State and Federal Contractors Water Agency

CONTRACT DOCUMENTS

For

TULE RED TIDAL RESTORATION PROJECT
HABITAT RESTORATION AND EARTHWORK PHASE 1

Volume 3 of 3

For Re-Bid

Solano County, California

July 11, 2016

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STATE AND FEDERAL
CONTRACTORS WATER AGENCY

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TULE RED TIDAL RESTORATION PROJECT
HABITAT RESTORATION AND EARTHWORK PHASE 1

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ATTACHMENTS

Volume 3 (on CD)

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GEOTECHNICAL INVESTIGATION

TULE RED
SOLANO COUNTY, CALIFORNIA

Project No. 816.01
December 22, 2015

Prepared by

Hultgren – Tillis Engineers

A California Corporation
Specializing in Geotechnical Engineering

Hultgren-Tillis Engineers

December 22, 2015
Project No. 816.01

Westervelt Ecological Services, LLC
600 North Market Boulevard, Suite 3
Sacramento, California 95834

Attention: Mr. Mark Young

Geotechnical Investigation
Tule Red
Solano County, California

Dear Mr. Young:

We performed a geotechnical investigation for levee rehabilitation and grading for the Tule Red project in accordance with the proposal and Service Agreement dated May 7, 2014. The results of the investigation are presented in the attached report.

It was a pleasure working with you on this project and we look forward to working with you during construction. If you have any questions, please call.

Sincerely,

Hultgren – Tillis Engineers

Gregory R. Olsen
Civil Engineer

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I. INTRODUCTION

This report presents the results of our geotechnical investigation for the Tule Red project in Solano County, California. The project consists of converting the existing parcel into a tidal marsh. The existing property is used primarily as a duck club. The parcel will be more directly connected to Grizzly Bay by breaching a phragmites berm to the west of the site adjacent to the bay and excavating a channel within the parcel. Adjacent parcels will be protected from the tidal water by an existing levee located on the perimeter of the parcel. The material excavated from the channel excavation will be used to fill a ditch located near the toe of the levee and also to buttress the levee. The focus of our work is on a portion of the existing perimeter levee, grading for the channels, and disposal of the excavated material from the channel. The levee reach is shown on Plate 2 and extends from Station 0+00 to Station 151+35.

The Tule Red property and the surrounding areas are shown on the Vicinity Map, Plate 1 and Site Plan, Plate 2. The elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD88).

Our scope of services was outlined in our proposal dated May 7, 2014. Our scope of services consisted of reviewing available geotechnical data, exploring site conditions, performing engineering analysis, and developing conclusions and recommendations regarding geotechnical aspects of the project. The results of our geotechnical investigation are presented in this report.

II. FIELD EXPLORATION AND LABORATORY TESTING

We explored subsurface conditions beneath the existing levee by drilling eleven borings with a hollow stem auger on July 8 through July 10, 2014. We explored the subsurface conditions in the areas to be excavated for the new channel by digging nine test pits with a small, track mounted excavator on August 21, 2014. The approximate boring and test pit locations are shown on the Site Plan, Plate 2.

A. Hollow Stem Borings

Our subcontractor drilled the borings through the levee crown with truck-mounted hollow-stem auger drilling equipment to depths ranging from about 30 to 55 feet below the levee crown. We collected samples with a 2.5-inch outside diameter (OD), 1.9-inch inside diameter (ID) split barrel sampler. The sampler was driven with a 140-pound down-hole hammer dropping approximately 30-inches for a penetration depth of up to 18-inches. The down-hole hammer utilized a wire line system. We collected Shelby tube samples with 3-inch OD, 2.87-inch ID thin walled sample tubes. The Shelby tubes were pushed into the ground with hydraulic pressure.

Our engineer logged the borings and recorded blow counts from driving the sampler. We recovered samples from the borings for further visual classification and for selection of materials for laboratory testing. Our engineer used a pocket penetrometer to evaluate unconfined compressive strength or a torvane to evaluate the soil shear strength. The borings were backfilled with grout.

The laboratory testing program consisted of moisture content and dry density measurements, Atterberg limits, No. 200 sieve analysis, unconsolidated-undrained triaxial compression (TxUU), and consolidation tests.

We converted the field penetration resistance obtained while driving the 2.5-inch sampler to equivalent SPT N-values by multiplying by 0.8 to account for sampler size. We did not correct the blow counts for hammer energy. Soil descriptions, equivalent SPT N-values and the laboratory test data are shown on the Logs of Borings in Appendix A, Plates A-1 through A-13. The soil descriptions are presented in general accordance with the Unified Soil Classification System presented on Plate A-23 with laboratory test results presented in the manner described by the Key to Test Data. Atterberg limits test results are shown in Appendix B, Plates B-1 and B-2. Triaxial (TxUU) test results are shown on Plates B-3 through B-5, and Consolidation test results are shown on Plates B-6 through B-9. The moisture content, dry density, and No 200 sieve measurements are presented on the individual boring logs.

B. Test Pits

The test pits were excavated in the existing parcel where the new channel is planned. The test pits were excavated to depths of 7 to 9 feet below existing grade. Our engineer logged the test pits and collected samples for further visual classification and for selection of materials for laboratory testing. The test pits were backfilled with spoils from the test pit excavations and tamped with the excavator bucket. The laboratory testing program consisted of moisture content measurements, Atterberg limits, and No. 200 sieve analysis.

Soil descriptions are shown on the Logs of Test Pits in Appendix A, Plates A-14 through A-22. The soil descriptions are presented in general accordance with the Unified Soil Classification System presented on Plate A-23 with laboratory test results presented in the manner described by the Key to Test Data. Atterberg limits test results are shown in Appendix B on Plates B-10 and B-11. The moisture content and No. 200 sieve measurements are presented on the individual test pit logs.

III. SITE CONDITIONS

A. Regional Geology

The United States Geological Survey (USGS) has published geologic maps for the area (Sims et al. 1973). The portion of the Sims et al. geologic map that includes Tule Red and the geologic descriptions of the map (geology) units are presented on Plate 3. The geology map shows that Tule Red is covered by “unconsolidated silt and clay with admixed abundant organic material; local peat, sand, sand, and gravel lenses or discontinuous beds (Qbm)”.

The present configuration of the San Francisco Bay and Sacramento-San Joaquin River Delta began to form after the last ice age, about 10,000 years ago. During the ice age, sea levels were 200 to 300 feet below present levels. Sea levels rose rapidly for several thousand years then the rate of sea level rise slowed. As sea levels rose, the Bay and Delta were inundated. The rise in sea level led to the accretion of silt and clay particles within Grizzly Bay (mapped as Qbm).

The site is underlain by highly plastic clay and silt known as bay mud, which consists of normally-consolidated or slightly over consolidated, weak, and highly compressible soils. Bay mud typically exhibits low permeability and low shear strength. Bay mud deposits are typically underlain by stronger and less compressible alluvial soils and geologic deposits.

B. Regional Seismicity

The predominant seismic hazard for this site is strong groundshaking resulting from earthquakes. No known active faults pass through the site and we conclude that the risk of fault rupture is low. For use with the 2013 California Building Code (CBC), the proposed site can be classified as Site Class E, a soft soil profile. The major active faults near the site are listed in the following table.

Fault	Distance
Concord - Green Valley	7.5 miles
Cordelia	9.5 miles
Clayton	10 miles
West Napa	15.5 miles
Hayward	21 miles
Rogers Creek	25 miles
San Andreas	40 miles

The following seismic design criteria based on the 2013 CBC can be used for the project. The site coordinates from USGS maps are estimated to be: Latitude 38.12201 and Longitude -122.98137. From the USGS website calculator, the mapped acceleration parameters S_S and S_1 are 1.500 and 0.600, respectively.

Soil liquefaction is a phenomenon in which a loose- to medium-dense saturated granular soil undergoes reduction of internal strength as a result of increased pore water pressure generated by shear strains within the soil mass. This behavior is most commonly induced by strong groundshaking associated with earthquakes.

At our exploration locations, the levee fills are predominately silts and clays. Our preliminary review suggests that most of the levee consists of material that is not expected to liquefy. Silty sand exists within the foundation soil directly beneath the marsh deposits and, where loose, the foundation sand could liquefy due to earthquake shaking. A detailed analysis of seismic risks for the levees has not been performed. The data is limited in extent and not sufficient for a complete analysis or a definitive conclusion on the levees performance should liquefaction occur in the foundation soil.

C. Surface Conditions

Westervelt performed a limited survey of the levee consisting of survey points along the centerline of the levee and occasional cross sections at roughly 500 feet intervals. The survey of the crown centerline indicates that the centerline of the levee varies from about Elevation 7.4 feet to Elevation 13.4 feet (NAVD88) with an average crown centerline of about Elevation 10 feet in the project area. The levee crown width generally ranges from about 12 to

22 feet with an average width of approximately 16 feet. The levee crown is covered with aggregate base or similar material between approximately Stations 86+37 to 151+35. The remainder of the levee crown is covered by vegetation or is bare.

The levee slope on the Tule Red side is generally inclined at between 2H:1V (horizontal to vertical) and 3H:1V with some locations locally as steep as 1.5H:1V and as flat as 4.7H:1V. The levee slope on the side opposite the Tule Red parcel is generally between 2H:1V and 3H:1V with some locations as steep as 1H:1V and as flat as 4.7H:1V. A drainage ditch runs along the toe of the levee along the entire length of the Tule Red parcel and most of the non-Tule Red side. The water level in the ditch fluctuates seasonally with a maximum depth of about 6 feet.

The area to be converted to tidal marsh is currently in use as a duck club. At the southern extent of the project, there is a clubhouse and unpaved parking area adjacent to the levee. The duck club is bounded by man-made levees to the east and a natural berm to the west, adjacent to Grizzly Bay, consisting predominately of phragmites. The phragmites berm has a lower elevation than the man-made levee but is high enough to protect the parcel from much of the tidal fluctuation within Grizzly Bay. A toe ditch on the Tule Red parcel connects to Grizzly Bay southwest of the clubhouse. During periods of high tides and wind conditions, water can overtop the banks of the toe ditch and the phragmites berm and flow into the southern portions of the project area, inundating the southern part of the site with standing water. An approximately 25 acre pond with small islands is located within the project area, approximately 0.3 miles northeast of the clubhouse.

The Tule Red parcel is currently covered with a variety of vegetation, including aquatic grasses, shrubs, and tules. Throughout the site, there are unpaved trails and roads which are accessible by vehicles ranging in size from an ATV to a pickup truck. Surface water levels in the marsh area vary seasonally, with little ponded water outside of the ditch in the summer months, and extensive areas of ponded water during other times.

The typical daily tidal range at Port Chicago, approximately 5 miles southwest of the project site, is from about Elevation 1.1 feet to Elevation 6.0 feet. The 100-year flood level is at Elevation 9.6 feet.

D. Subsurface Conditions

The existing levee consists of fill over marsh deposits. The upper portion of the fill below the levee crown consists of road base gravel (aggregate base or similar material) from approximate Stations 86+00 to 150+00. At the explored locations, the aggregate base layer ranges from 0.3 to 0.7 feet thick. Beneath the aggregate base is a heterogeneous mixture of fill consisting predominately of silt with some locations with elastic silt and fat clay. The silt is generally low plasticity and generally has consistency ranging from stiff to very stiff, with some select zones of soft to medium stiff material. In Boring 4, the fill was predominantly fat clay and in Boring 5, the fill was predominantly elastic silt. The fill thickness varies from about 4.5 to 10.5 feet at the exploration locations. The fill was likely derived from shallow cuts adjacent to the levee.

The fill is underlain by marsh deposits consisting predominately of elastic silt. The base of the marsh deposits range from about Elevation -3.5 feet to Elevation -34.1 feet. The marsh deposits have a very soft to soft consistency and are moderately to highly compressible. The marsh soils contain little to no organics. The marsh deposits are underlain by variable zones of silty sand, clayey sand, sandy silt, elastic silt, and elastic silt with sand. The consistency of the sand is variable and ranges from loose to dense. The consistency of the sandy silt ranges from soft to very stiff and the lower elastic silt layers are generally very soft to medium stiff. An idealized soil profile is presented on Plate 4.

The groundwater level in the borings noted during drilling ranged from 12.3 feet to 25.7 feet below grade. The borings were backfilled immediately after drilling and stabilized water levels were not obtained. The groundwater levels within the site are artificially controlled by evapo-transpiration and pumping.

In the test pits, the soil typically consists of elastic silt, with pockets of fat clay and silt. The soils have varying levels of sand, with some layers having up to 38 percent of coarser material retained on the No. 200 sieve. The moisture contents were significantly wetter than optimum moisture content for compaction.

The above descriptions of soil conditions summarize observations at the time of the investigation. Conditions are expected to vary across the site and with time and depend on several factors including changes in moisture content resulting from seasonal precipitation, irrigation practices, and tides.

IV. DISCUSSION AND CONCLUSIONS

A. Levee Safety Considerations

The existing levee at the perimeter of the Tule Red project does not conform to a specific standard as is typical for the Suisun Marsh levees. Much of the crown of the existing levee is below the 100-year flood level. The Tule Red parcel and parcels further west have routinely flooded and will continue to flood under existing conditions.

An evaluation of overall levee safety and reliability requires consideration of various factors including overtopping from flood stages, seepage through and below the levee, static stability of slopes, settlement and lateral creep deformation of the levee, wind-generated wave run-up, waterside erosion protection, and resistance to earthquake forces. The existing levee was not built to a specific design standard. A complete assessment of the levee is beyond the scope of this study. We understand that the intent for the project is to maintain the current level of protection for this levee. The Tule Red project is not intended to increase the level of flood protection beyond what is currently provided.

Converting the Tule Red parcel to a tidal marsh will cause the Tule Red levee to experience more frequent wetting than the current condition. Currently, higher tides or floods do not necessarily wet the levee because the floods may not overtop the berm or may not last long enough to fill the entire area bounded by the Tule Red levee. After the phragmites berm is breached, the water level in the channels and Tule Red parcel will be directly linked to the water levels in the bay.

We conclude that some rehabilitation of the levee is needed to maintain the existing integrity and reliability of the levee. The intent of the rehabilitation is to provide newly compacted soil against the existing upstream levee slope and to rework some of the existing upstream levee face. The project intends to buttress the existing levee using fill generated from the channel excavation.

We understand that the main purpose of the fill is to create habitat transition zones. The exact configuration has not been established and has gone through several iterations. Placement of this fill on the upstream face of the existing levee will improve the reliability of the levee and meet the need to improve the levee. We have performed analysis of two configurations to develop conclusions on construction sequences and methods and evaluate potential impacts to the levee. We support the concept of a buttress. Although we used two configurations for our analysis, other configurations will provide the needed benefits.

A narrow strip of land is located between Stations 74+00 and 98+00. As an alternative to rehabilitation of the levee between Stations 74+00 and 98+00, a new levee could be constructed to close off the strip. This levee would need a culvert passing through it fitted with either a sluice gate or a flap gate. The culvert would allow for passage of water between the Tule Red property and adjoining property when desired, but the gate would prevent flood water from flowing into the area between the two unbuttressed levees. The new levee will need to be constructed in stages with time between stages to allow for strength gain. We can provide more detailed design procedures when plans are fully developed.

Other configurations could be considered where the buttress does not fit or is not planned such as within the narrow land strip. For these areas, we conclude that the minimum berm shown on Plate 5 should be used to improve the existing levee. The existing crown should be widened at least 5 feet with a slope inclined at 3H:1V or flatter extending to the existing ground surface.

B. Slope Stability and Fill Placement

We have analyzed two configurations based upon two potential slope geometries for creating habitat. A discussion of the slope stability and fill placement analysis and the results are presented in Appendix C.

