NOC; notices to the public and agencies regarding the Draft IS/MND and public comment period

viii. **Potential deliverables:** Public meeting materials; public and agency notices for the public meeting

b. Prepare the Final IS/MND.

i. The lead agency is not required to directly respond to comments on the Draft IS/MND but must consider the feedback in determining whether to approve the project and the Final IS/MND.

ii. If it is determined that additional investigations, studies, or technical analyses are warranted based on comments, new information, or project updates, those steps need to be completed prior to preparing the Final IS/MND.

iii. If additional analyses, comments, or new information reveal that the project would result in new significant impacts not presented in the Draft IS/MND, the Draft IS/MND would require revision and recirculation.

iv. The Final IS/MND must include the Draft IS/MND or a revision of the Draft IS/MND, verbatim or summarized comments received on the Draft IS/MND, a list of Draft IS/MND commentors, and responses to significant environmental issues raised in comments.

v. The MMRP should also be prepared, including the final set of mitigation measures required for the project and implementation details, including persons responsible and timing.

vi. The Final EIR. MMRP, NOC, and NOC must be filed with the SCH and the county clerk(s) for the county in which the project is located within 5 days of the document being certified.

vii. **Required deliverables:** The Final IS/MND document; MMRP; NOD; NOC

viii. **Potential deliverables:** Technical studies needed to address comments on the Draft EIR

6.5.1.2 Regulatory Permitting Tasks and Deliverables

1. It is assumed that the CEQA process for either the Program or associated channels to be dredged would kick off prior to the regulatory permitting process. The scope of a given regulatory permitting effort may be smaller than that of the CEQA document. For example, the regulatory permitting scope may be specific to one, several, or many South Delta channels requiring dredging whereas the CEQA document scope may cover the Program in its entirety.
2. While pre-application coordination with agencies is generally helpful, the only agency with formal pre-application coordination requirements is CVRWQCB. For this agency, an email must be submitted at least 30 days prior to submitting a permit application describing the project location, elements, and anticipated impacts. CVRWQCB staff then respond with either a request for a pre-application meeting or confirmation that such meeting is not needed. The permittee should consider holding a larger pre-application meeting(s) for the project to gather agency input on the permitting requirements prior to developing permit applications. While these agencies would generally have been provided project information during the CEQA process, their staff may not have delved into the Draft EIR or IS/MND and/or the timing of regulatory permitting for a project could be years after the associated CEQA process was completed.
    a. **Required deliverables:** Pre-application meeting email to CVRWQCB
    b. **Potential deliverables:** Pre-application meeting materials for submittal to all agencies
3. To proceed with regulatory permitting, more specific project description and impact information is needed than for the CEQA review. The permittee should have completed a minimum of 30% or preferably closer to 60% design (see Section 4.3.4) to ensure that specific impacts can be presented to the agencies and that project description details are unlikely to change. The permitting-level project description should include descriptions and maps of the specific water and land areas on which construction (dredging and sediment management) activities would occur; a detailed description of construction activities, including equipment, sequencing, and BMPs to reduce potential environmental impacts; a description of long-term maintenance or

management activities; a detailed assessment of impacts to federal, state, and local jurisdictional resources; and mitigation measures needed to offset potential environmental impacts.

    a. **Required deliverables:** Project description reflective of 30% to 60% design for the project

4. Conduct site-specific assessments and studies, including but not limited to the following:
    a. Sediment characterization
    b. Special-status species and habitat assessment, including vegetation mapping
    c. Jurisdictional wetlands and waters delineation
    d. Cultural and historic resources assessment
    e. **Required deliverables:** Completed studies, assessments, and reports determined to be required to support regulatory permitting
5. Once the project description is confirmed and the project-specific site investigations and surveys are complete, the anticipated permitting requirements unique to the project can be confirmed and documented in a permit strategy document. For example: the type of CWA Section 404 and RHA Section 10 approval (Letter of Permission, Nationwide Permit, or Individual Permit) can be confirmed; the specific ESA- and CESA-listed species that could be affected by project construction and the anticipated effects determination can be confirmed; and the need for specific approvals, such as the approval to decant water from sediment management sites or an ITP, can be confirmed. While not required for agency approval, it is recommended that a permit strategy document be prepared to identify the permits and approvals to be obtained for the specific project.
    a. **Potential deliverables:** Project-specific permit strategy document
6. Prepare regulatory permit applications and supporting information, potentially including but not limited to the following:
    a. USACE CWA Section 404 and RHA Section 10 application form, supplemental documentation describing impacts to and proposed mitigation for USACE jurisdictional resources, and permit figures showing and tables detailing specific impacts to waters of the United States
    b. CVRWQCB Section 401 water quality certification application form, application form for coverage under the General Waste Discharge Requirements for Maintenance Dredging Operations in the Sacramento-San Joaquin Delta (Order No. R5-2009-0085), supplemental documentation describing impacts to and proposed mitigation for CVRWQCB jurisdictional resources, and permit figures showing and tables detailing specific impacts to waters of the state
    c. CDFW SAA online application form (EPIMS) regarding project impacts on CDFW jurisdictional aquatic, riparian, and habitat areas, proposed mitigation to compensate for impacts, and permit figures showing and tables detailing specific impacts to CDFW jurisdictional resources

d. Cultural and historic resources report prepared to support compliance with NHPA Section 106 requirements
e. A Biological Assessment that evaluates the project's anticipated effects on aquatic and terrestrial ESA-listed species and habitats
f. An EFH assessment that evaluates the project's anticipated effects on EFH
g. A mitigation plan, potentially addressing potential impacts on wetlands/waters or special-status species and habitats
h. A CWA Section 404(b)(1) alternatives analysis that evaluates the alternatives to the proposed discharge of fill into waters of the United States and determines the least environmentally damaging practicable alternative
i. Application for coverage under the SJCOG SJMSCP or ECCCHC HCP/NCCP and accompanying map of project footprint overlaid on the relevant HCP zones
j. An ITP application, if it is determined that the project could result in the take of CESA-listed species
k. A CVFPB permit application, supplemental documentation describing and figures showing impacts to levee resources in the project area
l. All of the above items can currently be submitted electronically either via email or through online agency application systems. Some of the above-noted items include permit application and/or issuance fees, including items b, c, i, j, and k. In general, permit application fees are due at or just after permit applications are submitted and issuance fees are due on an annual basis.
m. **Required deliverables:** Permit application forms, supplemental materials, figures, and reports/assessments for items a through f described above
n. **Potential deliverables:** Permit application forms, supplemental materials, figures, and reports/assessments for items g through k described above

7. After submitting the permit application materials identified in item 6 above, the permittee should be prepared to address agency comments and questions on the project and potentially conduct an agency site visit to resolve questions. In some cases, a multi-agency meeting (such as with USACE, NMFS, and USFWS for Section 7 ESA consultations or with CDFW and SJCOG for CESA-listed species avoidance measures) may be warranted. Regular check-ins with agency staff should be conducted so that project permit applications are not de-prioritized.
   a. **Potential deliverables:** Comment response letters, email correspondence with agency staff, and agency meeting agendas
8. Once permits are issued, the permittee should carefully review all permit conditions to ensure they are implementable. If specific conditions are deemed unfeasible, outreach with the issuing agency should be conducted immediately so that the permit can be modified or clarified prior to construction. It is recommended that the permittee prepare a matrix that includes all permit

conditions and due dates, responsible parties, and a column to document completion for each permit condition to ensure compliance.

a. **Potential deliverables:** Permit modification or clarification letters or emails and a permit compliance matrix

6.5.2 Sequencing and Timelines for Implementation

For planning purposes, Figure 6-1 provides a graphic of the anticipated sequencing and timelines for the CEQA compliance process steps outlined in Section 6.5.1.1—both for an EIR (program or project-level) and an IS/MND. It provides the recommended sequencing and a reasonable timeline given our current understanding of the Work Group's priorities and goals. In reviewing Figure 6-1, the following notes should be considered:

- While the NEPA process and document equivalents to CEQA are not shown in Figure 6-1, should a joint document be prepared for the Program or an associated channel dredging project, the schedule would be consistent with that shown in Figure 6-1.
- Figure 6-1 does not provide sequencing or timeline information for the potential subsequent CEQA documentation (e.g., addenda or supplemental EIRs or ND/MNDs) that may be required depending on the scope of the original CEQA documentation prepared for the Program or an associated channel dredging project.
- Depending on the extent of public and agency comments, the period of time required to prepare documentation may be longer or shorter than that shown in Figure 6-1.

For planning purposes, Figure 6-2 provides a graphic of the anticipated sequencing and timelines for the regulatory compliance steps outlined in Section 6.5.1.2. It provides the recommended sequencing and a reasonable timeline given our current understanding of the Work Group's priorities and goals. In reviewing Figure 6-2, the following notes should be considered:

- The CEQA project description may be sufficient for regulatory permitting. As noted in Section 6.5.1.2, item 3, the permittee should have completed a minimum of 30% or preferably closer to 60% design for the regulatory permitting project description to ensure that specific impacts can be presented to the agencies and that project description details are unlikely to change. If this level of detail is available at the time that the CEQA documentation is developed, then additional time for developing the project description during regulatory permitting may not be needed and those 2 months could be removed from the schedule.
- Similarly, if sufficient pre-application coordination is completed to support the CEQA review process, then the pre-application coordination step shown in Figure 6-2 may not be needed and that month could be removed from the schedule.
- Again similarly, if the studies and investigations undertaken to support the CEQA documentation sufficiently address project impact assessment needs for regulatory

permitting, then the step for completing investigations and studies shown in Figure 6-2 may not be needed and those 2 months could be removed from the schedule.

- The CEQA process must be complete in order for state and local agencies to issue discretionary permits or approvals for the Program or associated channel dredging project.
- Should a NEPA review be required, the NEPA process cannot be complete without completing ESA and Section 106 consultations with USFWS and/or NMFS or the SHPO, respectively.