The marsh soils are weak and deformable. Rapid placement of fill could cause ground movement below the fill and potentially deform the existing levee. Typical practice is to limit the thickness of fill to allow the ground to adjust to the load and the marsh soils to gain strength. We recommend that the initial lift include filling the ditch and placing fill up to 3 feet higher than the top of the ditch. The configurations used in our slope stability analysis are shown on Plates 6 and 7.

We have assumed that the levee crown does not need to be raised. Should fill be required to raise the crown to accommodate future settlement or to maintain the current level of flood protection to the neighbors, we can provide additional criteria. We conclude that up to

12-inches of fill can be placed on the crown during the second phase of filling without performing additional analysis.

C. Settlement and Lateral Deformation

The levee is underlain by compressible marsh deposits. The ground will settle under the weight of new fill. The settlement will be proportional to the fill thicknesses. For each foot of fill, we estimate that 0.2 to 0.3 feet of settlement will occur below the fill. Although no fill is planned on the levee crown, some settling should be expected from placement of the berm, since the stress from the berms will extend to the soil below the levee crest. We estimate that 0.1 to 0.2 feet of crown settlement will occur from placement of the landside berm. If new fill is needed to raise the levee, the settlement below the levee crest will be higher than these values. We estimate that 0.1 to 0.3 feet of settlement will occur for each foot of fill placed on the levee crest.

Ground settlement will occur slowly over many years with the rate of settlement decreasing with time. The design of the habitat berms and levee should account for settlement and changes in elevation with time.

Deformation of the levee can lead to cracking in the levee crown and slopes. Cracks are prevalent throughout the Suisun Marsh and Delta levee system. The cracking is undesirable and, coupled with an inadequate seepage barrier within the levee, will be a continuing concern for the levee. Deformation cannot be avoided and cracking should be expected.

D. Existing Vegetation and Encroachments

As a general practice, trees, brush, heavy vegetation and encroachments located within the footprint of the levee is undesirable. After trees die, the root system decays and may leave a void. The active or decayed root system of a tree could provide a convenient path for seepage to flow through a levee. Trees and other dense vegetation make it difficult to inspect levees and can obscure problems with the levee. The vegetation also makes it difficult to repair or rehabilitate the levee because the vegetation must be removed first. We conclude that trees, dense vegetation, and encroachments should be removed from the footprint of the levee and not be allowed in the future.

E. Borrow Materials / Channel Excavation

The material encountered in the test pits consists predominately of plastic silts and clays. The materials have a high moisture content. The fill will require some drying to adequately handle and place. The fill needs to be dry enough to place in lifts with standard construction equipment once the existing ditch is backfilled. We conclude that the material from the proposed channels is acceptable for use, provided it is dried to a moisture content closer to optimum moisture content and compacted in lifts.

V. RECOMMENDATIONS

A. Levee Configuration

We recommend that the rehabilitated levee have the minimum section shown on Plate 5 where a landside berm is not planned. For rehabilitation with landside berms, typical details are provided on Plates 6 and 7. The current rehabilitation scheme does not include raising the levee crown, however fill may be added to the levee crown if it is determined that the levee crown needs to be raised. Landside slopes should be inclined at 3H:1V or flatter. The fill should be placed in two phases as shown on Plates 6 and 7 where fill thickness exceeds 3 feet. The initial phase should include filling the ditch and placing up to 3 feet of fill above the ditch. The second phase should include placing the balance of the fill.

We recommend that Phase 1 be completed for the entire levee reach before completing Phase 2. This will allow for a period of time between Phase 1 and 2. To facilitate excavation, the material required for Phase 2 could be excavated and stockpiled at the toe of the rehabilitated levee. At a minimum, a waiting period of at least 60 days should occur between Phase 1 and 2.

B. Earthwork

1. Site Preparation

The footprint of the area planned for levee rehabilitation should be cleared and grubbed of surface and subsurface deleterious matter including trees, grasses, and other vegetation. Prior to filling the ditch, the existing vegetation should be removed from the ditch. If practical, the existing water should be partially or completely removed from the ditch.

2. Fill Materials

Fill for the levee should be a soil or soil/rock mixture free of deleterious and organic matter and contain no rocks or hard fragments larger than 6-inches in maximum dimension with less than 15 percent larger than 1-inch in maximum dimension. Fill material should have at least 10 percent fines passing the No. 200 sieve. Based upon our logging of the test pits in the areas planned for channel excavation, we conclude that the material excavated for the proposed channel will be acceptable to use as fill.

Aggregate base should meet the requirements for Caltrans Class 2 aggregate base.

Samples of fill material should be submitted to us for approval before importing to the site.

3. Compaction

Surfaces exposed by stripping or excavation should be scarified to a depth of at least 8-inches. The scarified soil should be moisture conditioned to at least optimum moisture content and compacted to at least 85 percent relative compaction. ASTM test method D-1557 should be used to establish the reference values for computing optimum moisture content and relative compaction.

Fill should be placed in lifts 12-inches or less in loose thickness and moisture conditioned to at least optimum moisture content. Moisture conditioning should be performed prior to compaction. Most of the material excavated from the channel will be significantly wet of optimum moisture content. The contractor should be prepared to aerate each lift of fill and allow for drying time prior to compaction. A disc should be considered for use in breaking up and drying the weak materials. Each lift should be methodically compacted to at least 85 percent relative compaction. A sheepsfoot compactor or equivalent should be used for compaction. Material that fails to meet the moisture or compaction criteria should be loosened by ripping or scarifying, moisture conditioned, and then recompacted. Fill should be placed on horizontal surfaces. The fill should be benched into the existing levee slope to allow recompaction of some of the existing soil and bonding between the existing levee and new fill. The horizontal bench width into the existing slopes should not exceed 5 feet.

On the levee crown and ramps, the upper 6-inches of subgrade should be compacted to at least 95 percent relative compaction and rolled to provide a smooth, non-yielding surface. Subgrade soils should be proof-rolled prior to placing aggregate base. Soft or pumping areas should be aerated or excavated and recompacted.

Aggregate base should be placed in thin lifts no greater than 8-inches in loose thickness and in a manner that avoids segregation, moisture conditioned as necessary, and compacted to at least 95 percent relative compaction.

4. Slopes

Fill slopes should be inclined at 3H:1V or flatter except as noted. Fill slopes should be constructed fat and trimmed back to expose well-compacted fill. The surface of the levee slopes may be turned with a disc or similar cultivation equipment to loosen the material for vegetation growth. Trees, bushes, and brush should not be allowed within the footprint of the levee slopes.

C. Geotechnical Services During Construction

Before construction, we should review project grading plans and specifications for conformance with the intent of our recommendations. During construction we should observe and/or test the geotechnical aspects of grading including but not limited to subgrade preparation, placement and compaction of fill, and finish grading. If conditions are encountered during construction that are not consistent with those described herein, we should be contacted to review our recommendations and provide alternatives, if appropriate.

REFERENCES

REFERENCES

California Department of Water Resources. 2013. Draft 1 Guidance Document for Geotechnical Analyses, Version 13 Draft 1, July 2013.

Idriss, I.M., and Ross W. Boulanger, R.W. 2008. Soil Liquefaction During Earthquakes, Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, California.

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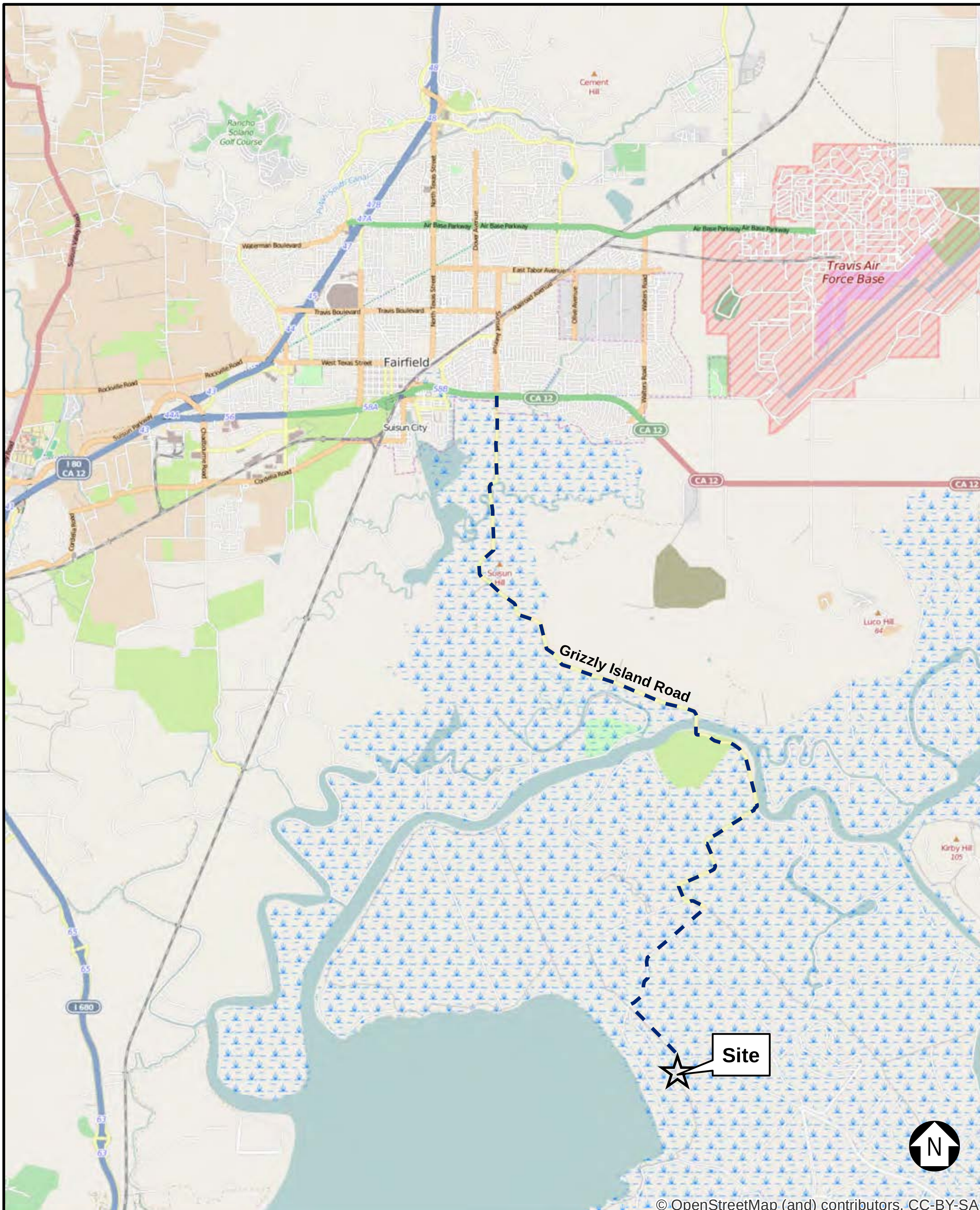
Sims, J.D., Fox, K.F., Bartow, J.A., and Helley, E.J., 1973, Preliminary Geologic Map of Solano County and Parts of Napa, Contra Costa, Marin, and Yolo Counties, California: USGS, Miscellaneous Field Studies Map MF-484.