6.5.3 Conceptual Costs

Order-of-magnitude costs for completing CEQA/NEPA documentation and regulatory permitting are presented in Table 6-4. These costs ranges are broad in nature and depend on the project specifics, such as the scope of a project (the entirety of the Program or a smaller channel dredging project), the types of permits and supporting materials required by agencies, the extent of technical analysis required, and public and agency concerns/comments.

Table 6-4
Order-of-Magnitude Costs for CEQA/NEPA Compliance and Regulatory Permitting

Activity	Order-of-Magnitude Cost	Description
CEQA/NEPA Documentation	$150,000 to $350,000	Low-end cost estimate assumes preparation of a single project-level IS/MND. High-end cost estimate assumes preparation of a single combined program and project-level EIR. Costs for Subsequent CEQA documentation (e.g., addenda or supplemental EIRs or ND/MNDs) are not included in these costs but are anticipated to range between $25,000 (addenda) to up to $200,000 (supplemental EIRs).
Sediment Characterization1	$150,000 to $250,000 (per every 100,000 cubic yards)	Assume sampling with a vibracore (not a drill rig); Typically, one core sample is required per 5,000 cubic yards of sediment and one composite sample is required per 10,000 cubic yards of sediment. Costs include preparation of documentation, sample collection, laboratory analysis, and results analysis for upland placement. Landfill or in-water disposal criteria testing may incur additional costs.
Environmental and Technical Studies1	$150,000	Assumed studies include habitat assessments for listed or sensitive species and cultural resources studies

Activity	Order-of-Magnitude Cost	Description
Regulatory Permitting	$125,000 to $225,000	Low-end cost estimate assumes preparation of the required items identified in Section 6.5.1.2, item 6. High-end cost estimate assumes preparation of the required and potential items identified in Section 6.5.1.2, item 6. Costs are for permitting a single project. If numerous separate permitting efforts are undertaken to complete the entirety of the Program, there would likely be cost savings (since information, application forms, and analyses would be relevant to multiple projects), but these estimates should be assumed per project for planning purposes.

Note:

1. These items and costs are also presented in Section 4.3.5.

7 Conceptual Costs

This section summarizes the order of magnitude costs for dredging design, permitting, and construction. Costs are provided for a single project of 100,000 cubic yards (assumed the equivalent of 1 mile of dredging) and for dredging of the entire Program area. It is assumed that the entire Program area would not be dredged at once, however this cost is provided to show which items would provide some cost savings if applied to a single project versus the overall Program. For examples, it may be cost effective to prepare a CEQA document or

7.1 Summary of Conceptual Costs

Table 7-1 summarizes the design and permitting costs presented throughout the report. All costs represent a project with a dredging volume of 100,000 cubic yards and 1 mile of channel length.

Table 7-1
Order-of-Magnitude Costs – Dredging, Disposal and Permitting (per 100,000 cy project)

Activity	Cost	Description
Design		
Hydrographic Surveying	\$8,000 to \$10,000	Assume bathymetric and topographic lidar survey data will be collected, including manual survey as needed for shallow or vegetated areas. Cost primarily impacted by required number of field days to collect data.
Hydrodynamic and Water Quality Modeling	\$75,000 to \$300,000	Low-end cost estimate assumes one-dimensional evaluation of flows and water quality under existing conditions and with the channel depth restoration program to support CEQA. High-end cost estimate includes multi-dimensional use of hydrodynamic modeling for refinement of channel depth restoration program to reduce project impacts as described in Section 4.3.1. The cost for hydrodynamic modeling includes modeling of the entire Program area because modeling only a portion would not be cost effective or technically useful. Therefore, this cost would not be repeated if additional dredging volume was added to the project.
Geotechnical Investigation	\$30,000 to 50,000 (per channel mile)	Allowance for geotechnical investigation of channel sediments and levee soils.
Geotechnical Evaluations[1]	\$25,000	Allowance for geotechnical investigation of channel sediments and levee soil to assess strength and settling properties, as well as determine dredging offset from toe of levee to avoid undermining.
Sediment Characterization	\$150,000 to \$250,000	Assume sampling with a vibracore (not a drill rig); Typically, one core sample is required per 5,000 cubic yards of sediment and one composite sample is required per 10,000 cubic yards of sediment. Costs include preparation of documentation, sample collection, laboratory analysis, and results analysis for upland placement. Landfill or in-water disposal criteria testing may incur additional costs. The General Order for maintenance dredging in Sacramento-San Joaquin Delta is applicable up to 100,000 cubic yards. Guidance

Activity	Cost	Description
		for dredging above this volume is undefined. It may be possible to negotiate with the agencies to reduce the level of testing for a volume that is significantly greater than 100,000 cubic yards.
Engineering Design and Bid Support Services[3]	$150,000	Assume engineering design includes preparation of basis of design report; bid documents at 30%, 60%, 90%, and 100% completion; cost evaluations at each level of design; and bid support.
Permitting		
CEQA/NEPA Documentation	$150,000 to $350,000	Low-end cost estimate assumes preparation of a single project-level IS/MND. High-end cost estimate assumes preparation of a single combined program and project-level EIR. Costs for subsequent CEQA documentation (e.g., addenda or supplemental EIRs or ND/MNDs) are not included in these costs but are anticipated to range between $25,000 (addenda) to up to $200,000 (supplemental EIRs).
Environmental and Technical Studies	$150,000	Assumed studies include habitat assessments for listed or sensitive species and cultural resources studies
Regulatory Permitting	$125,000 to $225,000	Low-end cost estimate assumes preparation of the required items identified in Section 6.5.1.2, item 6. High-end cost estimate assumes preparation of the required and potential items identified in Section 6.5.1.2, item 6. Costs are for permitting a single project. If numerous separate permitting efforts are undertaken to complete the entirety of the Program, there would likely be cost savings (since information, application forms, and analyses would be relevant to multiple projects), but these estimates should be assumed per project for planning purposes.
Subtotal:	$865,000 to $1,500,000 (approximate)	
Contingency (25%):	$215,000 to $375,000	
Total:	**$1,080,000 to $1,875,000**	

Tables 7-2 through 7-4 summarizes the construction for viable dredging alternatives. The include:

- Mechanical dredging with placement at MWRP
- Mechanical dredging with placement at an adjacent upland site, using working and disking of sediment to dewatering and dry. Costs do not include off haul.
- Hydraulic cutterhead dredging and pumping to an adjacent upland site, using geotubes to contain and dewater sediment. Costs do not include off haul.

All costs represent a project with a dredging volume of 100,000 cubic yards and 1 mile of channel length. Actual construction costs are highly variable to market conditions and other factors, such as fuel costs. These costs are representative of similar projects in the region and the time the Guide was prepared.

Table 7-2
Order-of-Magnitude Costs – Construction (Mechanical Dredging with Placement at MWRP)

Activity	Unit	Quantity (100,000 cy / 1 mile)	Unit Rate	Cost	Description
Mobilization and Demobilization	Lump Sum	1	$200,000	$200,000	Dredge, scows, ancillary equipment
Dredging	Cubic Yard	100,000	$75	$8,000,000	-
Surveying	Lump Sum	1	$20,000	$20,000	Pre- and Post-Dredge (2)
Tipping Fee	Cubic Yard	100,000	$15	$1,500,000	Clean sediment; No other site fees
			Subtotal:	$9,220,000	
			Contingency (25%):	$2,305,000	
			Total:	**$11,525,000**	

Table 7-3
Order-of-Magnitude Costs – Construction (Mechanical Dredging with Working/Disking at Adjacent Upland)

Activity	Unit	Quantity (100,000 cy / 1 mile)	Unit Rate	Cost	Description
Mobilization and Demobilization	Lump Sum	1	$300,000	$300,000	Dredge, scows, offloader, ancillary equipment
Dredging and Placing Upland	Cubic Yard	100,000	$50	$5,000,000	Double Handling
Surveying	Lump Sum	1	$20,000	$20,000	Pre- and Post-Dredge (2)
Dewatering (Working/Disking)	Cubic Yard	100,000	$15	$1,500,000	Using land-based equipment; Effluent collected and gravity drained to channel
Land Lease	Month	6	$30,000	$180,000	Variable per site; Assumed $30,000 per month @ 6 months
Site Preparation	Lump Sum	1	$250,000	$250,000	Water collection/management system; Offloading area
			Subtotal:	$7,250,000	
			Contingency (25%):	$1,813,000	
			Total:	**$9,063,000**	

Table 7-4
Order-of-Magnitude Costs – Construction (Hydraulic Dredge with Geotextile Tub Dewatering at Adjacent Upland)

Activity	Unit	Quantity (100,000 cy / 1 mile)	Unit Rate	Cost	Description
Mobilization and Demobilization	Lump Sum	1	$500,000	$500,000	10-inch dredge and pipeline, tubes, ancillary equipment
Dredging	Cubic Yard	100,000	$25	$2,500,000	
Surveying	Lump Sum	1	$20,000	$20,000	Pre- and Post-Dredge (2)
Dewatering (Geotextile Tube)	Cubic Yard	100,000	$20	$2,000,000	Tubes ~80 feet circumference; length to be determined; ~1 month to fill and dewater tube
Land Lease	Lump Sum	1	$30,000	$180,000	Variable per site; Assumed $30,000 per month @ 6 months
Site Preparation	Lump Sum	1	$200,000	$200,000	
			Subtotal:	$5,400,000	
			Contingency (25%):	$1,350,000	
			Total:	**$6,750,000**	

8 Next Steps and Recommendations

The following summarizes the next steps for planning and implementation of a dredging project within the Program area, including recommendations for considerations.