PLATES



Tule Red Solano County, California	**Vicinity Map**

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 1

Approximate Location of Boring

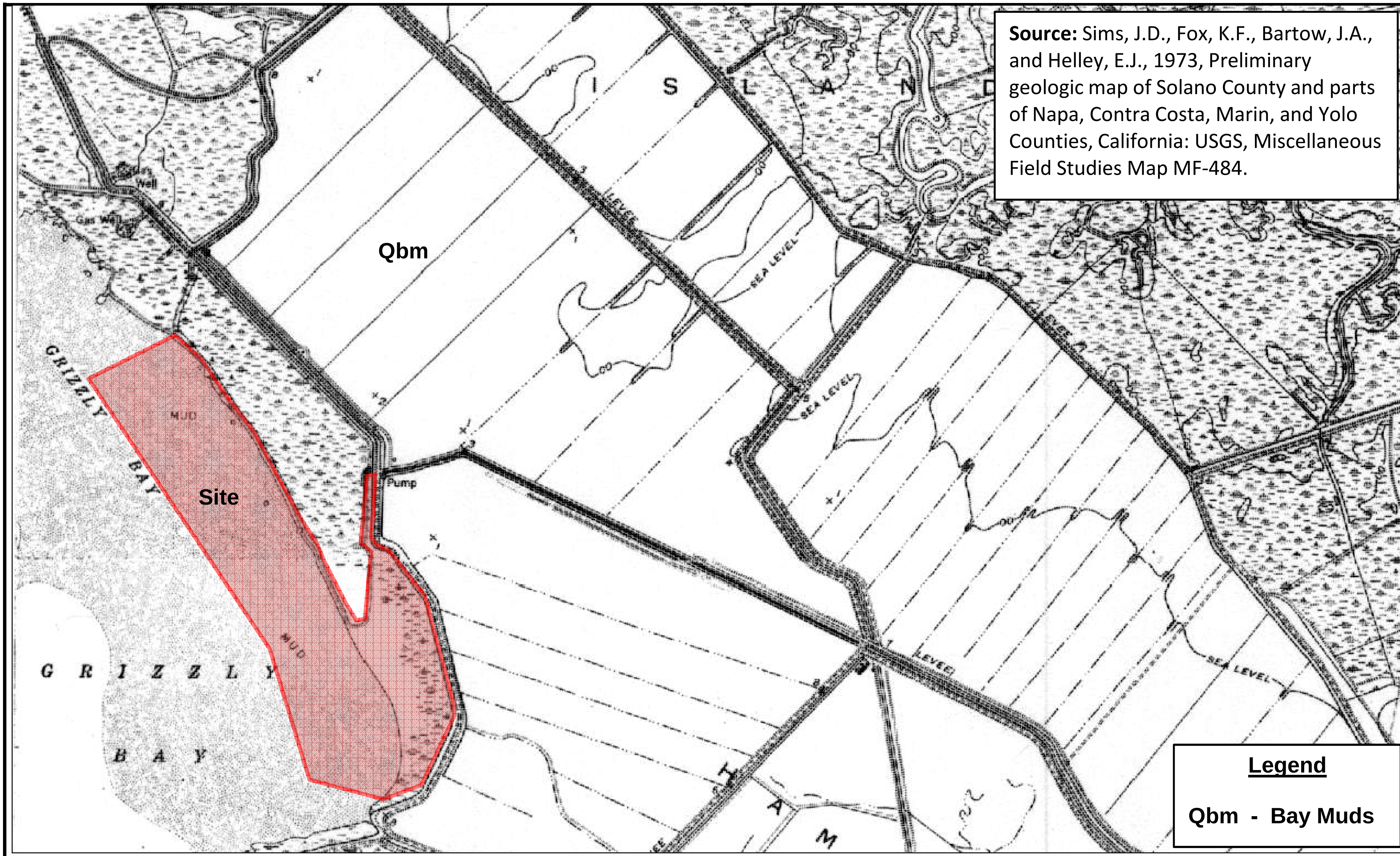
Approximate Location of Test Pit

N

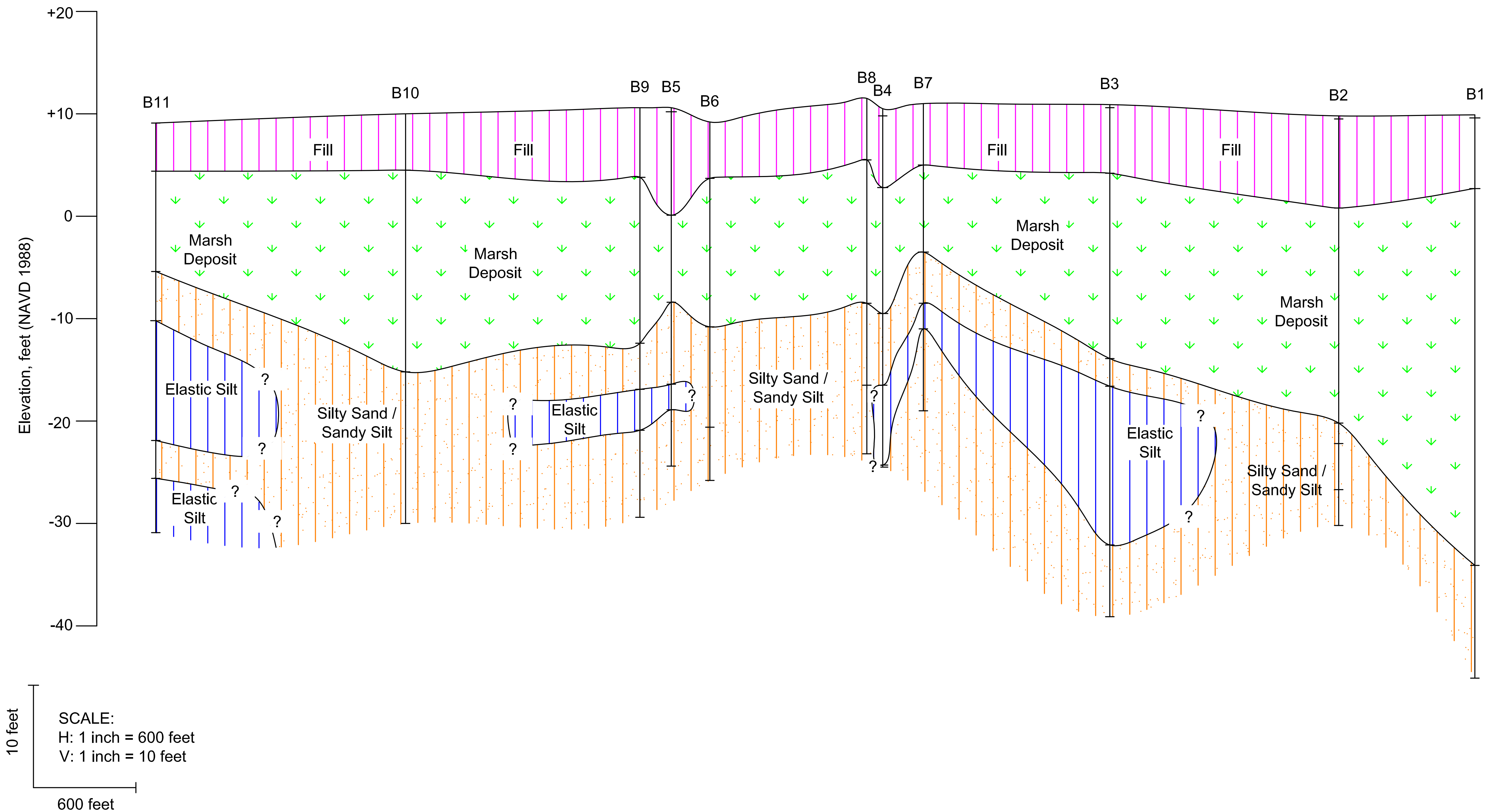
0 1,000 Feet

1 inch = 1,000 feet

Tule Red Solano County, California		**Site Plan**
Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 2



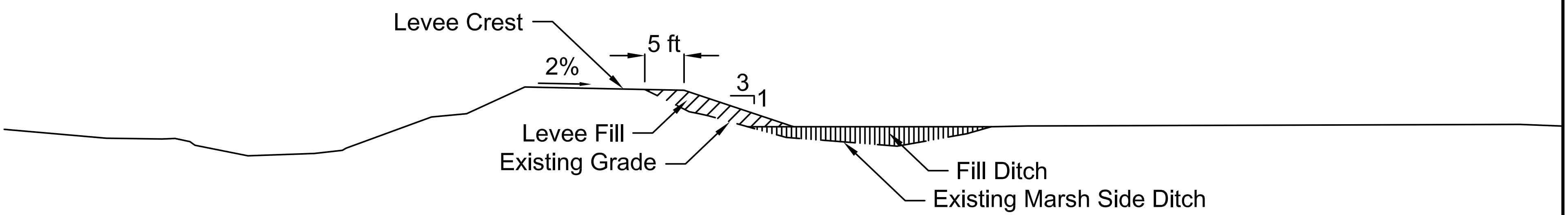
Tule Red Solano County, California	**Geologic Map**	
Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 3



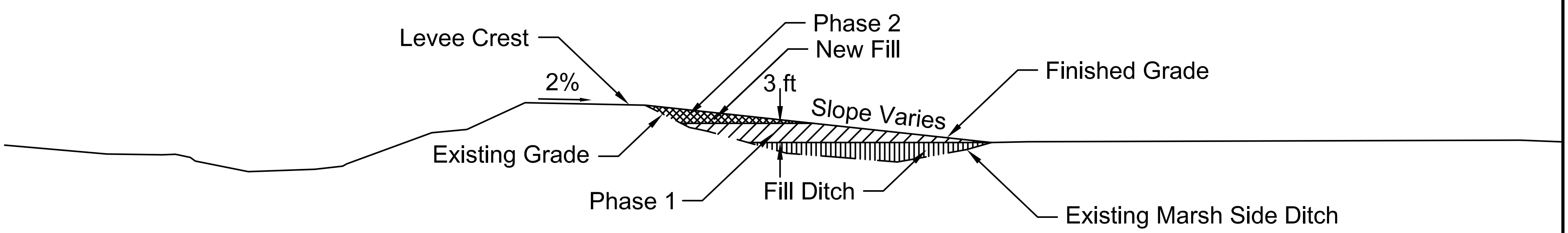
SCALE:
H: 1 inch = 600 feet
V: 1 inch = 10 feet

Tule Red Solano County, California	**Idealized Subsurface Cross Section A-A**

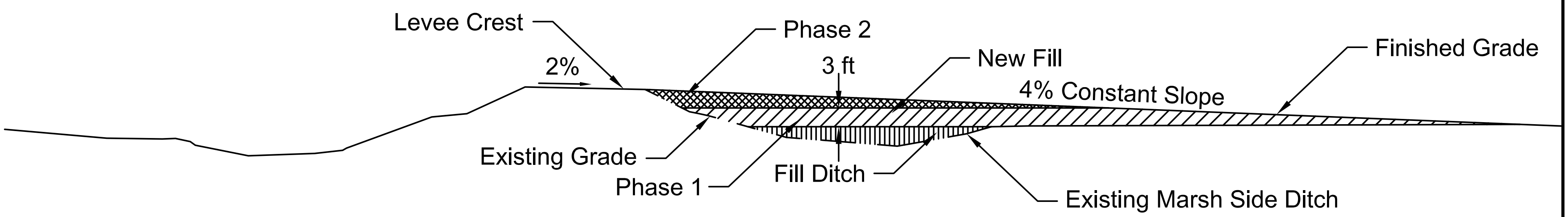
Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 4



Not to Scale	Tule Red Solano County, California	**Minimum Levee Buttress**	
	Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 5



Not to Scale	Tule Red Solano County, California	**Configuration 1**	
	Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 6



Not to Scale	Tule Red Solano County, California	**Configuration 2**	
	Hultgren - Tillis Engineers	Project No. 816.01	Plate No. 7

APPENDIX A

LOGS OF BORINGS AND TEST PITS

Date	: 7/8/2014
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 9.9 (NAVD88)
Latitude	: 38.11419
Longitude	: -121.97894

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				SW		Well-Graded Sand with Gravel (SW), gray, dry, dense, (fill)					
	M	11						1.3			
						Silt (ML), gray brown, moist, stiff, (fill)					
				ML							
5	M	5				Soft to medium stiff		0.8 0.5	37	80	LL=45 PI=7
	M	3					0.3 0.2		52	69	
				ML		Silt (ML), olive gray to dark gray, wet, soft Soft to medium stiff					
10	M	2					0.8	0.9	71	58	
				ML		Silt with Sand (ML), dark gray, poorly graded, fine grained sand, wet, medium stiff					
						Elastic Silt (MH), dark gray, wet, very soft to soft					
15	T						0.1		62	63	TxUU=562
20	M	2					0.1		55	66	
25	M	3				Very soft to soft, trace fine sand	0.3 0.2				LL=81 PI=43
					∇	7/8/2014 Saturated					
				MH							
30	M	3					0.2 0.2		60	64	
35	T						0.1		65	60	Consol
40	M	3					0.2 0.1		74	55	
				SM		Silty Sand (SM), dark gray, saturated, medium					

Tule Red
Solano County, California

Log of Boring 1
(Page 1 of 2)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-1

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 7/8/2014 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 9.9 (NAVD88) Latitude : 38.11419 Longitude : -121.97894 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	M	25				dense		0.8			-200=24
50	M	17		SM							
55	M	28						1.4 1.5	28	93	

Bottom of boring at 55 feet
Groundwater encountered at 25.8 feet during drilling

Tule Red
Solano County, California

Log of Boring 1
(Page 2 of 2)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-2

Date : 7/8/2014
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 9.8 (NAVD88)
Latitude : 38.11735
Longitude : -121.97695

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				SW		Well-Graded Sand with Gravel (SW), gray, dry, dense, (fill)					
	M	9				Silt (ML), brown, moist, stiff, (fill)		1.8 1.3 2.8	29	83	
5	M	6		ML							
	M	3						0.7	52	70	
10	M	2				Elastic Silt (MH), dark gray, wet, soft With trace peat	0.2 0.2	1.4	74	56	
15	T						0.2		56	67	TxUU=686
20	M	2		MH	▽	7/8/2014 Very soft to soft Saturated	0.2				
25	M	4				With sand and shell pieces	0.1 0.2		73	57	
30	T			SM		Silty Sand (SM), dark gray, saturated, medium dense to dense		0.7			
35	M	18		ML		Sandy Silt (ML), dark gray, saturated, medium stiff					
40	M	24		SM		Silty Sand (SM), dark gray, saturated, medium dense			32	86	-200=20

Bottom of boring at 40 feet
Groundwater encountered at 18.7 feet during drilling

Tule Red
Solano County, California

Log of Boring 2
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-3

Date	: 7/8/2014
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 10.9 (NAVD88)
Latitude	: 38.12104
Longitude	: -121.97782

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
			SW		Well-Graded Sand with Gravel (SW), gray, dry, dense, (fill)					
	M	9	ML		Silt (ML), olive brown, moist, stiff, (fill)		2.0 1.5	23	81	LL=36 PI=2
	M	3					1.0 1.5	43	77	
5										
	M	2			Medium stiff	0.2	0.7 0.5 0.8	51	71	
			MH		Elastic Silt (MH), mottled black and gray, wet, soft					
10	T					0.2		67 53	58 70	TxUU=583 Consol
	M	1				0.1		67	60	
15			OH		Organic Silt (OH), dark gray, wet, very soft	0.1				
20	T		ML		Sandy Silt (ML), dark gray, wet, very stiff		2.3			
	M	6			(Soft) 7/8/2014	0.1				
25			ML	▽	Silty Sand (SM), dark gray, wet, medium dense	0.1				
			MH		Elastic Silt (MH), dark gray, saturated, soft					
30	M	5				0.2 0.2				LL=75 PI=33
35	M	9			Trace sand	0.2		46	73	
40	M	5				0.2				
	M	12	SM		Silty Sand (SM), dark gray, saturated, medium dense			28	96	

Tule Red
Solano County, California

Log of Boring 3
(Page 1 of 2)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-4

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 7/8/2014 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 10.9 (NAVD88) Latitude : 38.12104 Longitude : -121.97782 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
50	M	40		SM		Dense					

Bottom of boring at 50 feet
Groundwater encountered at 25.5 feet during drilling

Tule Red
Solano County, California

Log of Boring 3
(Page 2 of 2)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-5

Date : 7/9/2014
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 10.5 (NAVD88)
Latitude : 38.12444
Longitude : -121.97964

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
			SW		Well-Graded Sand with Gravel (SW), gray, dry, dense, (fill)					
	M	8			Fat Clay (CH), gray brown, moist, very stiff, (fill)		4.5+			
5	M	3	CH		Medium stiff to stiff		1.5 1.0	48	71	LL=63 PI=33
	M	3					0.8 1.0	49	72	
					Elastic Silt (MH), gray, moist to wet, soft					
10	T					0.2	0.7			
15	M	2	MH			0.2 0.1		65	61	LL=58 PI=22
20	T							48	73	TxUU=534
					Silty Sand (SM), gray, medium to coarse grained sand, wet, medium dense					
				▽	7/9/2014					
25	M	15	SM		Saturated			29	94	-200=20
					Sandy Elastic Silt (MH), gray, saturated, soft					
30	M	13	MH			0.2 0.2				
	M	17				0.2		58	65	
35			SM		Silty Sand (SM), gray, fine grained sand, saturated, medium dense	0.2	1.5			

Bottom of boring at 35 feet
Groundwater encountered at 23.2 feet during drilling

Tule Red
Solano County, California

Log of Boring 4
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-6

Date	:	7/9/2014
Drilling Method	:	Hollow-Stem Auger
Elevation (Feet)	:	10.6 (NAVD88)
Latitude	:	38.12750
Longitude	:	-121.98140

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				SW		Well-Graded Sand with Gravel (SW), gray, dry, dense, (fill)					
	M	6		ML		Silt with Sand (ML), gray brown, moist, stiff to very stiff, (fill)		2.0 2.6	30	71	
	M	5						1.7			
5				MH		Elastic Silt (MH), light brown, moist, stiff to very stiff, (fill)					
	M	2				Soft Peaty	0.2 0.2		51	71	LL=54 PI=19
	M	2						0.8			
10				ML		Silt with Sand (ML), gray, wet, medium stiff, (fill)					
						Elastic Silt (MH), dark gray, wet, very soft					
	M	2		MH			0.1 0.1		74	57	
15											
	T					Silty Sand (SM), dark gray, wet, medium dense					
20					∇	7/9/2014					
				SM							
	M	6				Saturated	0.2		30	94	
25											
				MH		Elastic Silt (MH), dark gray, saturated, soft					
	M	8					0.2				
30						Silty Sand (SM), dark gray, saturated, medium dense					
				SM							
	M	11									
35											

Bottom of boring at 35 feet
Groundwater encountered at 21 feet during drilling

Tule Red
Solano County, California

Log of Boring 5
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. A-7

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
					Date : 7/9/2014 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 9.2 (NAVD88) Latitude : 38.12664 Longitude : -121.98188					
			ML		Silt (ML), yellow brown, moist, stiff, (fill)					
	M	4					1.3	67	56	
5	M	5		▽	Soft 7/9/2014	0.1	0.7	41	80	
			ML		Silt (ML), dark gray, wet, very soft to soft	0.2 0.1				
	M	2								
10	T					0.2		56	68	LL=37 PI=NP TxUU=607
15	M	2				0.1 0.1		69	59	
			MH		Sandy Elastic Silt (MH), dark gray, saturated, medium stiff					
20	T									
			SM		Silty Sand (SM), black, saturated, medium dense		1.0			
25	M	13						26	97	-200=18
			SM		Silty Sand (SM), dark gray, saturated, medium dense					
30	M	12								-200=40
			ML		Sandy Silt (ML), dark gray, saturated, stiff					
35	B	9								

Bottom of boring at 35 feet
Groundwater encountered at 12.5 feet during drilling

Tule Red
Solano County, California

Log of Boring 6
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-8

Date : 7/9/2014
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 11.0 (NAVD88)
Latitude : 38.12301
Longitude : -121.98153

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Silt (ML), yellow brown, moist, very stiff, (fill)			32	84	
	M	5		ML				3.5			
	M	2						0.8	45	67	LL=40 PI=0
5						Wet, medium stiff	0.2	0.9			
	M	2		MH		Elastic Silt (MH), dark gray, wet, soft to medium stiff	0.2	0.6			
	M	2					0.2				
10						Grades sandier	0.2				LL=34 PI=NP
				ML		Silt with Sand (ML), dark gray, wet, soft					
					▽	7/9/2014					
	T										
15				SM		Silty Sand (SM), dark gray, saturated, loose					
	M	2							73	57	
20				MH		Elastic Silt (MH), dark gray, saturated, soft	0.2	0.4			
				SM		Silty Sand (SM), dark gray, saturated, medium dense					
	M	28									
25						Fine-grained					
	M	18							39	80	
30											

Bottom of boring at 30 feet
Groundwater encountered at 13 feet during drilling

Tule Red
Solano County, California

Log of Boring 7
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-9

Date	: 7/10/2014
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 11.5 (NAVD88)
Latitude	: 38.12332
Longitude	: -121.98346

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Silt (ML), gray brown, moist, very stiff, (fill)					
	M	4		ML				2.3	32	81	
5	M	3						1.2	27	85	
	M	2				Elastic Silt (MH), mottled gray black, wet, soft, trace organics	0.2 0.2		94	46	
10	T						0.2	1.0	49 48	72 73	TxUU=823 Consol
15	M	2		MH			0.1	0.6	57	66	
20	T										
						Sandy Silt (ML), dark gray, wet, stiff		1.8			
25	M	8		ML		Medium stiff		0.6 0.4	45	76	LL=NP PI=NP
						Silty Sand (SM), dark gray, wet, medium dense					
30	M	15		SM							
	M	15		ML		Sandy Silt (ML), dark gray, wet, soft	0.2				
				SM		Silty Sand (SM), dark gray, wet, medium dense					
						Bottom of boring at 34.7 feet					

Tule Red
Solano County, California

Log of Boring 8
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-10

Date	:	7/10/2014
Drilling Method	:	Hollow-Stem Auger
Elevation (Feet)	:	10.6 (NAVD88)
Latitude	:	38.12665
Longitude	:	-121.98562

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	M	4	ML		Silt (ML), yellow brown, moist, stiff, (fill)		1.3 1.6	22	80	
5	M	2			Mottled gray Soft		0.5			LL=39 PI=NP
	M	3			Stiff	0.2	1.2 2.0	54	65	
10	M	3	MH		Elastic Silt (MH), mottled gray black, wet, soft Very soft to soft	0.2 0.1		63	62	
15	T									
			MH		Sandy Elastic Silt (MH), dark gray, wet, very soft to soft			63	62	TxUU=362
				▽	7/10/2014					
20	M	2			Saturated	0.1 0.2		67	60	
25	M	6	SM		Silty Sand (SM), dark gray, saturated, loose		0.8			
30	M	6	MH		Elastic Silt with Sand (MH), dark gray, saturated, soft	0.2 0.2				
35	T		SM		Silty Sand (SM), dark gray, saturated, medium dense					
40	M	12	SM		Silty Sand (SM), dark gray, saturated, medium dense					

Bottom of boring at 40 feet
Groundwater encountered at 16.6 feet during drilling

Tule Red
Solano County, California

Log of Boring 9
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-11

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 7/10/2014 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 10.0 (NAVD88) Latitude : 38.12987 Longitude : -121.98787 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				ML		Silt (ML), yellow brown, moist, stiff, (fill)		1.5			
	M	3									
	M	3				Medium stiff		1.0	48	71	LL=39 PI=2
5											
	M	3		MH		Elastic Silt (MH), mottled gray black, wet, soft	0.3 0.2				
	T										
10									41	79	TxUU=1076
						Sandy					
	M	2					0.2				LL=62 PI=22
15											
	M	4				Very soft to soft	0.2 0.1				
20											
					∇	7/8/2010					
									60 51	65 71	Consol TxUU=577
	T										
25				SM		Silty Sand (SM), gray, saturated, dense					
	M	10									
30											
	M	33							24	100	-200=14
35											
	M	27				Medium dense					
40											

Bottom of boring at 40 feet
Groundwater encountered at 21.8 feet during drilling

Tule Red
Solano County, California

Log of Boring 10
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. A-12

Date	: 7/10/2014
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 9.1 (NAVD88)
Latitude	: 38.13326
Longitude	: -121.99062

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
					Silt with Sand (ML), brown, moist, stiff, (fill)					
	M	4	ML				1.3	30	81	
	M	3	MH				1.2	75	55	
5					Elastic Silt (MH), mottled brown, moist, soft to medium stiff, (fill)	0.2				
					Elastic Silt (MH), dark gray, wet, very soft	0.1				
	M	3								
	M	3	MH			0.2		42	79	
10					Sandier	0.1				
	T							67	61	TxUU=370
15			SM		Silty Sand (SM), gray, wet, loose					
	M	4						57	67	
20					Elastic Silt (MH), gray, wet, soft	0.2				
	M	3		▽	7/10/2014 Very soft to soft					
25			MH			0.2 0.1				LL=96 PI=48
	M	2				0.2		69	58	
30										
			SC		Clayey Sand (SC), gray, saturated, medium dense					
	M	14								-200=25
35					Elastic Silt (MH), gray, wet, very soft					
			MH							
	M	6			Very soft	0.1				
40										

Bottom of boring at 40 feet
Groundwater encountered at 24 feet during drilling

Tule Red
Solano County, California

Log of Boring 11
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. A-13

Date : 8/21/2014
Drilling Method : Test Pit
Elevation (Feet) :
Latitude : 38.13461
Longitude : -121.99252

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Elastic Silt with Sand (MH), brown, moist to wet, medium stiff					
	B							0.5			
				MH		Dark gray, becomes soft					
	B										
	B					Sandy Silt (ML), dark gray, fine grained sand, saturated, stiff					
	B										
				ML							
	B					Becomes soft					
5					▽	8/21/2014					
						Layers of silt and sand					
						Silt (ML), dark gray, saturated, soft					
	B								63		LL=47 PI=19
	B			ML							
	B					Gray					
	B										

Bottom of test pit at 9 feet
Groundwater encountered at 5 feet during excavation
Groundwater encountered at 3 feet after excavation

Tule Red
Solano County, California

Log of Test Pit 1
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-14

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 8/21/2014 Drilling Method : Test Pit Elevation (Feet) : Latitude : 38.13316 Longitude : -21.99106 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B B			MH		Elastic Silt (MH), mottled gray brown, moist, medium stiff, approximately 4-inches of roots and vegetation			109		LL=87 PI=42
5	B B B B B B			MH	▽	Elastic Silt with Sand (MH), dark gray, fine grained sand, wet, soft 8/21/2014			51 68		-200=71 LL=54 PI=24

Bottom of test pit at 8 feet
Groundwater encountered at 3.5 during excavation

Tule Red
Solano County, California

Log of Test Pit 2
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-15

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 8/21/2014 Drilling Method : Test Pit Elevation (Feet) : Latitude : 38.13168 Longitude : -121.98983 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B B B			MH		Elastic Silt (MH), mottled gray brown, wet, soft to medium stiff, approximately 4-inches of roots and vegetation					
5	B B B			MH	▽	Sandy Elastic Silt (MH), dark gray, wet to saturated, medium stiff, slight trickle of water Grades sandier 8/21/2014			42		-200=69
	B			ML		Silt (ML), dark gray, saturated, soft to medium stiff			54		LL=NP PI=NP

Bottom of test pit at 7 feet
Groundwater encountered at 4 feet during excavation

Tule Red
Solano County, California

Log of Test Pit 3
(Page 1 of 1)

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. A-16

Date : 8/21/2014
Drilling Method : Test Pit
Elevation (Feet) :
Latitude : 38.13093
Longitude : -121.98873

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B					Elastic Silt (MH), mottled gray brown, moist to wet, medium stiff, approximately 1 foot of roots and vegetation					
	B			MH					61		LL=52 PI=16
	B										
	B					Sandy Silt (ML), dark gray, wet, medium stiff					
	B			ML					38		-200=62
5	B					Soft to medium stiff					
	B			MH		Elastic Silt (MH), dark gray, wet, medium stiff					
	B			CH		Fat Clay (CH), light gray, wet, soft to medium stiff					

Bottom of test pit at 9 feet
No groundwater encountered

Tule Red
Solano County, California

Log of Test Pit 4
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-17

Date : 8/21/2014
Drilling Method : Test Pit
Elevation (Feet) :
Latitude : 38.12565
Longitude : -121.98544

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B, B			MH		Elastic Silt (MH), brown, moist to wet, soft, approximately 4-inches of roots and vegetation Slight trickle of water					
	B, B			MH		Elastic Silt (MH), dark gray, wet, soft			51		-200=88
5	B, B			MH		Sandy Elastic Silt (MH), dark gray, fine grained sand, wet, soft, thin layer approximately 3-inches of silt to sand					
	B			MH		Elastic Silt (MH), dark gray, wet, soft			50		-200=91
	B			CH		Fat Clay (CH), light gray, wet, soft					

Bottom of test pit at 8.5 feet
No groundwater encountered

Tule Red
Solano County, California

Log of Test Pit 5
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-18

Date : 8/21/2014
Drilling Method : Test Pit
Elevation (Feet) :
Latitude : 38.12060
Longitude : -121.98364

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B					Elastic Silt (MH), mottled gray brown, wet, soft to medium stiff, approximately 3-inches of roots and vegetation					
	B				▽	8/21/2014 Water shooting in			77		LL=70 PI=25
	B			MH		Brown					
	B					Decreased plasticity and sandier					
5	B B										
	B			MH		Elastic Silt with Sand (MH), dark gray, saturated, soft			51		-200=80
	B			CH		Fat Clay (CH), light gray, saturated, soft					

Bottom of test pit at 8 feet
Groundwater encountered at 1.5 feet during excavation

Tule Red
Solano County, California

Log of Test Pit 6
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-19

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 8/21/2014 Drilling Method : Test Pit Elevation (Feet) : Latitude : 38.12010 Longitude : -121.98546 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				CH		Fat Clay with Sand (CH), mottled gray brown, wet, soft, approximately 4-inches of roots and vegetation					
	B										-200=86
	B					Saturated					
	B										
	B					Becomes dark gray					
	B					Mottled brown			84		LL=91 PI=53
5	B										
	B					Dark gray					
	B			MH		Elastic Silt with Sand (MH) Shell pieces, mica					

Bottom of test pit at 8 feet
No groundwater encountered

Tule Red
Solano County, California

Log of Test Pit 7
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. A-20

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 8/21/2014 Drilling Method : Test Pit Elevation (Feet) : Latitude : 38.12188 Longitude : -121.98004 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			MH		Elastic Silt (MH), mottled brown, wet, soft, approximately 1 foot of roots and vegetation			75		LL=77 PI=40
	B										
					▽	8/21/2014					
	B			ML		Elastic Silt with Sand (MH), brown, saturated, soft to medium stiff					
	B								48		-200=78
	B			MH		Elastic Silt (MH), dark gray, saturated, soft					
5	B										
	B			MH		Elastic Silt with Sand (MH), dark gray, saturated, soft					
	B			CH		Fat Clay (CH), gray, saturated, soft					

Bottom of test pit at 8 feet
Groundwater encountered at 2.3 feet during excavation

Tule Red
Solano County, California

Log of Test Pit 8
(Page 1 of 1)

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. A-21

Date : 8/21/2014
Drilling Method : Test Pit
Elevation (Feet) :
Latitude : 38.12370
Longitude : -121.97972

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			ML		Silt (ML), mottled brown, wet, medium stiff, approximately 2 feet of roots and vegetation					
	B										
	B					Becomes soft			56		LL=NP PI=NP
	B			MH		Elastic Silt with Sand (MH), dark gray, wet, soft					
	B										
5	B			MH		Elastic Silt with Sand (MH), dark gray, wet, soft			49		-200=81
	B										
	B			CH		Fat Clay (CH), gray, wet, soft			68		LL=54 PI=27

Bottom of test pit at 8 feet
No groundwater encountered

Tule Red
Solano County, California

Log of Test Pit 9
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. A-22

MAJOR DIVISIONS				GROUP NAMES
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	**GRAVELS** MORE THAN 50% OF COARSE FRACTION IS RETAINED ON NO. 4 SIEVE	**CLEAN GRAVELS** WITH LESS THAN 5% FINES	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	**CLEAN SANDS** WITH LESS THAN 5% FINES	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		SANDS WITH OVER 12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		ML	SILT
			CL	LEAN CLAY
			OL	ORGANIC CLAY, ORGANIC SILT
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH	ELASTIC SILT
			CH	FAT CLAY
			OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			Pt	PEAT

UNIFIED SOIL CLASSIFICATION SYSTEM- ASTM D 2487

S	- SPT		- Water Level at Time of Drilling	P	- Push
			- Water Level after Drilling (with date measured)	Perm	- Permeability
M	- 2.5 inch	Consol	- Consolidation	Sieve	- Particle Size Analysis
		Gs	- Specific Gravity	VS	- Laboratory Vane Shear (psf)
C	- 3.0 inch	LL	- Liquid Limit (%)	-200	- % Passing No. 200 Sieve
		PI	- Plasticity Index (%)		
T	- Shelby Tube	TxUU	- Shear Strength (psf) - Unconsolidated Undrained Triaxial Shear		
		TxCU	- Shear Strength (psf) - Consolidated Undrained Triaxial Shear		
B	- Bag	UC	- Compressive Strength (psf) - Unconfined Compression		