1. Hydrographic (and possibly topographic) surveying:
   a. Hire a licensed surveyor to perform the surveys; Require performance of site reconnaissance before conducting the survey so they use the proper methods to meet site conditions.
   b. Establish the survey datum in advance; If possible have the survey data provided in both NAVD88 and MLLW datums.
   c. Begin with a large-scale Program survey to establish baseline conditions of the entire Program area, or of project areas that may be dredged within the next decade.
   d. In the future, continue to perform routine surveys to assist with determination of accretion rates which are used in long-term dredging plans.

2. Hydrodynamic and water quality modeling:
   a. Create a Program model instead of a project level model to capture potential impacts from dredging in adjacent channels.
   b. Continue to incorporate routine surveying data into the model, when possible, to improve the reliability of the estimated shoaling rates and patterns.
   c. Coordinate with stakeholders to determine project objectives, such as a net flow, seasonal capacity, or minimal parameters to support diversions, navigation, and water quality improvements.
   d. Applying the project objectives, determine the dredging template(s) through the model. Ensure that the critical elevation (the elevation of sediment where the channel would no longer operate at optimum functionality) is shallower than the dredging design depth to allow a buffer for sediment accretion after a dredging event.

3. Preliminary Design:
   a. Using the templates established through modeling, calculate dredging volumes.
   b. Perform supporting evaluations, including geotechnical analysis. Revise dredging template if needed based on analysis results.
   c. Run a preliminary cost evaluation to see if the preliminary dredging and anticipated dredging methods are within available budget. If not, refine the dredging template, reduce dredging, or revaluate dredging and placement methods.
   d. Prepare dredging calculations and drawings at approximately 30% design level for use in the regulatory process.

e. Reach out to potential temporary and permanent placement sites and begin discussions and negotiations for land use.

4. Initiate the CEQA process and permitting process. See Section 6 and Figure 6-1 and 6-2 for information on sequencing the work.
5. Sediment Characterization
   a. At an appropriate time during the regulatory process, initiate sediment characterization.
   b. Coordinate with the CVRWQCB to conform the proposed testing program is within the General Order protocols and suitable for the proposed placement site.
6. Prepare Final Design:
   a. Although draft design can be prepared in parallel with investigations and regulatory process, it is prudent to wait until all results and approvals are complete to avoid potential redesign and project delays.
   b. Notify the dredging community in advance (up to a year) of the anticipated bid date.

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Figures

Figure 1-1
South Delta Channels Depth Restoration Program Area

Note: Program channels are shown in red.

Figure 2-1
MLLW Program Area Map

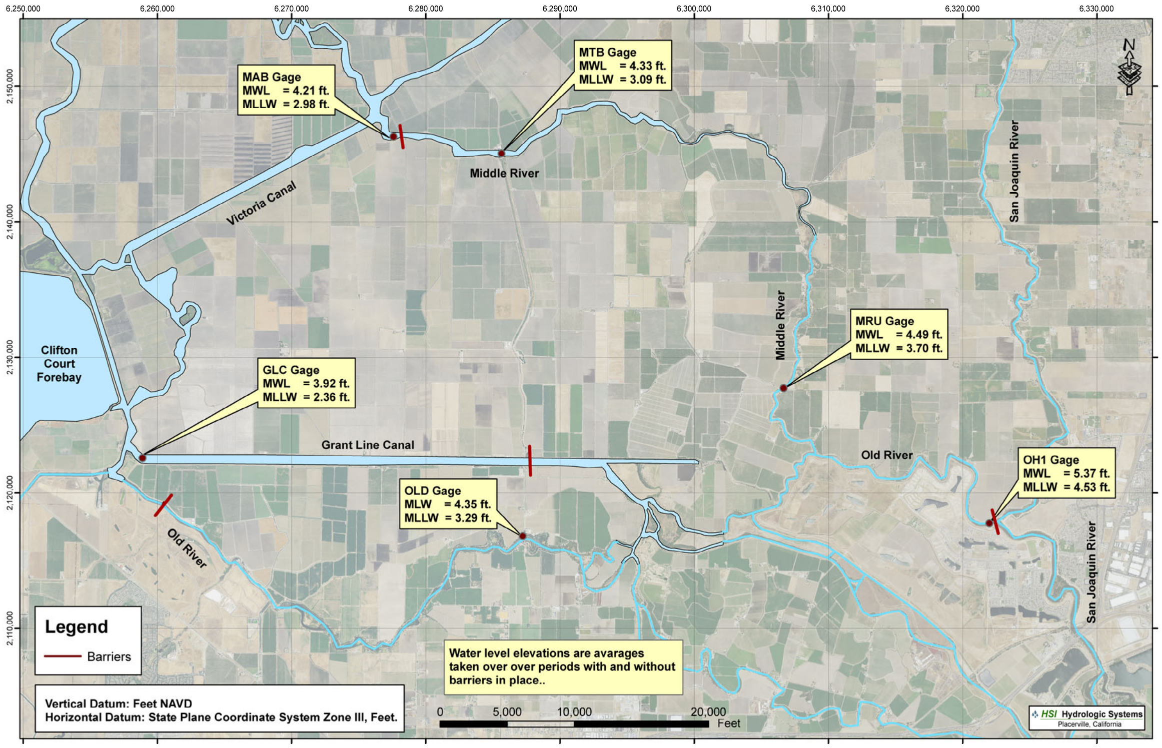


Figure 2-2
Investigative Sediment Analysis (Old River and Middle River)

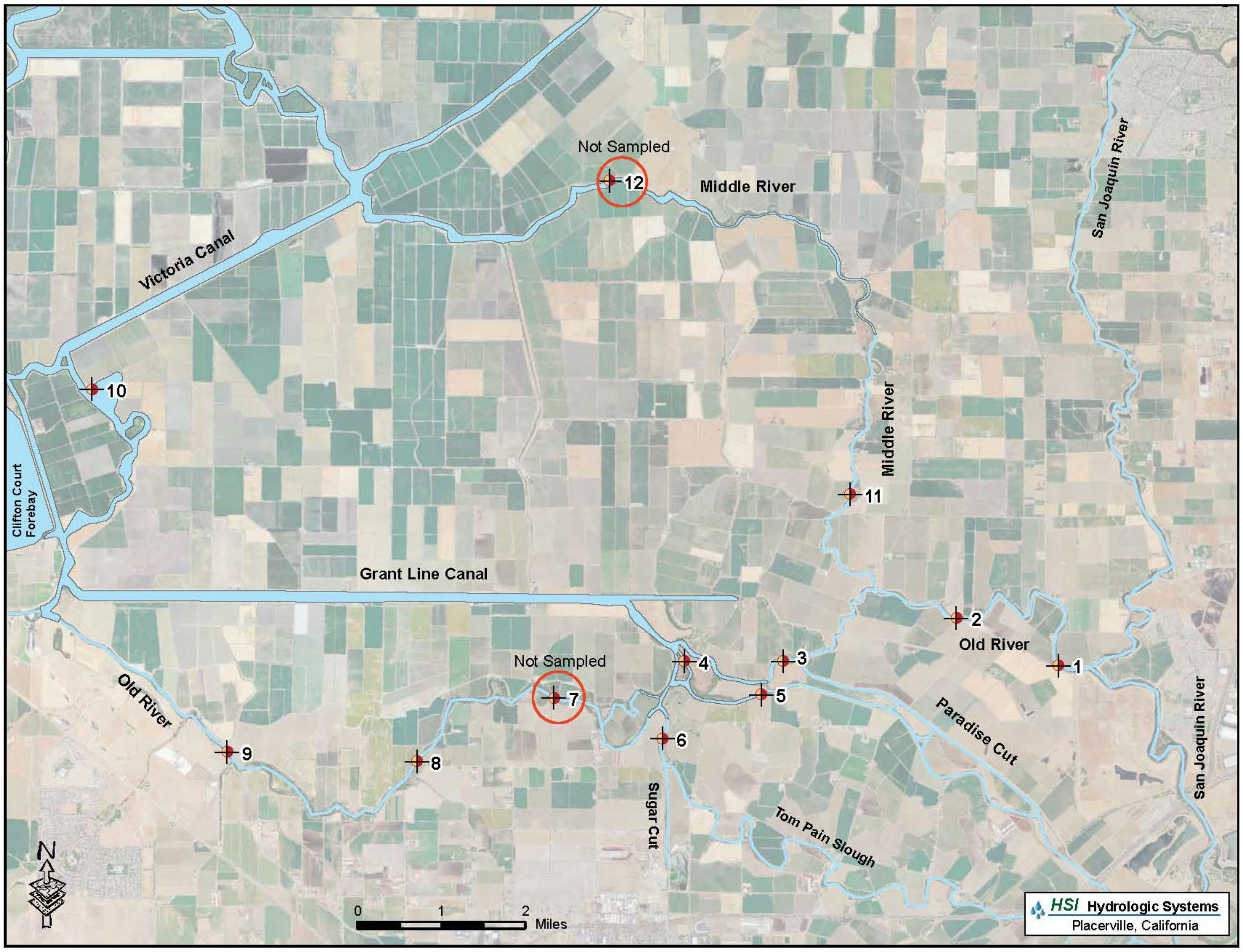


Figure 3-1
Small Cutterhead Hydraulic Dredge Equipment

Figure 3-2
Small Mechanical Dredge Equipment

Figure 3-3
Knockdown Dredging Configuration – I-Beam Mounted on Boat Stern

Figure 3-4
Diver-Assisted Dredging Hose

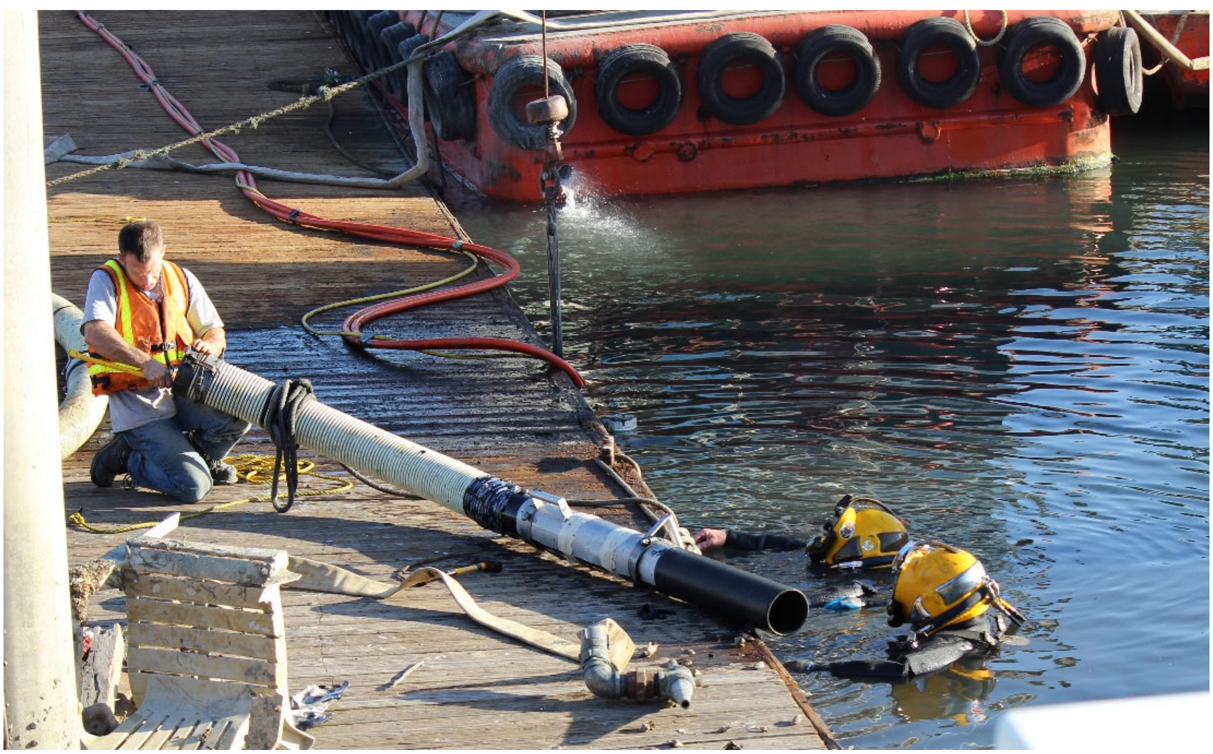


Figure 4-1
Channel Reaches Used to Establish Historic and Target Dredging Depths

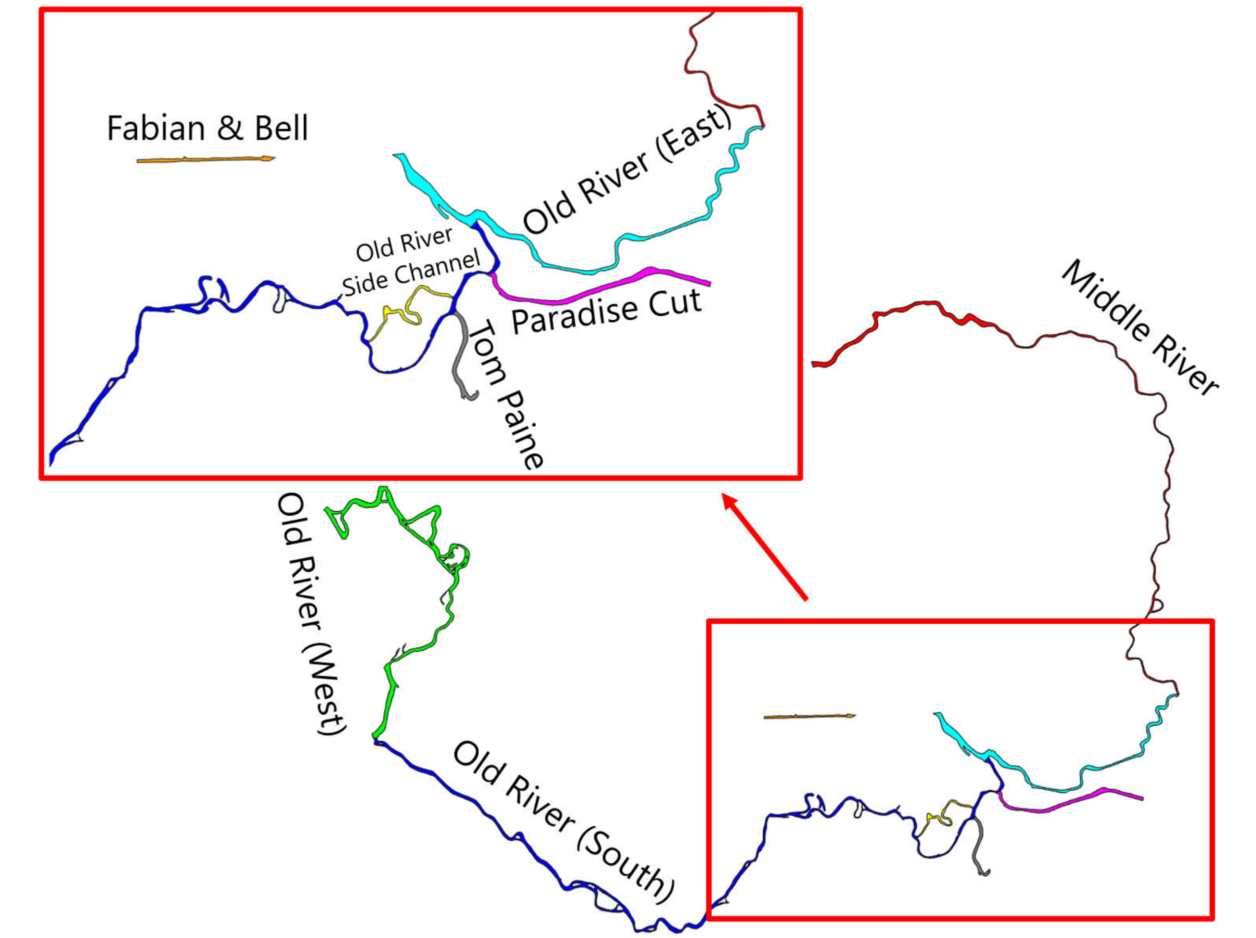


Figure 4-2
Components of Dredging Templates

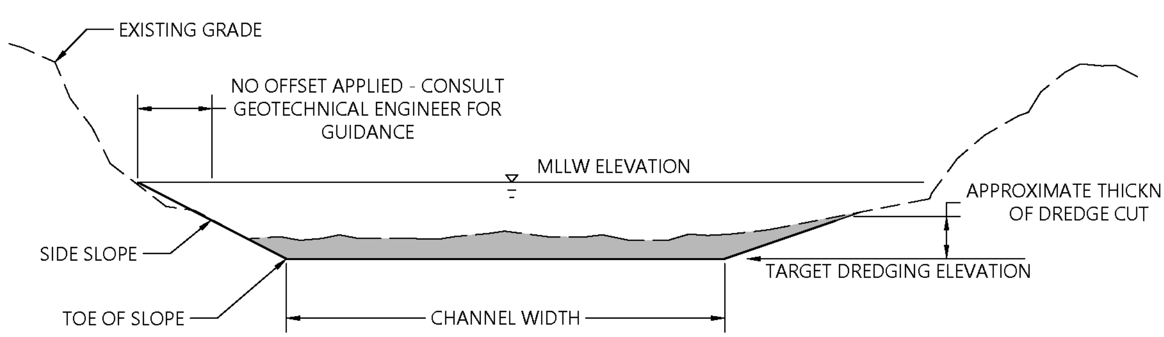
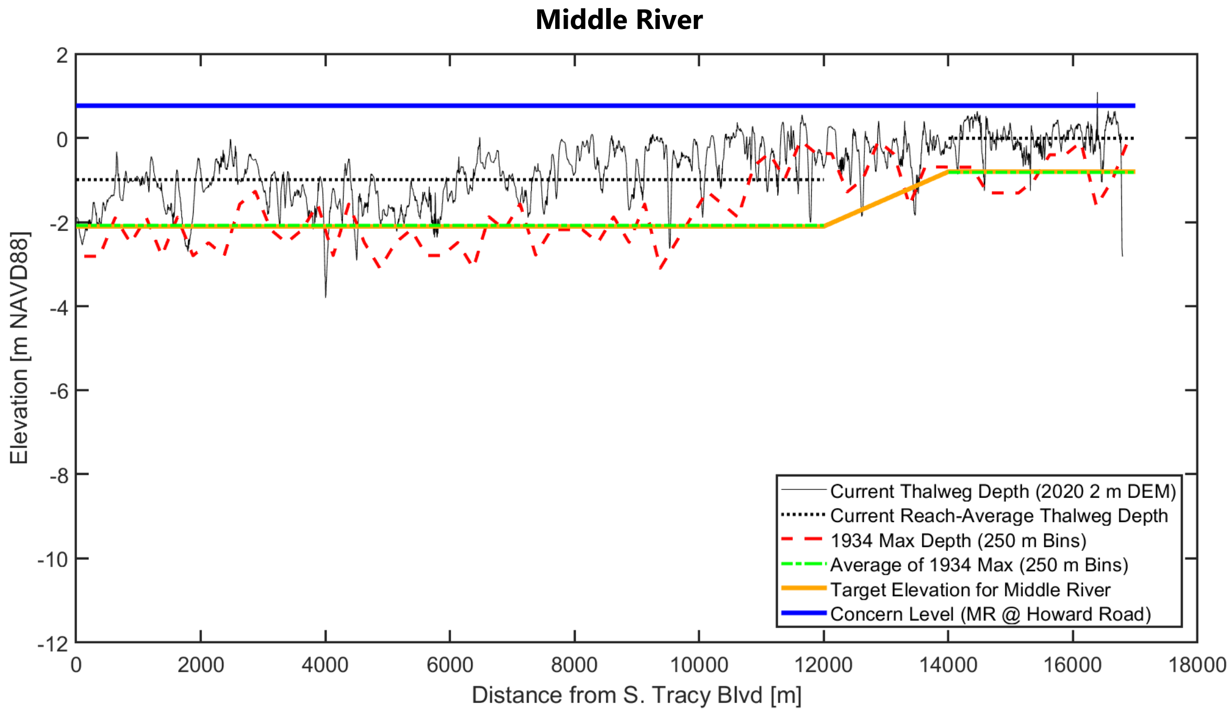