KEY TO TEST DATA

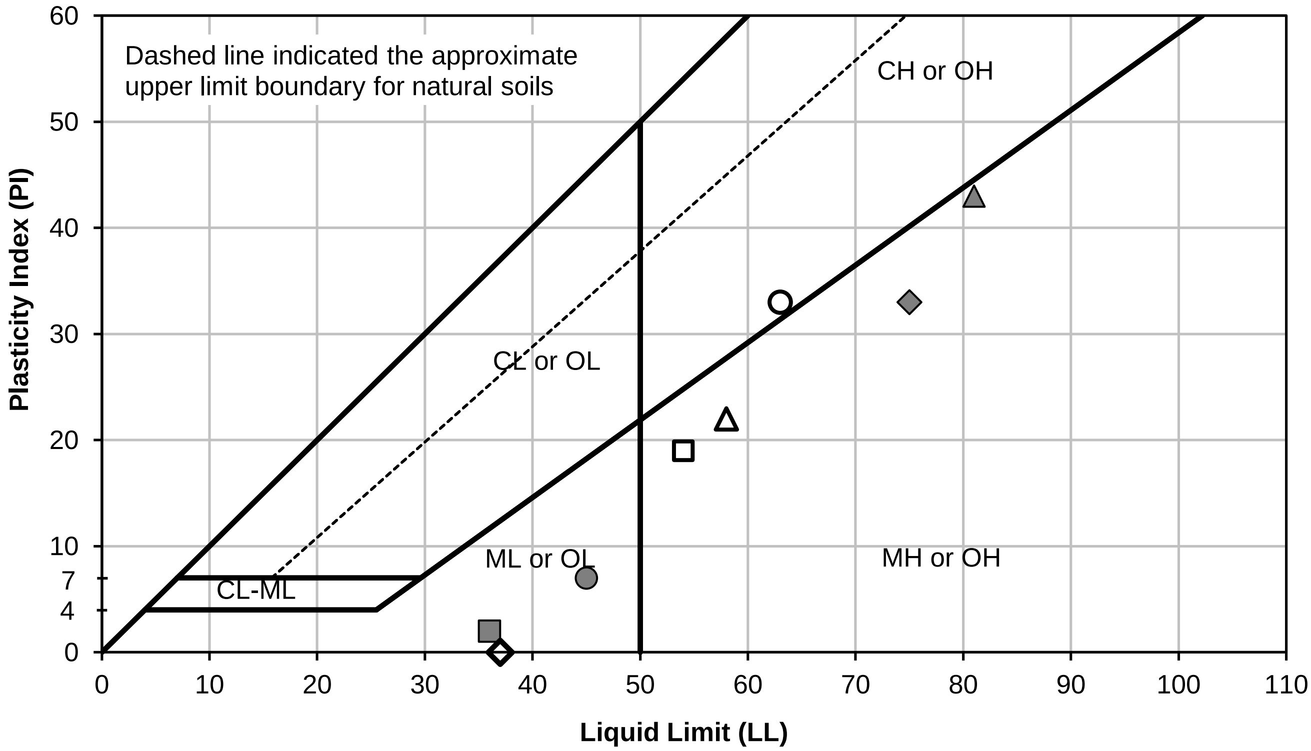
Tule Red
Solano County, California

Soil Classification Chart

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. A-23

APPENDIX B

LABORATORY TEST RESULTS



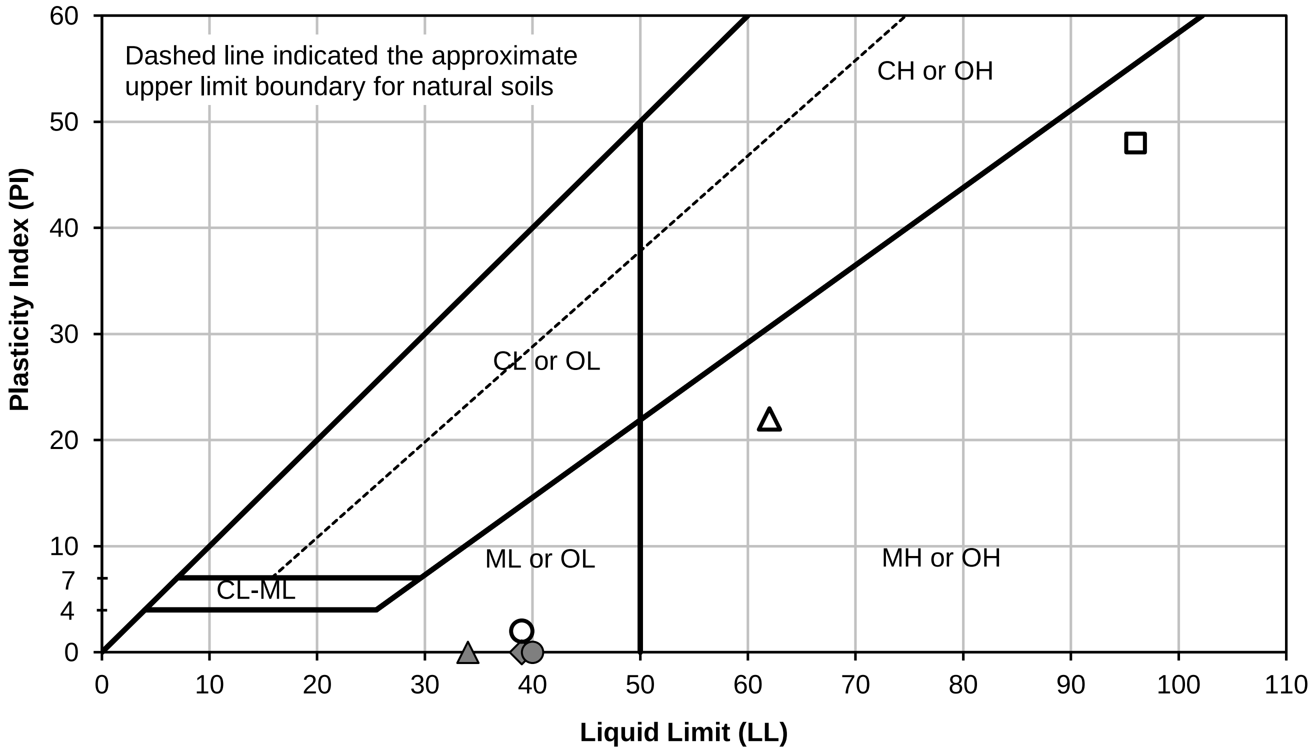
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	1	4.3 - 4.8	Gray Brown SILT	45	38	7	37
▲	1	24 - 24.5	Dark Gray ELASTIC SILT	81	38	43	
■	3	1.3 - 1.8	Olive Brown SILT	36	34	2	23
◆	3	29.5 - 30	Dark Gray ELASTIC SILT	75	42	33	
○	4	3.6 - 4.1	Gray Brown FAT CLAY	63	30	33	48
△	4	13.7- 14.2	Gray ELASTIC SILT	58	36	22	65
□	5	6.7 - 7.2	Light Brown ELASTIC SILT	54	35	19	51
◇	6	8.5 - 10.5	Dark Gray SILT	37	NP	NP	56

Testing performed by Cooper Testing Laboratory

Tule Red
Solano County, California

Atterberg Limits
Borings

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. B-1



Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	7	4.2 - 4.7	Yellow Brown SILT	40	40	0	45
▲	7	9.2 - 9.7	Dark Gray SILT with Sand	34	35	NP	
■	8	24.5 -25	Dark Gray SANDY SILT		NP	NP	45
◆	9	3.8 - 4.3	Yellow Brown SILT	39	40	NP	
○	10	4.2 -4.7	Yellow Brown SILT	39	37	2	48
△	10	14 - 14.5	Mottled Gray Black ELASTIC SILT	62	40	22	
□	11	24.5 - 25	Gray ELASTIC SILT	96	48	48	

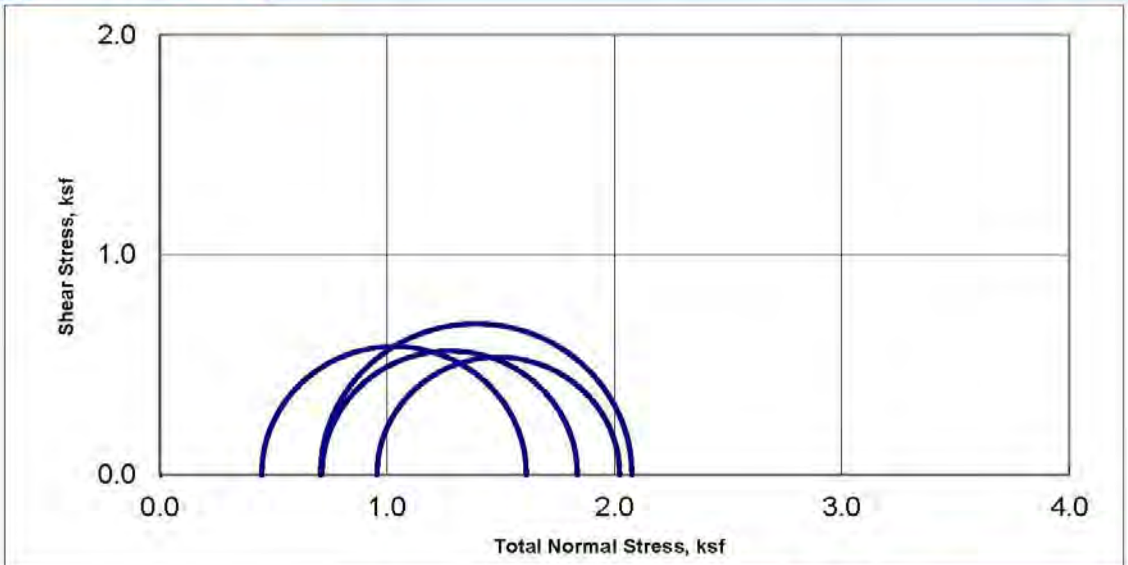
Testing performed by Cooper Testing Laboratory

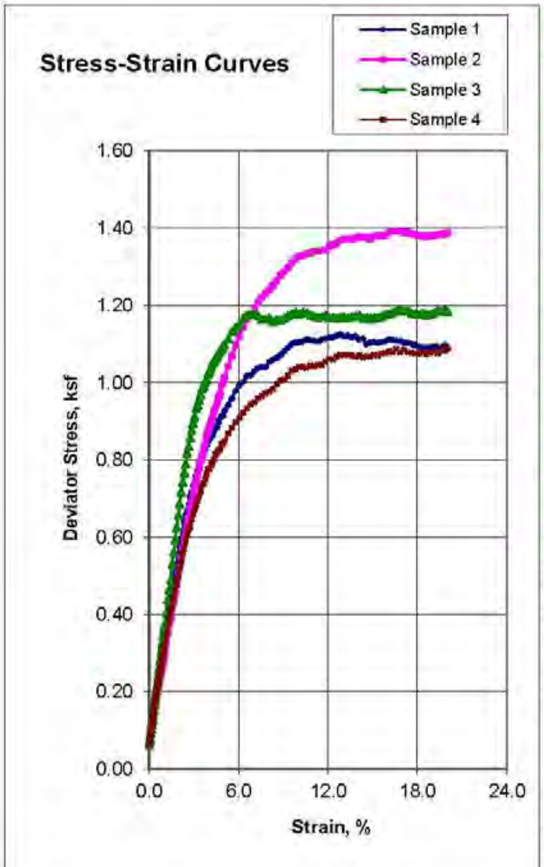
Tule Red
Solano County, California

Atterberg Limits
Borings

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-2

Unconsolidated-Undrained Triaxial Test
ASTM D2850





Sample Data	1	2	3	4
Moisture %	62.0	56.2	66.6	48.0
Dry Den,pcf	62.8	66.9	58.4	73.0
Void Ratio	1.684	1.519	1.885	1.309
Saturation %	99.4	100.0	95.4	99.0
Height in	6.00	5.98	5.98	5.97
Diameter in	2.87	2.85	2.88	2.87
Cell psi	4.9	4.9	3.1	6.6
Strain %	12.82	15.00	15.00	15.00
Deviator, ksf	1.124	1.371	1.165	1.068
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.060	0.060	0.060	0.060
Job No.:	212-123a			
Client:	Hultgren-Tillis Engineers			
Project:	Tule Red Marsh Restoration - 816.01			
Boring:	1	2	3	4
Sample:				
Depth ft:	13.5-15.7	13.5-15.5(Tip-1")	8.5-10.5(Tip-4")	18.5-20.5(Tip-12.5")

Visual Soil Description	
Sample #	
1	Very Dark Bluish Gray Sandy SILT
2	Very Dark Bluish Gray Sandy SILT
3	Black SILT w/ Sand & organics
4	Black Silty SAND lenses of Sandy Silt
Remarks:	

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

Testing performed by Cooper Testing Laboratory

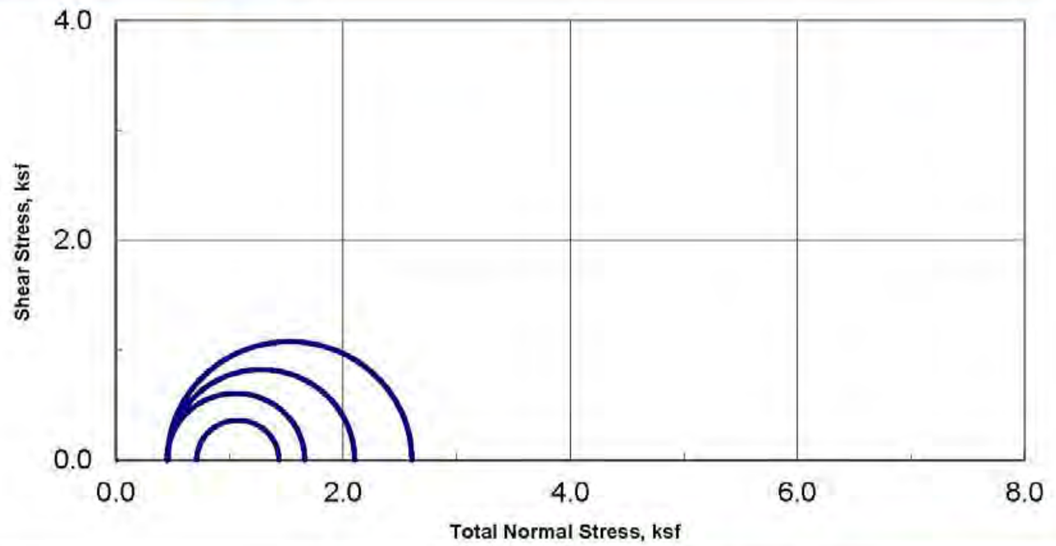
Tule Red
Solano County, California

Triaxial (UU) Test Results

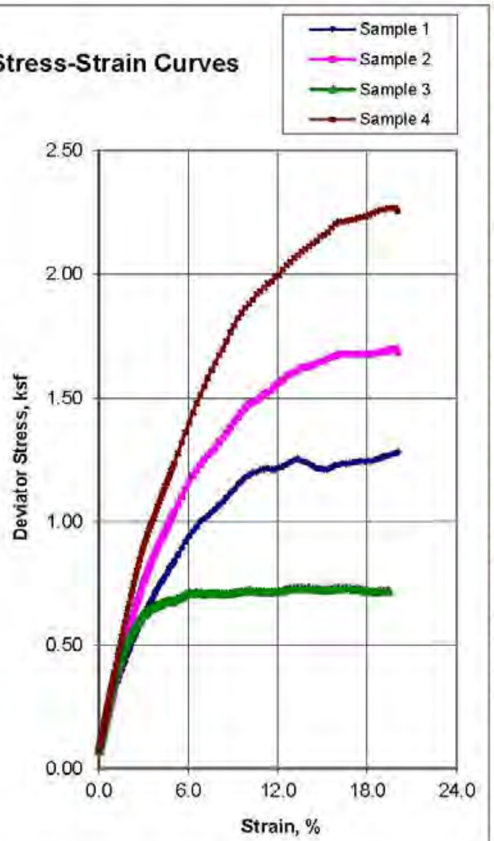
Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-3

COOPER TESTING LABORATORY

Unconsolidated-Undrained Triaxial Test
ASTM D2850



Stress-Strain Curves



Sample Data	1	2	3	4
Moisture %	55.8	48.6	62.7	40.7
Dry Den,pcf	67.8	71.5	62.4	79.0
Void Ratio	1.578	1.446	1.801	1.212
Saturation %	99.1	94.0	97.4	94.1
Height in	6.00	6.09	5.99	5.98
Diameter in	2.87	2.85	2.87	2.87
Cell psi	3.1	3.2	4.9	3.2
Strain %	15.00	15.00	15.00	15.00
Deviator, ksf	1.214	1.645	0.723	2.152
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.060	0.061	0.060	0.060
Job No.:	212-123b			
Client:	Hultgren-Tillis Engineers			
Project:	Tule Red Marsh Restoration - 816.01			
Boring:	6	8	9	10
Sample:				
Depth ft:	8.5-10(Tip-1"	8.5-10.5(Tip-4")	13.5-15.5(Tip-1")	8.5-10(Tip-1")

Visual Soil Description	
Sample #	
1	Very Dark Bluish Gray Sandy SILT
2	Very Da Bl Gr Sa SILT/ near Si SAND
3	Very Dark Bluish Gray Sandy SILT
4	Very Dark Bluish Gray Silty SAND (slightly plastic)

Remarks:

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

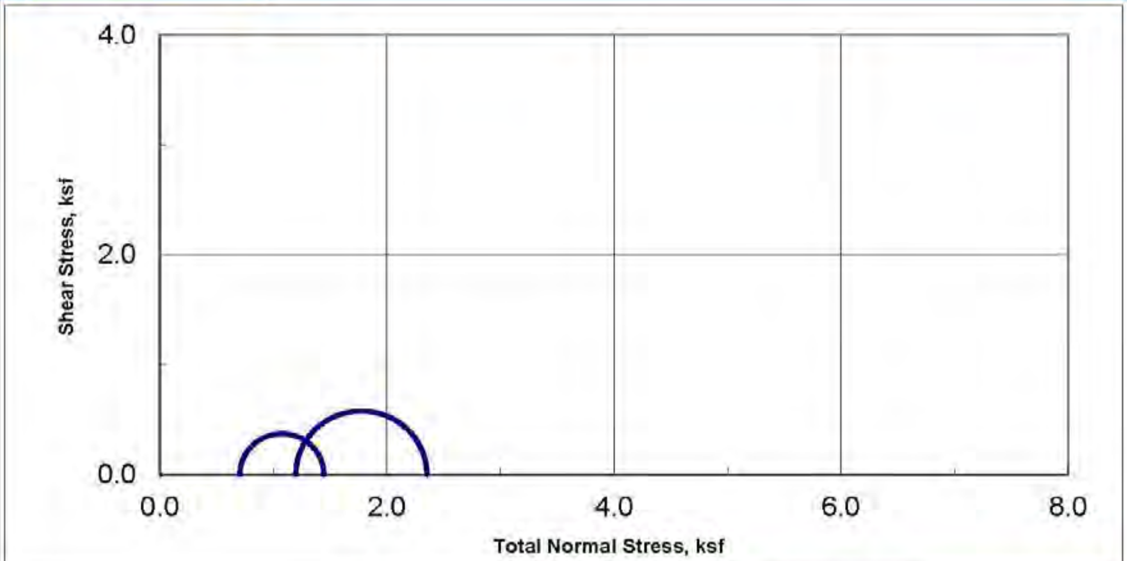
Testing performed by Cooper Testing Laboratory

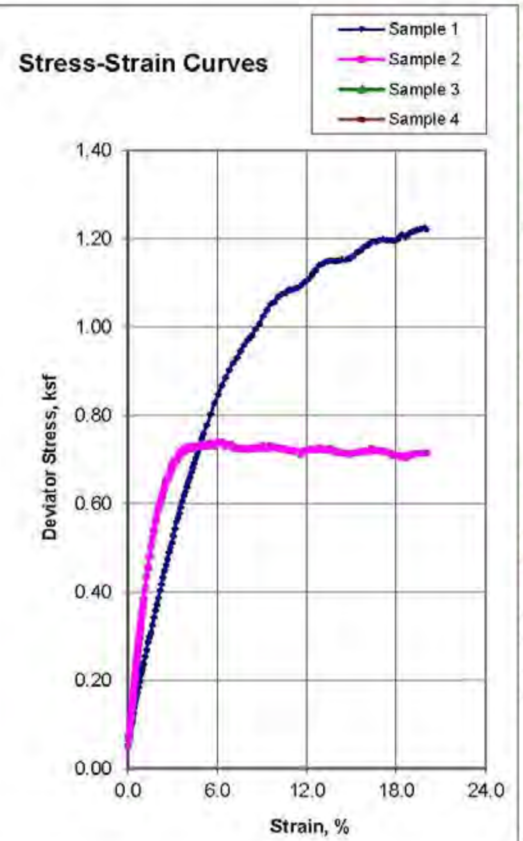
Tule Red
Solano County, California

Triaxial (UU) Test Results

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. B-4

Unconsolidated-Undrained Triaxial Test
ASTM D2850





Sample Data				
	1	2	3	4
Moisture %	51.1	67.3		
Dry Den,pcf	71.0	60.6		
Void Ratio	1.463	1.887		
Saturation %	97.9	99.8		
Height in	6.09	5.99		
Diameter in	2.86	2.85		
Cell psi	8.3	4.9		
Strain %	15.00	6.05		
Deviator, ksf	1.154	0.740		
Rate %/min	1.00	1.00		
in/min	0.061	0.060		
Job No.:	212-123c			
Client:	Hultgren-Tillis Engineers			
Project:	Tule Red Marsh Restoration - 816.01			
Boring:	10	11		
Sample:				
Depth ft:	23.5-25.5(Tip-4.5")	13.5-15.5(Tip-12")		

Visual Soil Description	
Sample #	
1	Very Dark Bluish Gray Silty SAND
2	Very Dark Bluish Gray SILT w/ Sand
3	
4	

Remarks:

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

Testing performed by Cooper Testing Laboratory

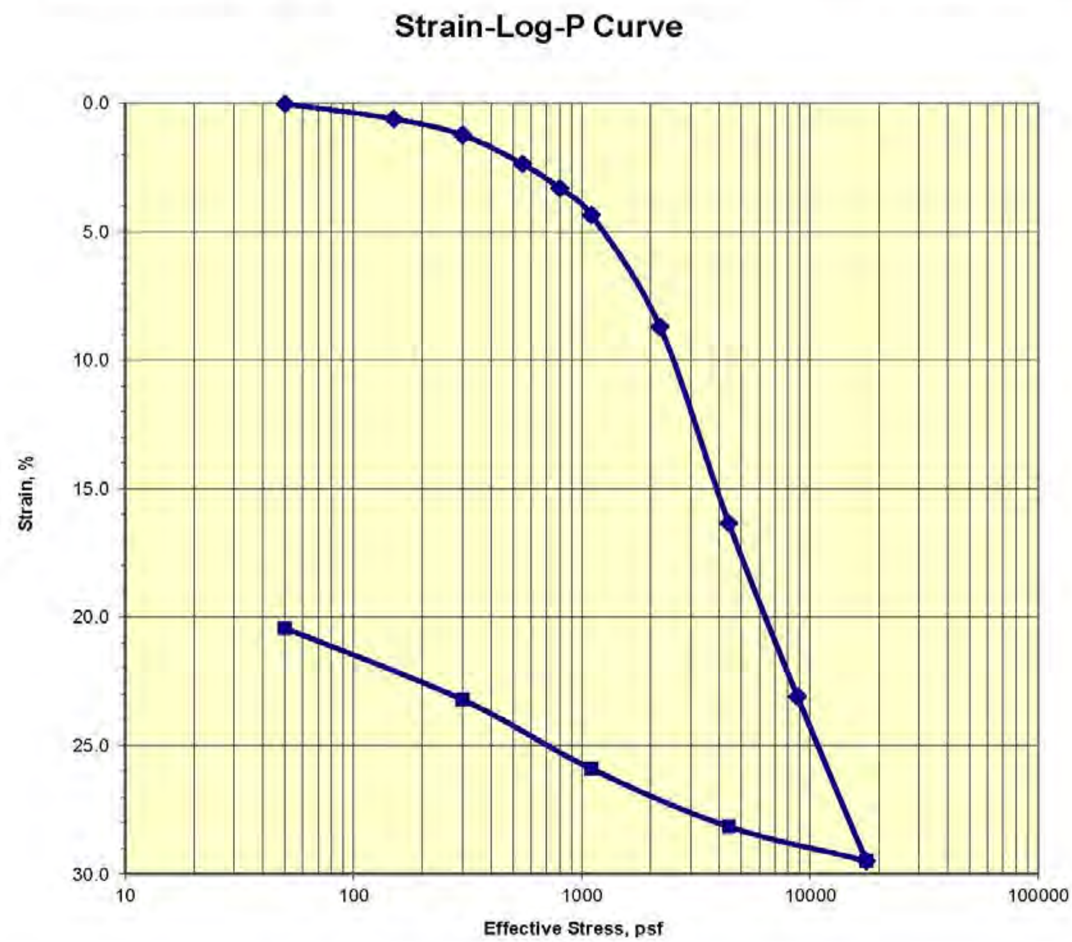
Tule Red
Solano County, California

Triaxial (UU) Test Results

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-5

Consolidation Test
ASTM D2435

Job No.:	212-123	**Boring:**	1	**Run By:**	MD
Client:	Hultgren-Tillis Engineers	**Sample:**		**Reduced:**	PJ
Project:	Tule Red Marsh Restoration - 816.01	**Depth, ft.:**	33.5-35.5(Tip-2")	**Checked:**	PJ/DC
Soil Type:	Very Dark Bluish Gray Sandy SILT w/ organics			**Date:**	8/8/2014



Assumed Gs 2.75	Initial	Final
Moisture %:	64.9	47.3
Dry Density, pcf:	60.3	74.6
Void Ratio:	1.846	1.300
% Saturation:	96.6	100.0

Remarks:

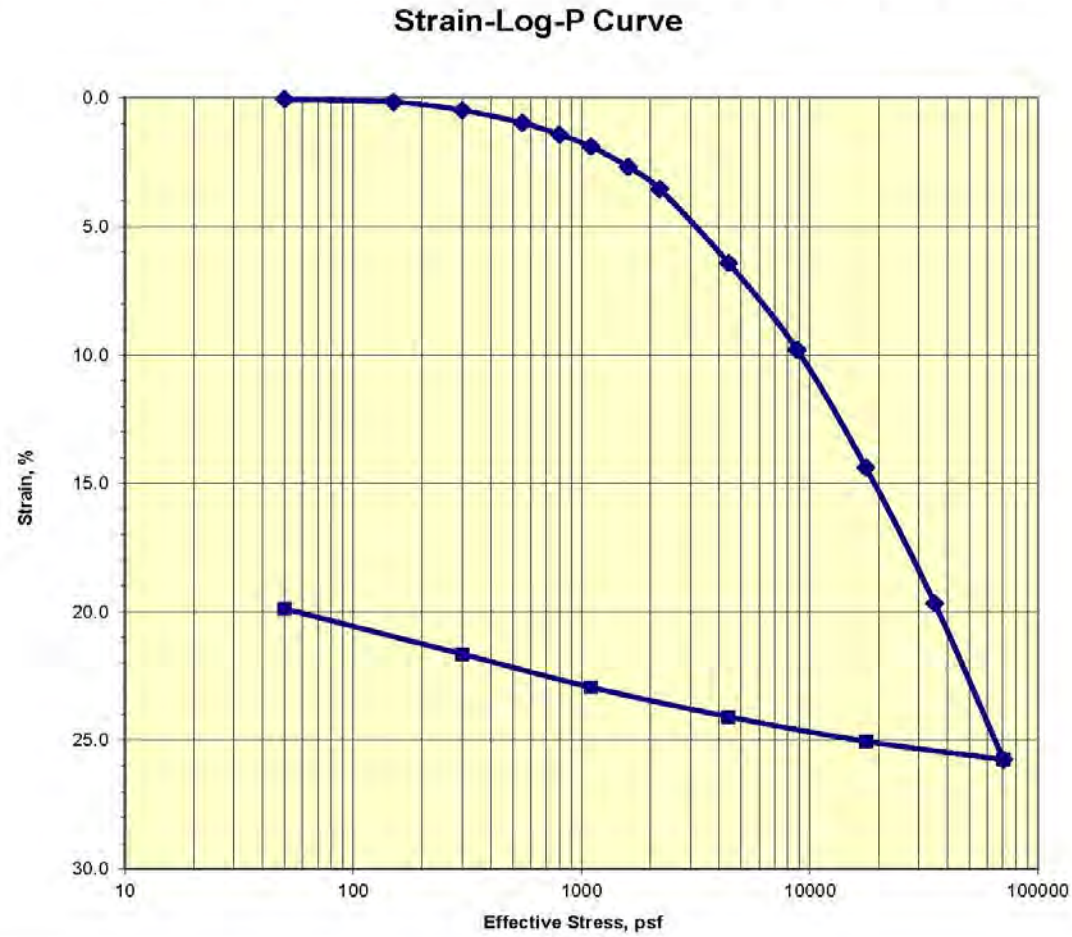
Testing performed by Cooper Testing Laboratory

Tule Red
Solano County, California

Consolidation Test Results

Consolidation Test
ASTM D2435

Job No.:	212-123	**Boring:**	3	**Run By:**	MD
Client:	Hultgren-Tillis Engineers	**Sample:**		**Reduced:**	PJ
Project:	Tule Red Marsh Restoration - 816.01	**Depth, ft.:**	8.5-10.5(Tip-2")	**Checked:**	PJ/DC
Soil Type:	Very Dark Bluish Gray Silty SAND/ Sandy SILT			**Date:**	8/13/2014



Assumed Gs 2.8	Initial	Final
Moisture %:	52.5	35.6
Dry Density, pcf:	70.2	87.5
Void Ratio:	1.491	0.997
% Saturation:	98.5	100.0

Remarks:

Testing performed by Cooper Testing Laboratory

Tule Red
Solano County, California

Consolidation Test Results

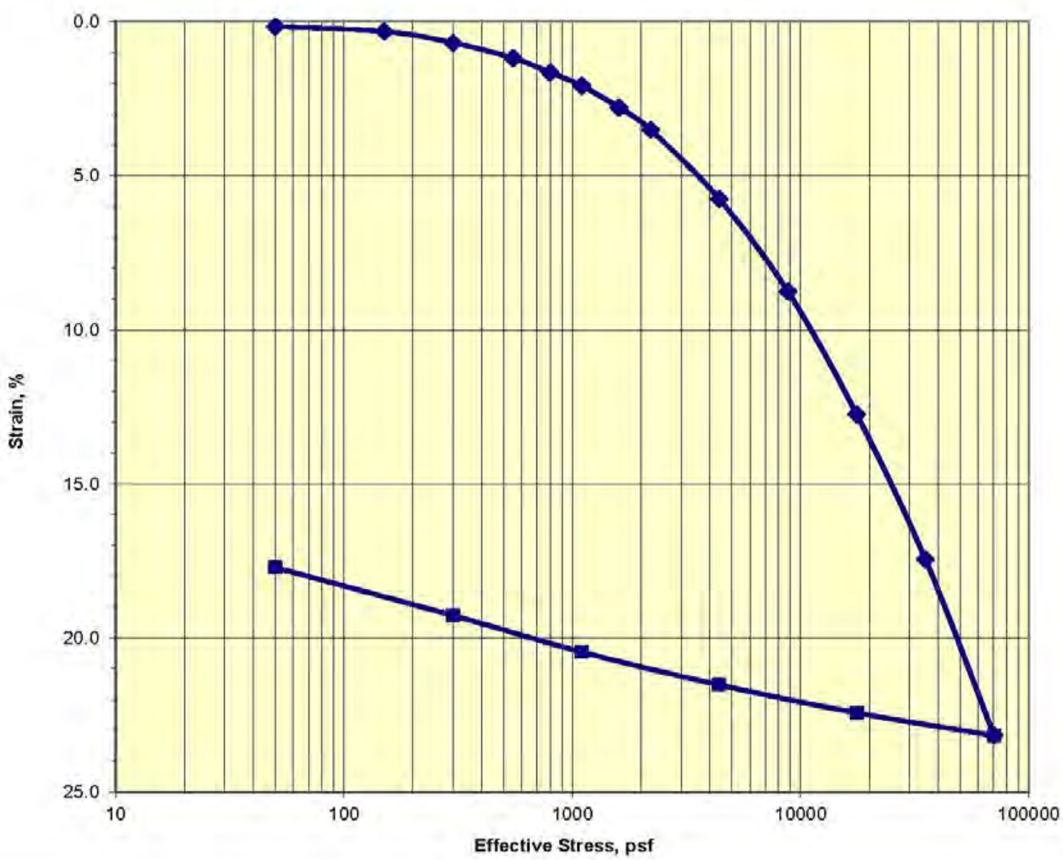
Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-7

Consolidation Test

ASTM D2435

Job No.:	212-123	Boring:	8	Run By:	MD
Client:	Hultgren-Tillis Engineers	Sample:		Reduced:	PJ
Project:	Tule Red Marsh Restoration - 816.01	Depth, ft.:	8.5-10.5(Tip-2")	Checked:	PJ/DC
Soil Type:	Very Dark Bluish Gray Sandy SILT			Date:	8/13/2014