Figure 4-3
Primary Channel Target Elevation Determination



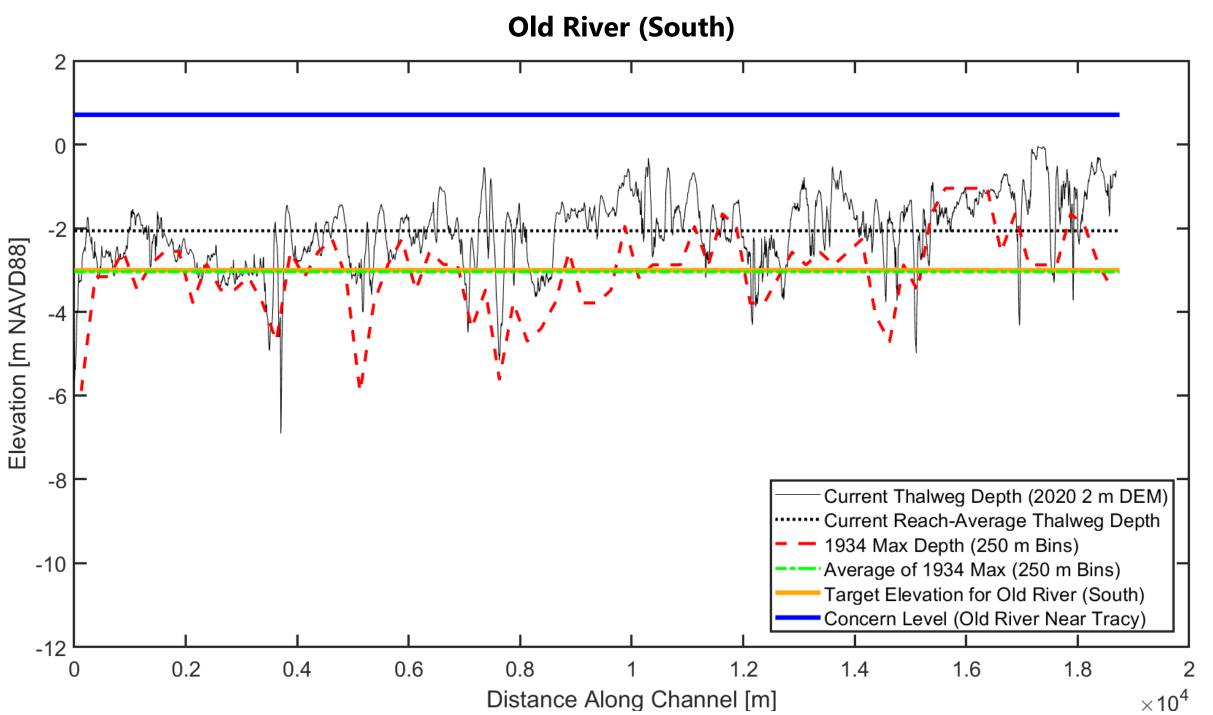
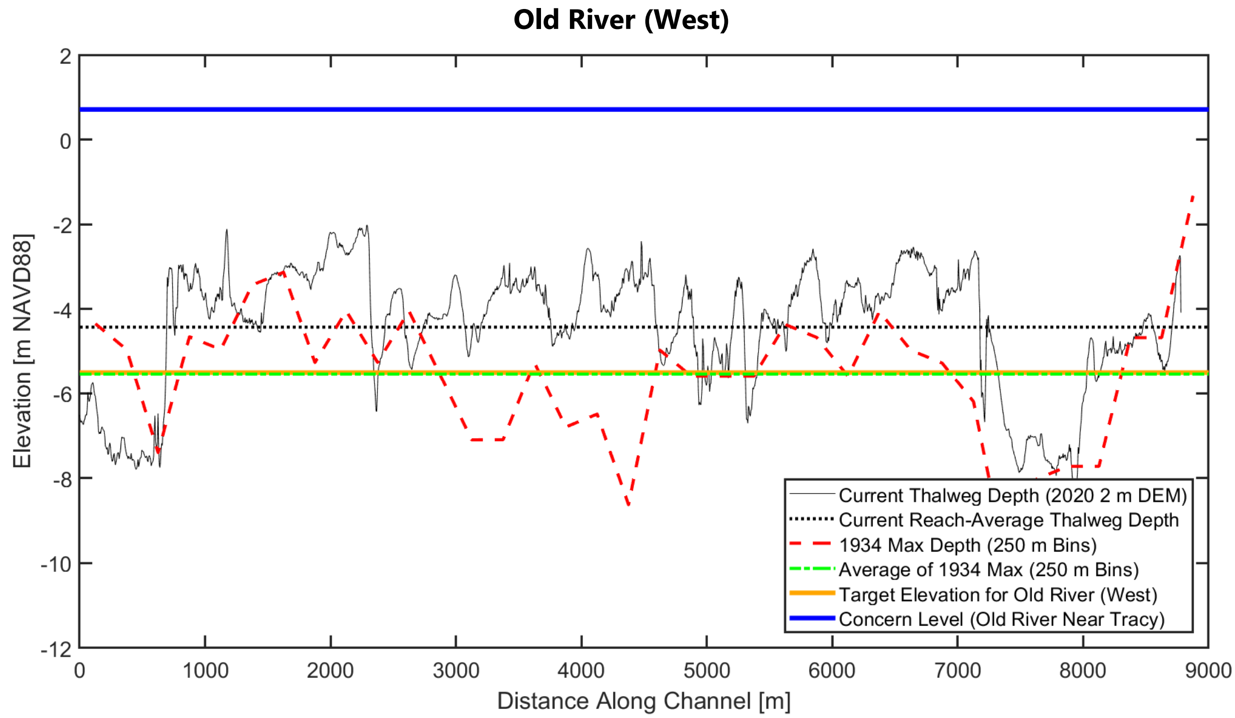


Figure 4-3 (cont.)

Primary Channel Target Elevation Determination



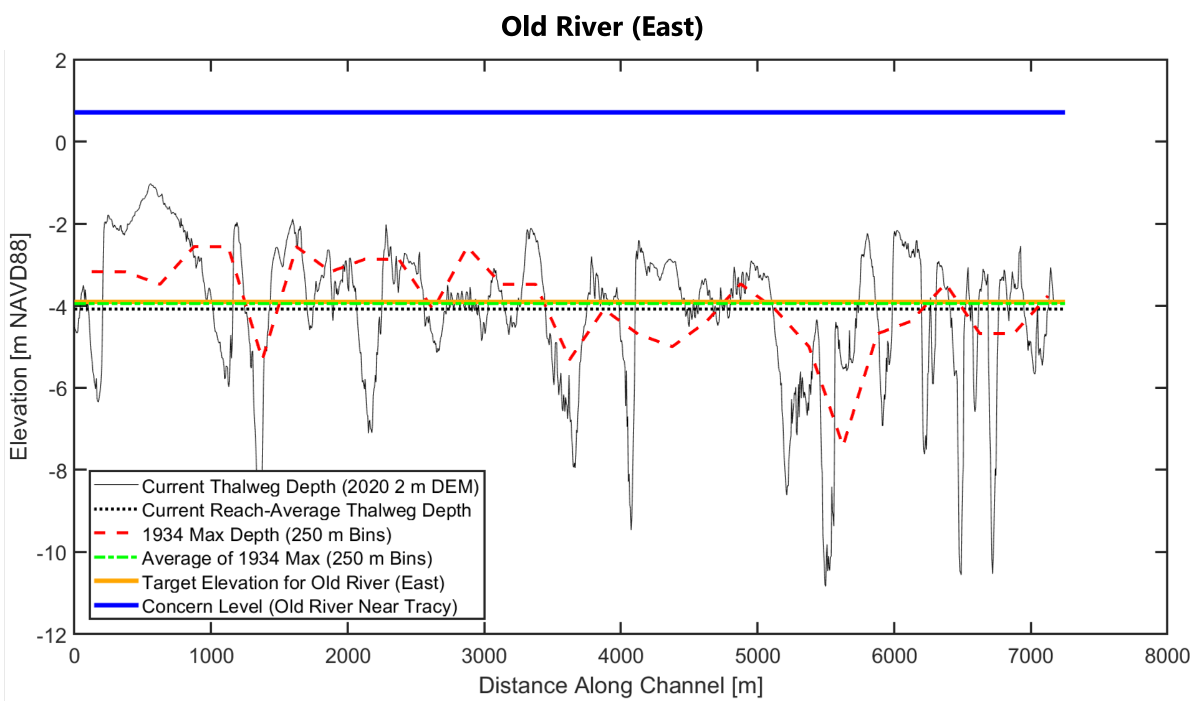
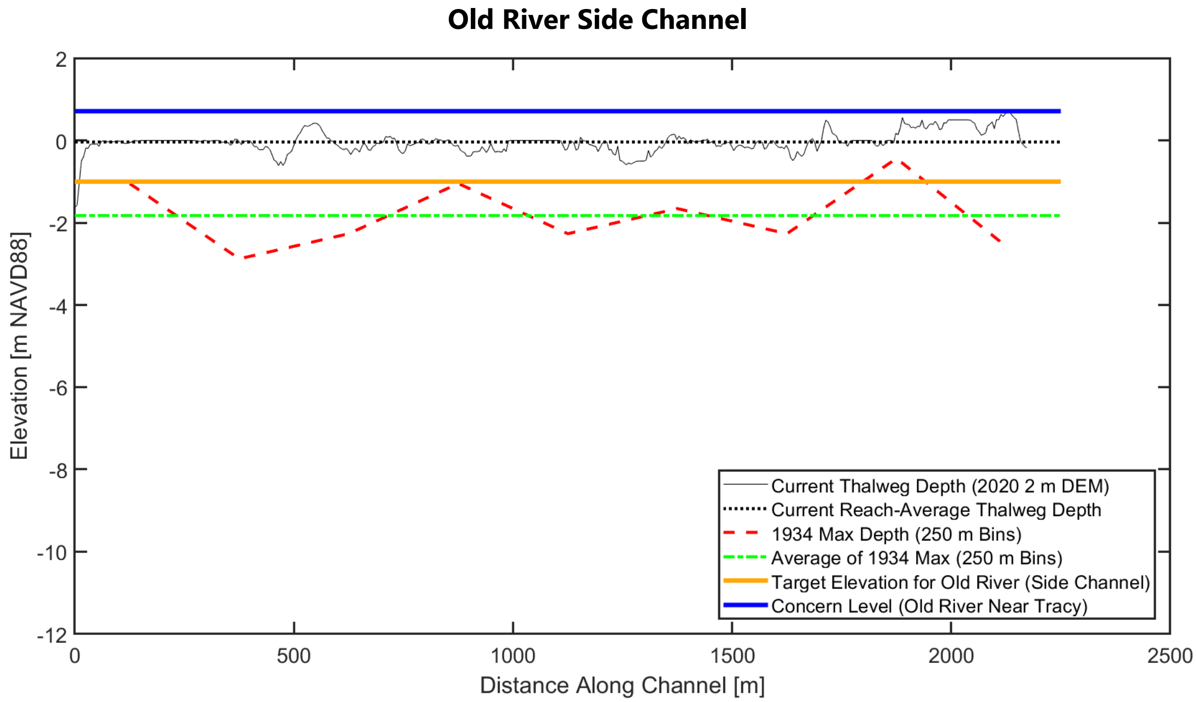


Figure 4-3 (cont.)

Primary Channel Target Elevation Determination



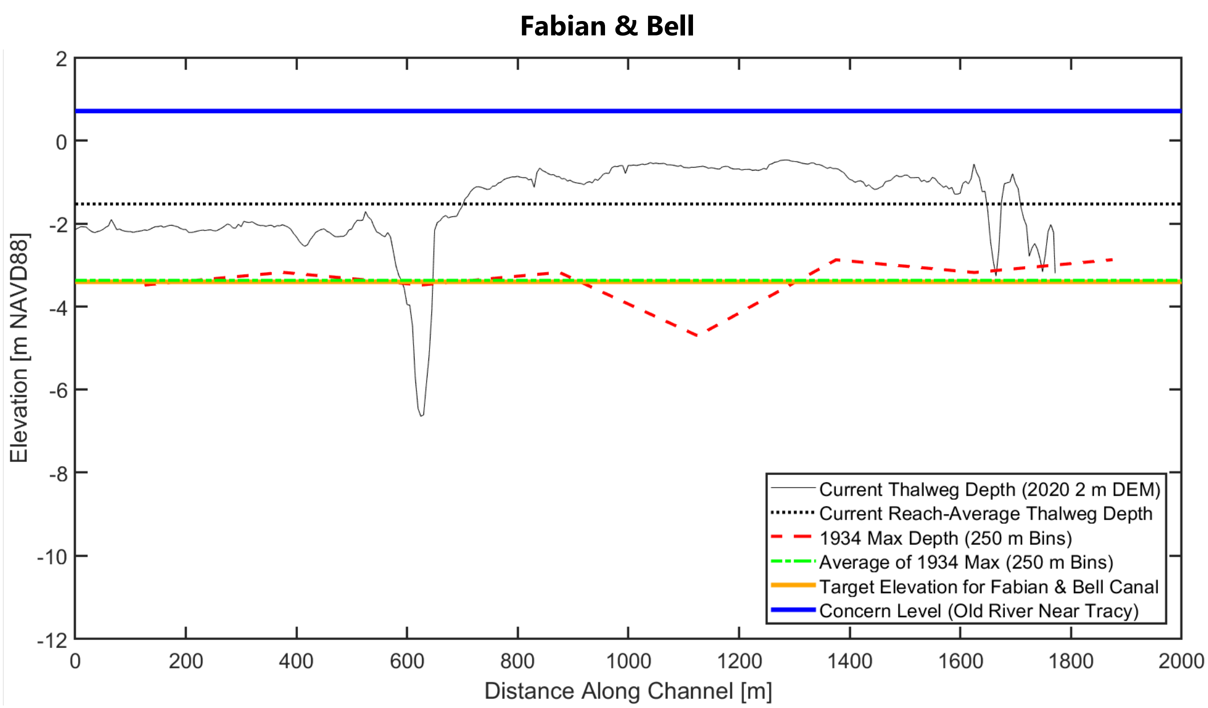
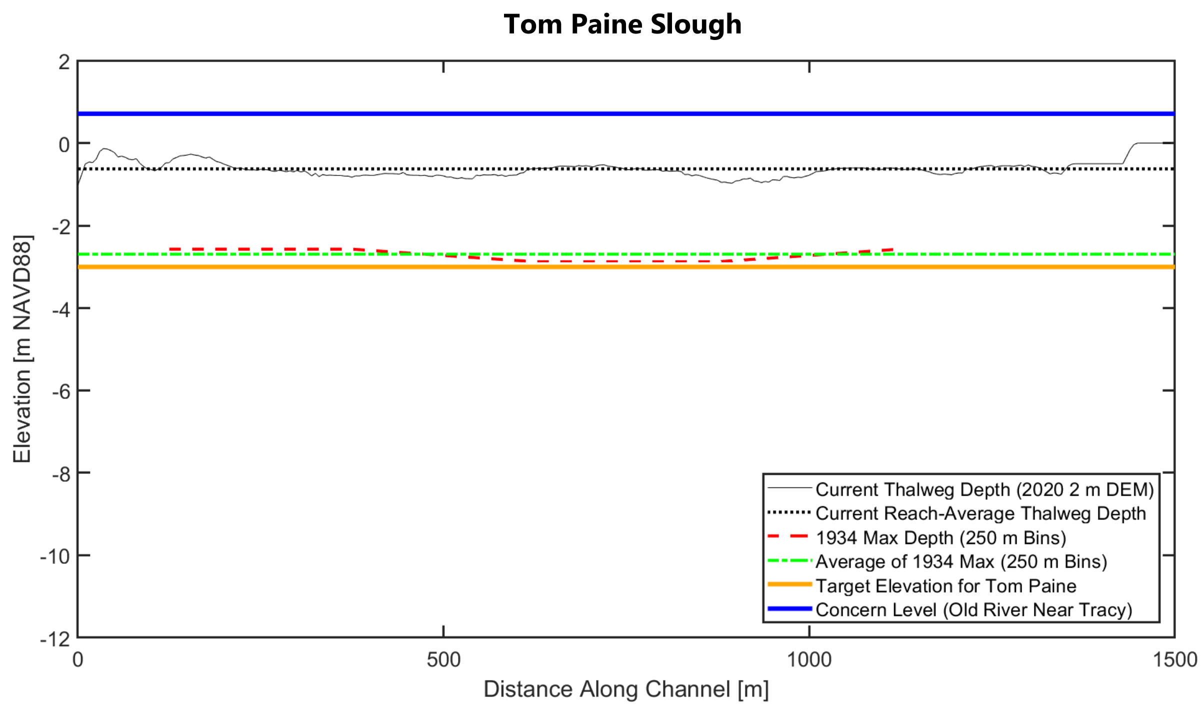


Figure 4-3 (cont.)