Strain-Log-P Curve



Assumed Gs 2.75	Initial	Final
Moisture %:	48.4	33.9
Dry Density, pcf:	73.4	88.9
Void Ratio:	1.339	0.932
% Saturation:	99.4	100.0

Remarks:

Testing performed by Cooper Testing Laboratory

Tule Red
Solano County, California

Consolidation Test Results

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-8

Consolidation Test
ASTM D2435

Job No.:	212-123	Boring:	10	Run By:	MD
Client:	Hultgren-Tillis Engineers	Sample:		Reduced:	PJ
Project:	Tule Red Marsh Restoration - 816.01	Depth, ft.:	23.5-25.5(Tip-2")	Checked:	PJ/DC
Soil Type:	Very Dark Bluish Gray Sandy SILT w/ organics near SILT w/ Sand & organics			Date:	23.5-25.5(Tip-2")

Assumed Gs 2.75	Initial	Final
Moisture %:	59.7	41.8
Dry Density, pcf:	64.7	79.9
Void Ratio:	1.655	1.149
% Saturation:	99.1	100.0

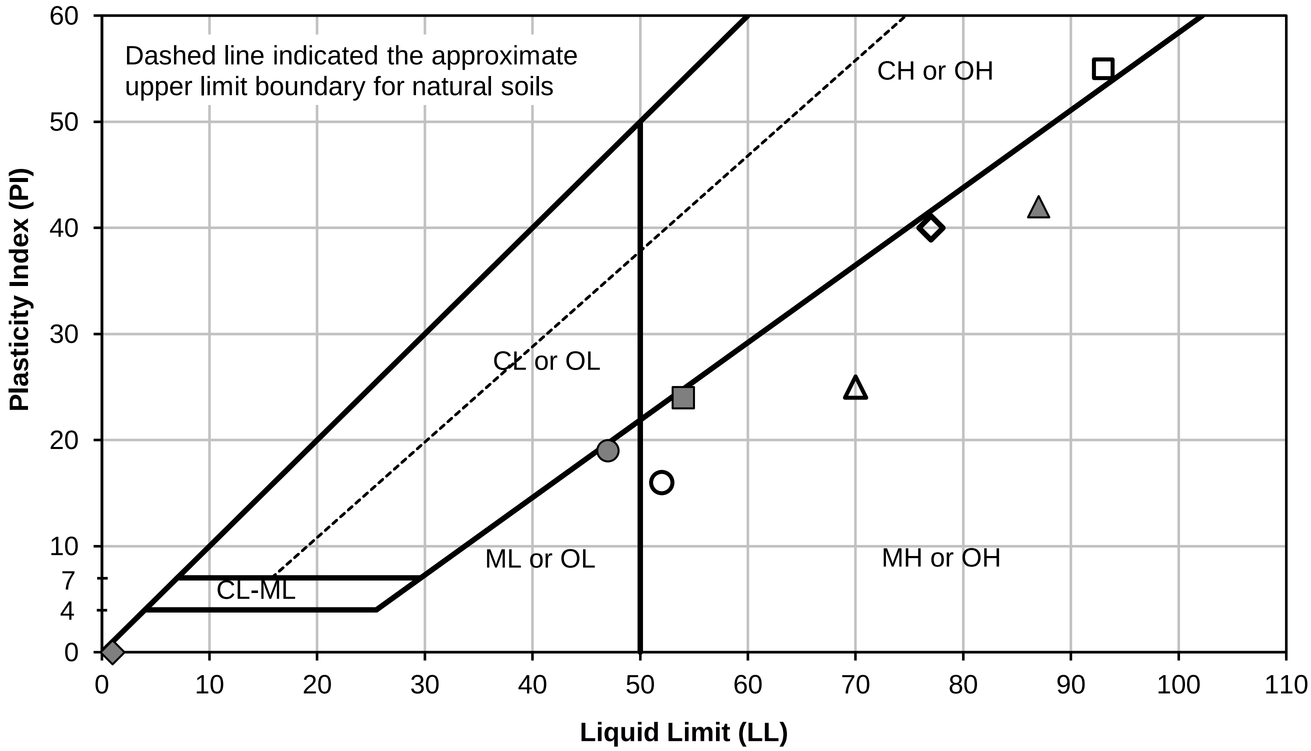
Remarks:

Testing performed by Cooper Testing Laboratory

Tule Red
Solano County, California

Consolidation Test Results

Hultgren - Tillis Engineers	Project No. 816.01	Plate No. B-9

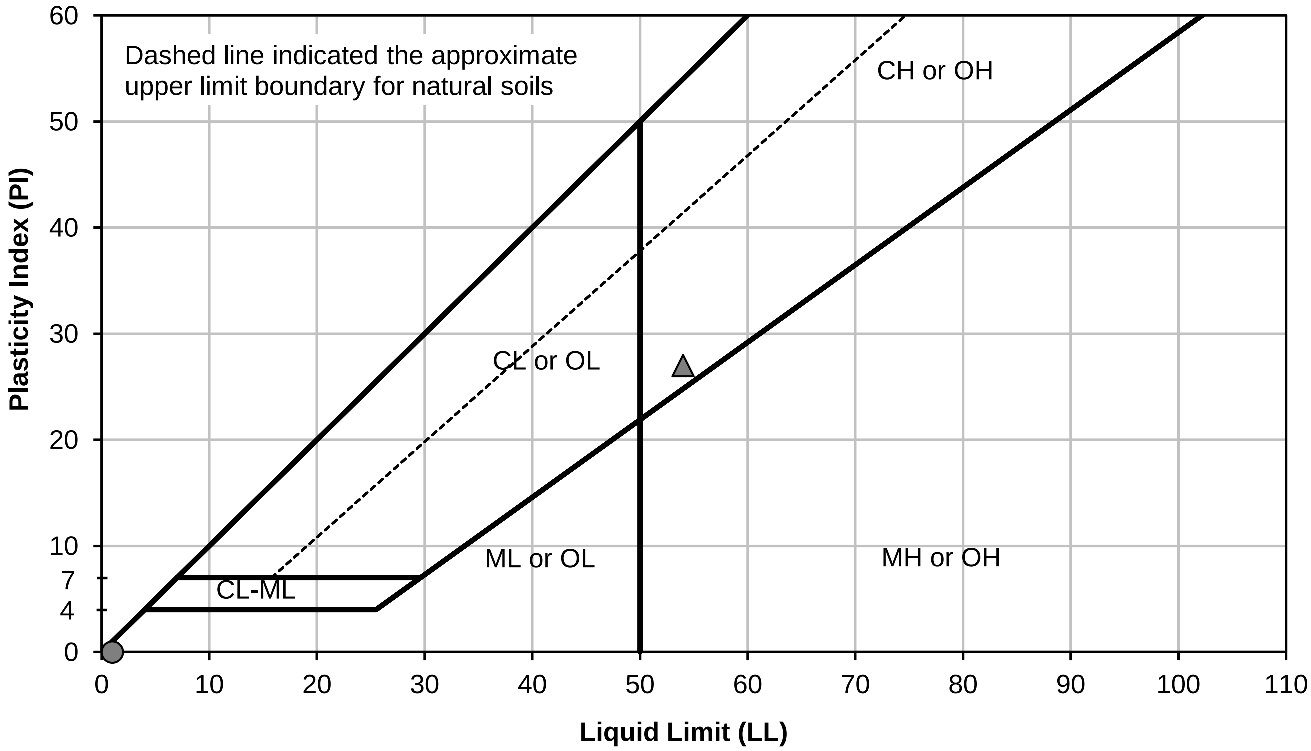


Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	TP - 1	5.5 - 6	Dark Gray SILT	47	28	19	63
▲	TP - 2	0.5 - 1	Mottled Gray Brown ELASTIC SILT	87	45	42	109
■	TP - 2	7 - 8	Dark Gray ELASTIC SILT w/ SAND	54	30	24	68
◆	TP - 3	6 - 7	Dark Gray SILT	NP	33	NP	54
○	TP - 4	1.3 - 1.7	Mottled Gray Brown ELASTIC SILT	52	36	16	61
△	TP - 6	1.5 - 2	Mottled Gray Brown ELASTIC SILT	70	45	25	77
□	TP - 7	4.5 - 5	Mottled Gray Brown FAT CLAY w/ SAND	93	38	55	84
◇	TP - 8	0.5 - 1	Mottled Brown ELASTIC SILT	77	37	40	75

Tule Red
Solano County, California

Atterberg Limits
Test Pits

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. B-10



Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	TP - 9	2.5 - 3	Mottled Brown SILT	NP	34	NP	56
▲	TP - 9	7-8	Gray FAT CLAY	54	27	27	68

Tule Red
Solano County, California

Atterberg Limits
Test Pits

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. B-11

APPENDIX C

SLOPE STABILITY AND SETTLEMENT RESULTS

C-1. SLOPE STABILITY

A. General

We performed analysis to check the factors of safety of the existing levee and the rehabilitated levee for static loading conditions. We used the computer program SLOPE/W and Spencer's method of analysis. We used data obtained from the borings along with our assessment of average effective stress and undrained shear strengths for marsh deposits. Typically, fill placement occurs over a period of time that is relatively short compared to the time required for marsh soils to gain strength. We assumed that the marsh soils will not gain shear strength prior to the end of construction. The long-term rehabilitated levee cases were performed with strength gain after consolidation of the marsh soils. The soil parameters used in our analysis are presented on Plates C-1 through C-35.

We reviewed the topography and cross-sections and selected seven (7) sections (Stations 11+54, 26+48, 46+89, 65+86, 105+59, 121+95, 145+03) to represent the levee between Stations 0+00 to 150+00. The cross-sections were selected to represent varying slope angles, levee heights, crown widths, and depths of marsh soils. For the existing configuration and end of construction configurations, we used a water level two feet below the existing ground elevation. We used the top of levee for the water level for the analysis of the long-term rehabilitated levee for the landside slope.

We analyzed the existing levee using both effective stress and undrained strength parameters. We analyzed the rehabilitated levee using undrained strengths for end of construction and effective stress for the long-term consolidation condition. For fills and the underlying foundation sand, effective stress strength parameters were used in the analysis. The analyses included:

Static Loading

- Existing Levee – Effective Stresses
- Existing Levee – Undrained Strength
- Rehabilitated Levee – End of Construction – Undrained Strength – Configuration 1
- Rehabilitated Levee – End of Construction – Undrained Strength – Configuration 2

- Rehabilitated Levee – Long-Term Consolidation – Effective Stresses – Configuration 1
- Rehabilitated Levee – Long-Term Consolidation – Effective Stresses – Configuration 2

Two configurations for each section were analyzed for the rehabilitated levee. Configuration 1 consists of placing fill on the Tule Red parcel side of the levee. The side slope for the fill will vary depending upon the levee height and the width of the toe ditch. Configuration 2 consists of placing fill on the Tule Red parcel side of the levee to create a constant 4 percent slope.

The results of our analysis for slopes are presented in Tables C-1 and C-2. We have presented the results of the slope stability cases and the soil properties used in our analysis on Plates C-1 through C-35.

Table C-1: Factors of Safety for Non-Tule Red Parcel Slopes

Station	Existing Levee		Rehabilitated Levee			
	Effective Strength	Undrained Strength	End of Construction Undrained Strength		Long-Term Consolidation Effective Strength	
			Configuration 1	Configuration 2	Configuration 1	Configuration 2
11+54	2.43	1.60	1.60	1.60	2.12	2.12
26+48	2.69	1.62	1.62	1.62	1.94	1.94
46+89	2.37	1.42	1.42	1.42	1.76	1.76
65+86	2.62	1.45	1.44	1.44	1.88	1.88
105+59	2.34	1.80	1.79	1.79	1.86	1.89
121+95	1.67	1.40	1.39	1.39	1.30	1.28
145+03	3.12	1.68	1.68	1.68	2.22	2.22

Table C-2: Factors of Safety for Marsh Side Slopes

Station	Existing Levee		Rehabilitated Levee			
			End of Construction Undrained Strength		Long-Term Consolidation Effective Strength	
	Effective Strength	Undrained Strength	Configuration 1	Configuration 2	Configuration 1	Configuration 2
11+54	2.61	1.58	2.79	4.04	6.22	9.54
26+48	2.68	1.74	2.64	3.86	5.56	9.30
46+89	2.59	1.50	2.40	3.69	5.46	9.05
65+86	2.53	1.40	2.26	3.48	5.48	9.37
105+59	2.98	1.63	2.63	4.05	6.11	10.05
121+95	3.05	1.63	2.95	3.66	6.99	8.95
145+03	3.90	2.13	3.15	4.20	6.89	9.43

The results indicate the factors of safety for the slopes for the end of construction conditions is generally the same or higher than the factor of safety for existing conditions for undrained strength assuming the levee slope and levee crown are constructed in one sequence. As the marsh soils consolidate and gain strength the factors of safety increase.

B. Settlement Analysis

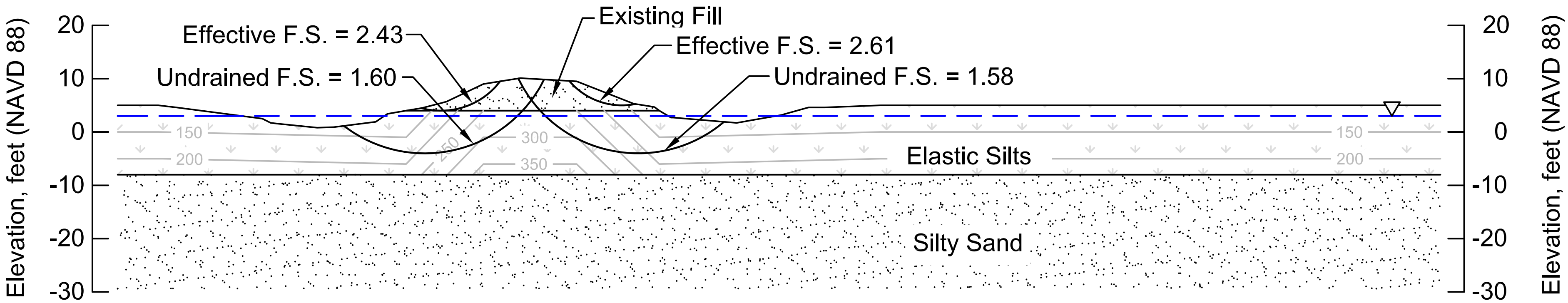
The base of the marsh deposits varies from about Elevation -8 feet to Elevation -14 feet over the northernmost 12,000 feet of levee. In the southernmost 3,000 feet of levee, the base of the marsh deposits varies from Elevation -14 feet to Elevation -34 feet. The marsh deposits are highly compressible. We performed analysis to estimate settlement of the levee based on the theory of consolidation. Consolidation occurs from compression of the marsh soils beginning when weight is placed on the soil. The initial weight is transferred to the water within the soil. The water builds up pressure causing flow to occur. As the water flows out of the soil, the soil structure compresses and continues to compress until the water flow is complete and the water pressure returns to hydrostatic levels.

We have performed analysis for two cases of settlement: (1) a 20 foot thick marsh, which applies to the northernmost 12,000 feet of levee, and (2) a 37 foot thick marsh, which applies to the southernmost 3,000 feet of levee. The settlement estimates are based upon placing fill in Configuration 2 described in rehabilitation scheme section. The settlement analysis assumes that no new fill will be placed on the levee crown, the existing levee crown is 16 feet wide, and the existing levee side slope is 2H:1V. If a configuration with a steeper new fill slope than Configuration 2 is constructed, the settlement amounts will be lower.