Primary Channel Target Elevation Determination



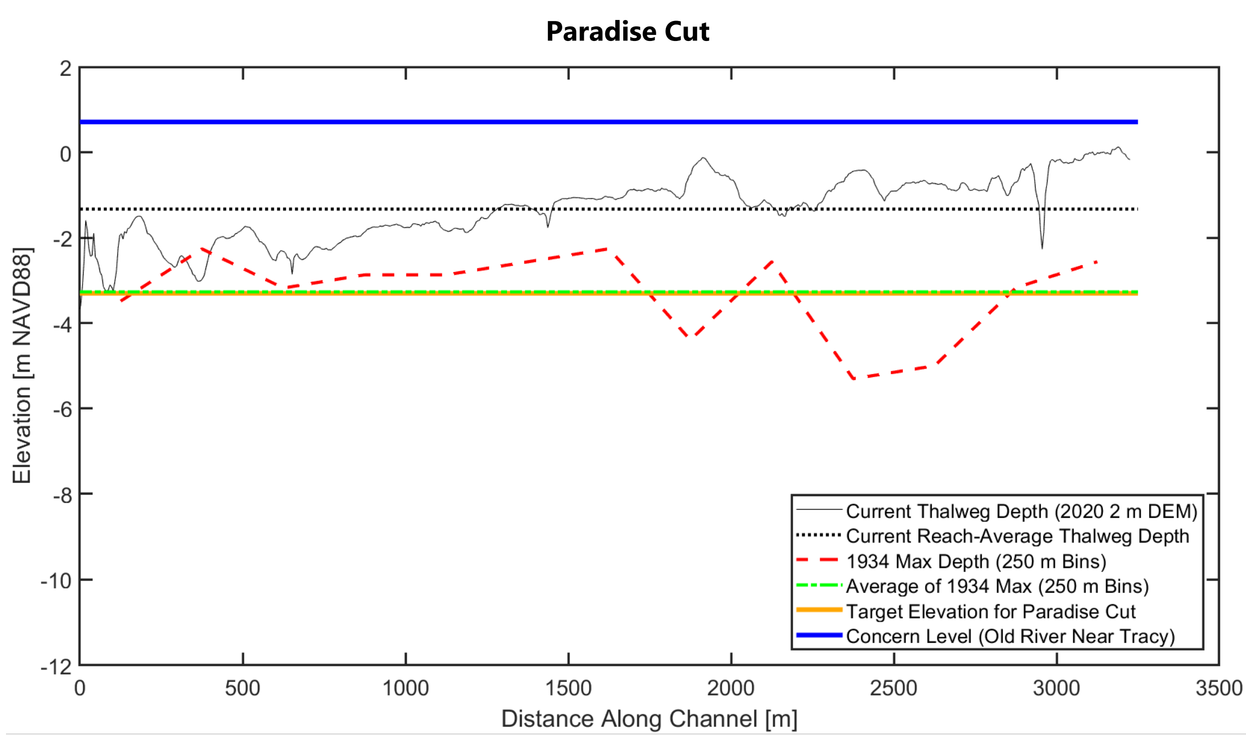


Figure 4-4
Minimum and Maximum Channel Width – Tom Paine Slough Example

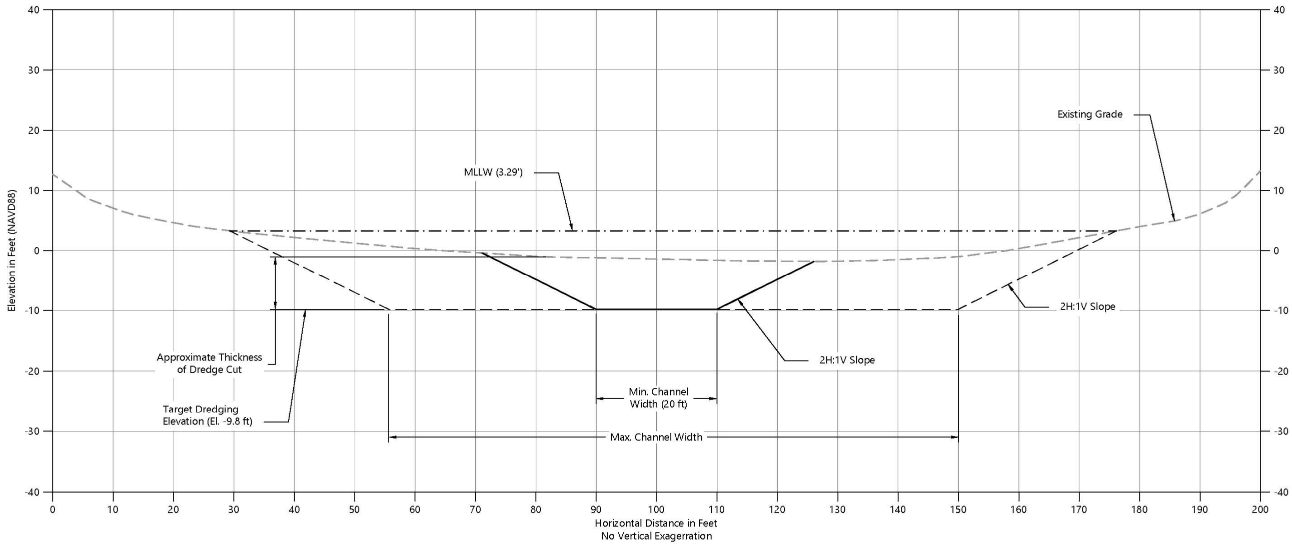


Figure 5-1
Potential Permanent Placement Sites (Active or Planned)

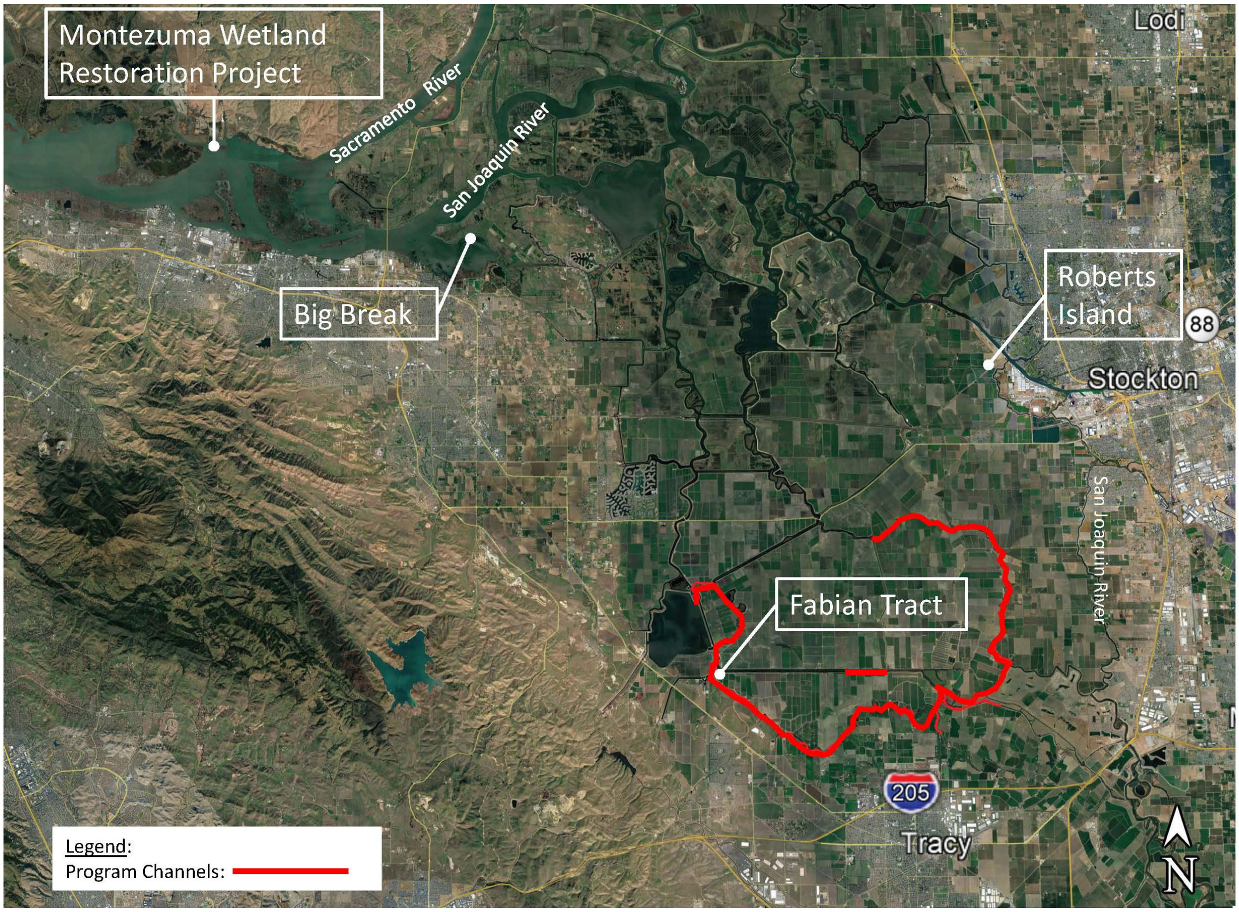


Figure 5-2
Potential Temporary Processing Sites (Private Land)

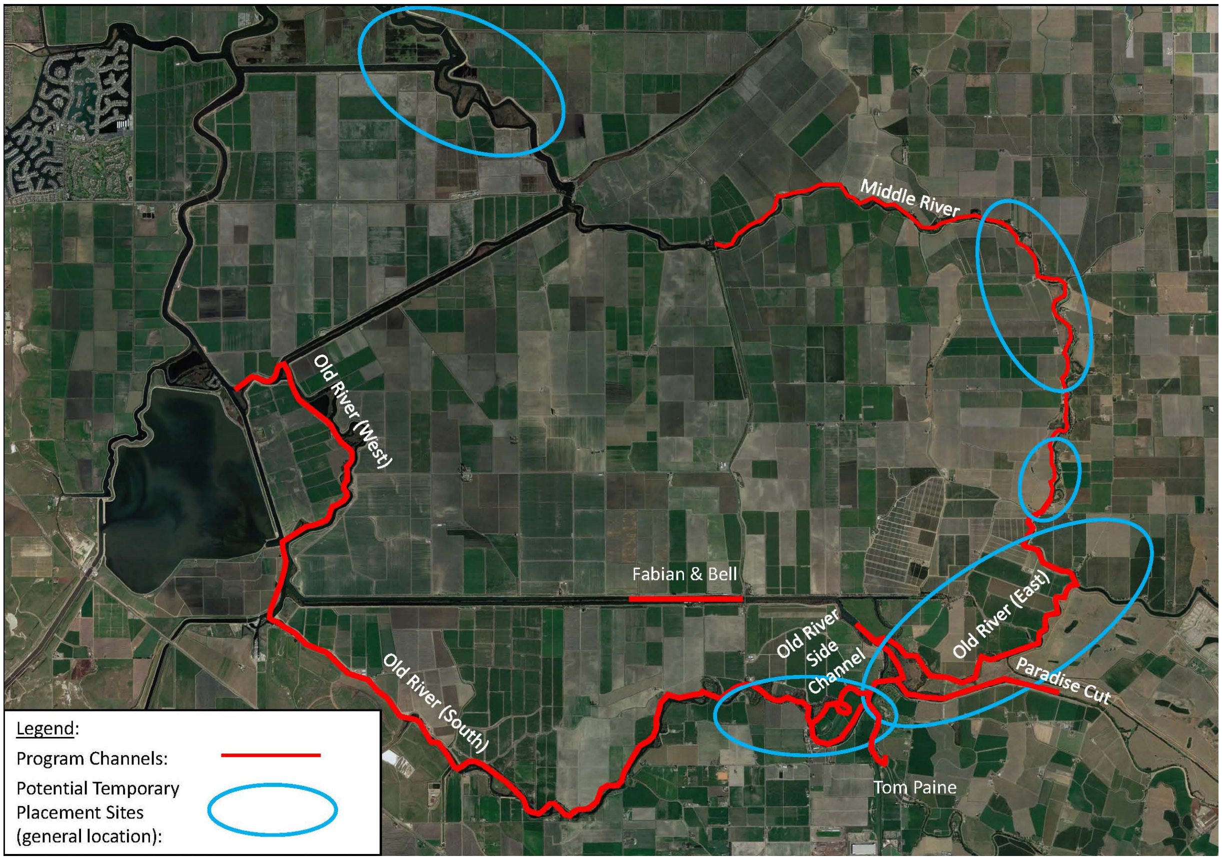


Figure 6-1
Anticipated Sequencing and Timeline for CEQA Compliance Process

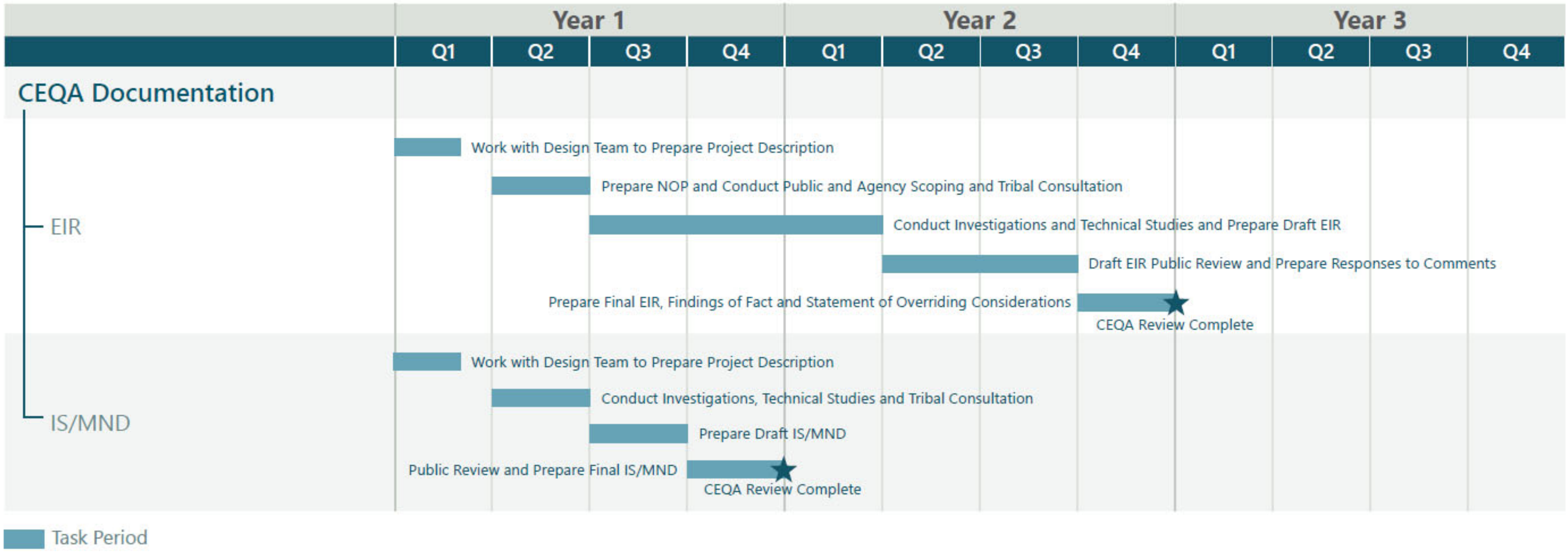
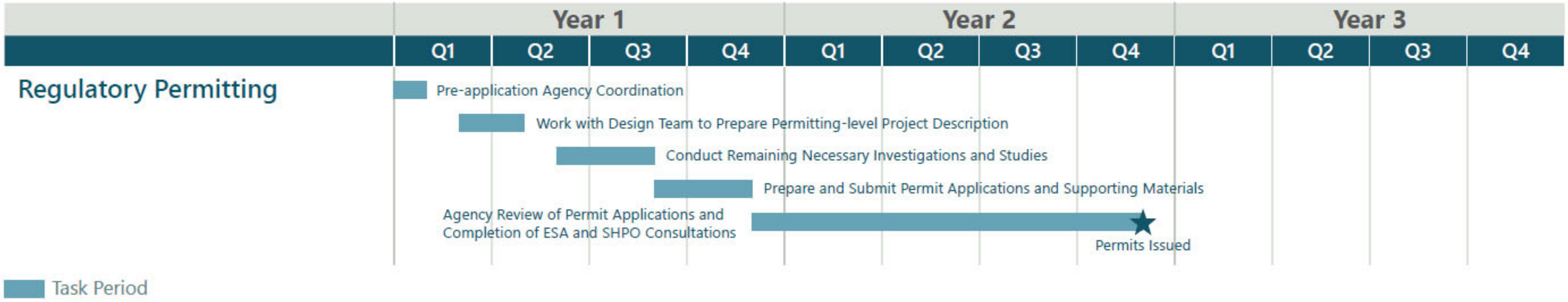


Figure 6-2
Anticipated Sequencing and Timeline for Regulatory Permitting



Appendix A
Historical Literature and Data Reference Detailed List

South Delta Channels Depth Restoration Planning Guide
Reference Document & Data Log
Current 11/29/2021

Item	From Entity	Contact	Document/File Name	Date Provided	Provided via:	Related to	Details
1	Working Group	Jacob McQuirk	diff_dem_noaa1934.png	11/20/2010	email	Hydraulics	Map comparing 1934 NOAA soundings with the latest DEM.
2	Working Group	Jacob McQuirk	Crosssection Plots.pdf	11/10/2020	email	Hydraulics	Cross-sections of 1934 vs. recent bathy with lowest elevation that allows for full agricultural diversions.
3	Working Group	Jacob McQuirk	Old River Cross Sections.pdf	11/10/2020	email	Hydraulics	Cross-sections of 1934 vs. recent bathy with lowest elevation that allows for full agricultural diversions.
4	Working Group	Jacob McQuirk	Middle River Cross Sections.pdf	11/10/2020	email	Hydraulics	Cross-sections of 1934 vs. recent bathy with lowest elevation that allows for full agricultural diversions.
5	Working Group	Karen Tolentino	noaa_1934_pts_sel_poly_mod_buf2m_mod.zip	2/18/2021	email	Hydraulics	Zip containing the shapefile for the 1934 NOAA soundings.
6	Working Group	Karen Tolentino	NOAA1934Data_forAnchor.gdb20210226	2/24/2021	SharePoint	Hydraulics	Zip contains 1934 NOAA points and approximate 1934 channel polygon (data provided by Rueen-Fang Wang, mapped by Karen).
7	Working Group	Gilbert Cosio	Driftwood Marina Maintenance Dredging Project (w_figs) 2002-09.pdf	3/4/2021	email	Regulatory (chemistry)	Sediment sampling and testing report.
8	Working Group	Gilbert Cosio	Elliott Pump Maintenance Dredging Project 2005-03-10.pdf	3/4/2021	email	Regulatory (chemistry)	Sediment properties and chemistry.
9	Working Group	Karen Tolentino	DWR_SingleAndMultibeamBathymetryData.zip -BathymetryIndex.gdb -Multibeam Bathymetry -Singlebeam Bathymetry	3/10/2021	SharePoint	Hydraulics	2011 to 2018 data for Old River, Victoria Canal, West Canal, Fabian Bell Canal, Grant Line Canal, and Middle River: • Bathymetry index showing locations and other information • Multibeam bathymetry data (tiff format) • Single beam bathymetry data (point feature classes)
10	Working Group	John Herrick	1980 Report 1st half.pdf	3/11/2021	SharePoint	Hydraulics	Effects of the CVP on Southern Delta water supply.
11	Working Group	John Herrick	1980 Report 2nd half.pdf	3/11/2021	SharePoint	Hydraulics	Effects of the CVP on Southern Delta water supply.
12	Working Group	Anna Hegedus	SDIP ASIP (May 2005).pdf	3/23/2021	email	Regulatory (CEQA/permits)	SDIP action specific implementation plan (biological assessment)
13	Working Group	John Herrick	SDWA Old River Bathymetry	3/30/2021	SharePoint	Hydraulics	2018 and 2020 bathymetric data from Old River
14	Working Group	John Herrick	SDWA Sediment Sampling Results	3/30/2021	SharePoint	Regulatory (chemistry)	2021 Old and Middle River physical and chemical testing results
15	Working Group	Jacob McQuirk	LICENSE EXTENSION - Holderman ROW DWR 12-LC-20-0054	4/30/2021	email	Real Estate	DOI License for DWR access to Fabian Tract
16	Working Group	Anna Hegedus	Appendix A. Delta Levees Maintenance Subvention Program (Levee Stan	6/10/2021	email	Dredging Methodology	DWR Delta Levees Maintenance Subvention Program - Delta levee standards
17	Working Group	Anna Hegedus	RECIRC_2646_ATT 3.pdf	6/10/2021	email	Dredging Methodology	Sacrament Delta San Joaquin Atlas 1995
18	Working Group	Karen Tolentino	Project_Nonproject_Levees.pdf	6/11/2021	email	Dredging Methodology	Map of project/nonproject levees.
19	Working Group	Thomas Burke	MLLW Delta Map.pdf	6/17/2021	email	Dredging Methodology	Grain size curves for each of the sediment sampling sites in SDWA Sediment Sampling Results (2021)
20	Working Group	Thomas Burke	Grain Size Distribution For Sediment Sampling Sites.pdf	6/17/2021	email	Dredging Methodology	Map with mean water level and mean lower low water level for various locations in the south delta.