In the northernmost 12,000 feet, where the marsh is less than 20 feet thick, we estimate that the settlement beneath the existing levee centerline will be less than 0.1 feet and the settlement beneath the thicker portions of new berm fill will range from 1.2 to 1.6 feet. The majority of the settlement will likely occur within 1 year of fill placement.

In the southernmost 3,000 feet, where the marsh is up to 37 feet thick, the settlement will be higher in magnitude and take longer to occur. We estimate that the settlement beneath the existing levee centerline will be as much as 0.2 feet thick and the settlement beneath the thicker portions of new berm fill will be as high as much as 2 feet. Within the first year of fill placement, settlement will range from 25 to 90 percent of the total settlement. Within the first five years of fill placement, settlement will range from 55 to 100 percent of the total settlement.

If additional levee freeboard is needed and new fill is to be placed on the levee crown, then more settlement beneath the levee crown will occur. We estimate that for each 1 foot of new fill placed on the levee crown, there will be an additional 0.1 to 0.3 feet of settlement beyond the amounts listed in the preceding paragraphs.



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

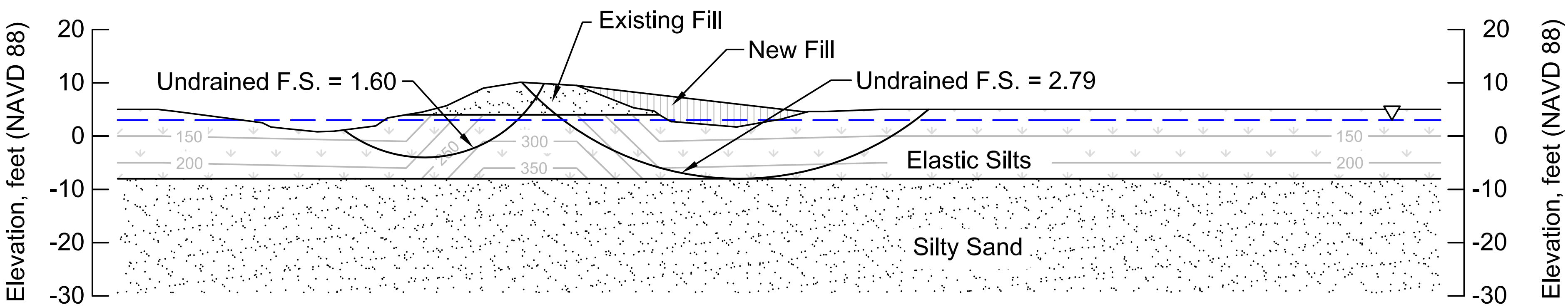
Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 11+54

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-1



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

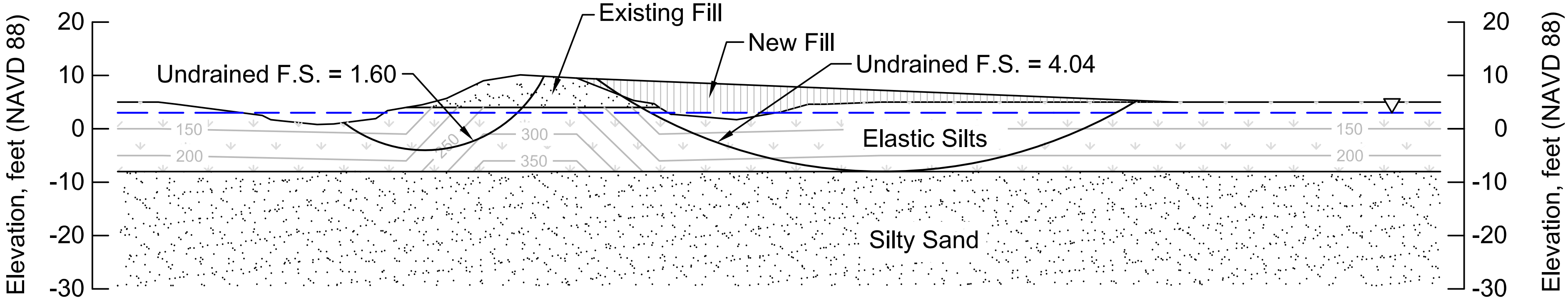
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 11+54

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-2



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

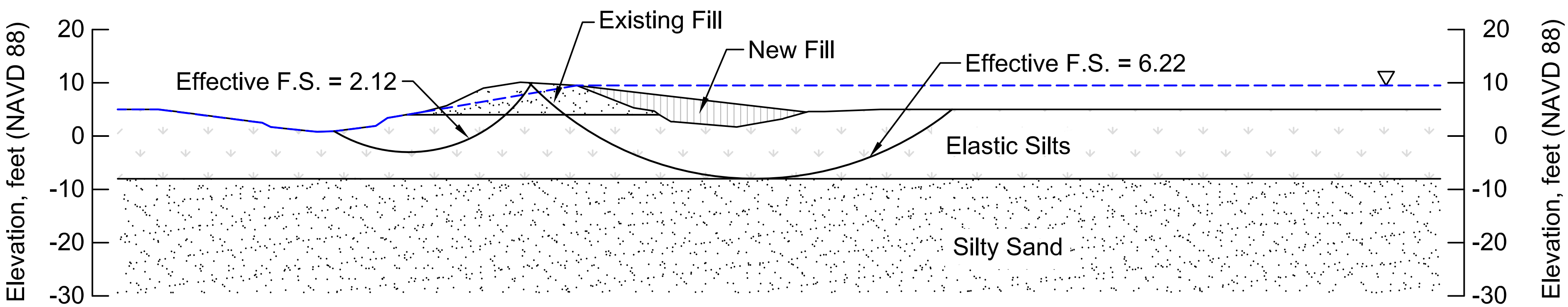
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 11+54

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-3



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

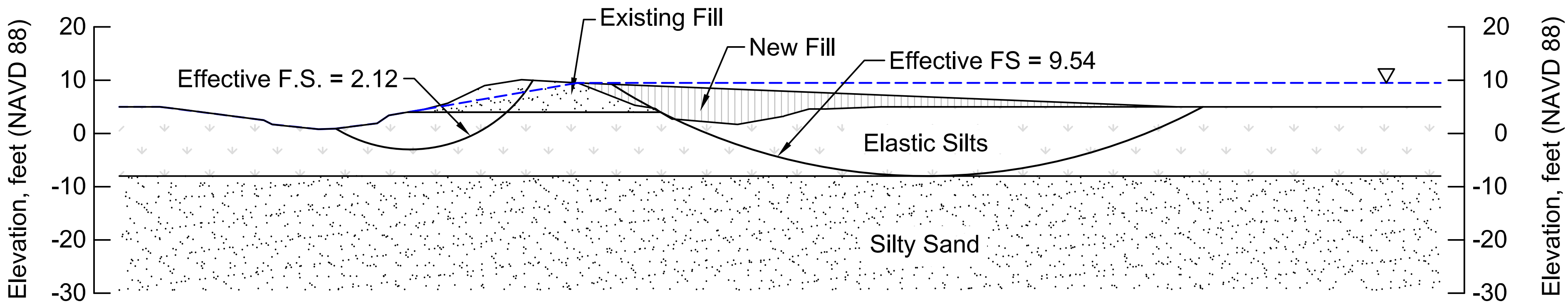
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 11+54

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-4



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

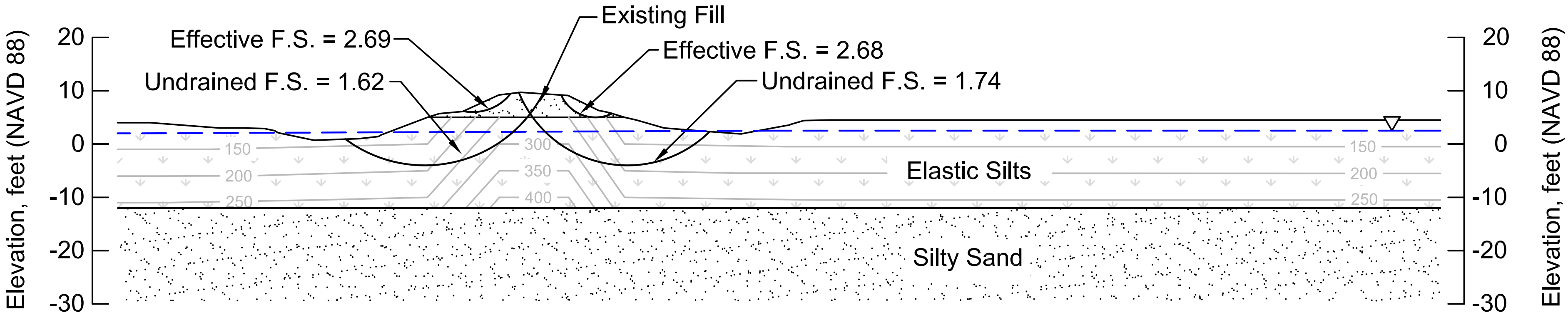
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 11+54

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-5



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

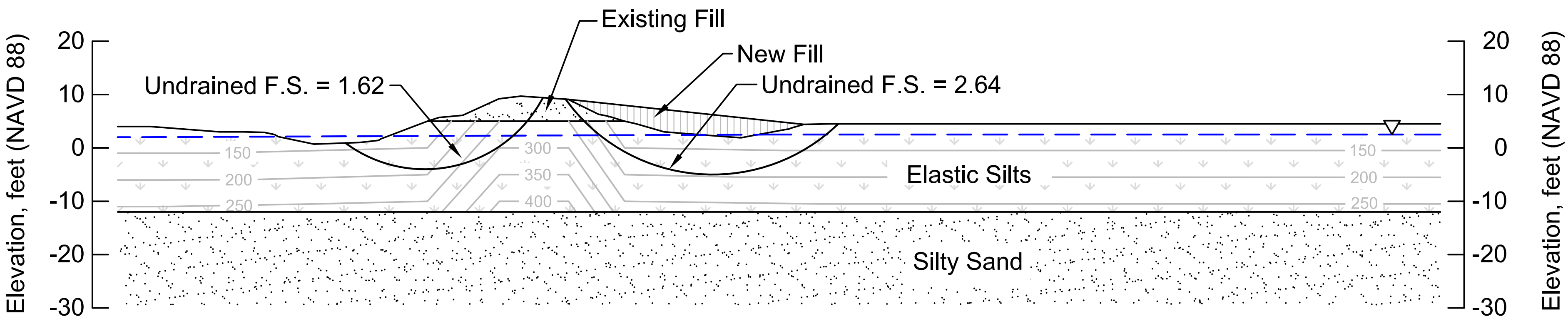
*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 26+48

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. C-6



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

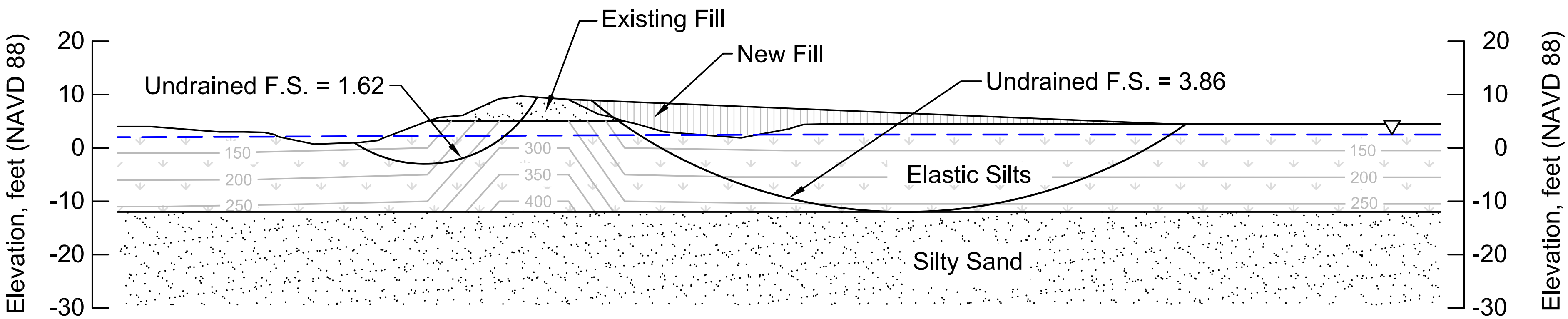
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 26+48

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-7



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

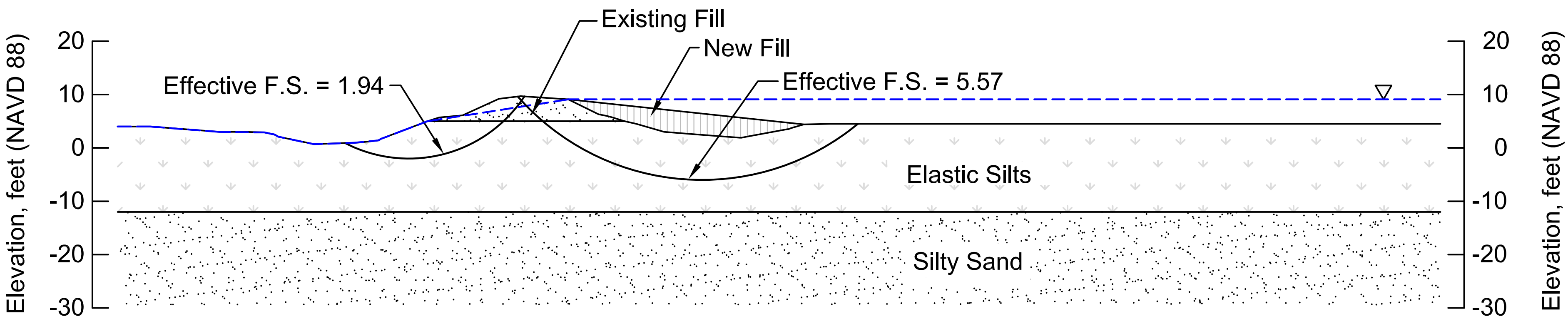
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 26+48

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-8



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

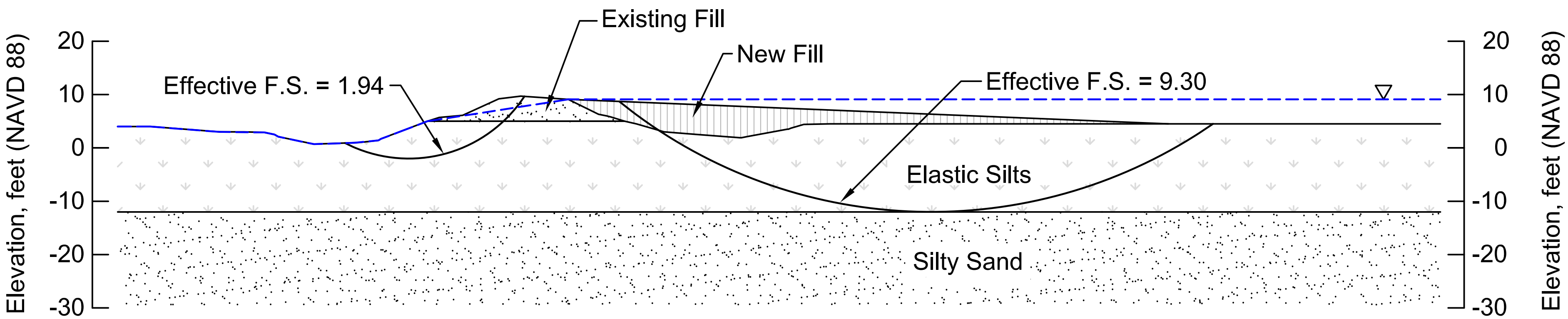
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 26+48

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-9



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE

0 30 feet

1 inch = 30 feet

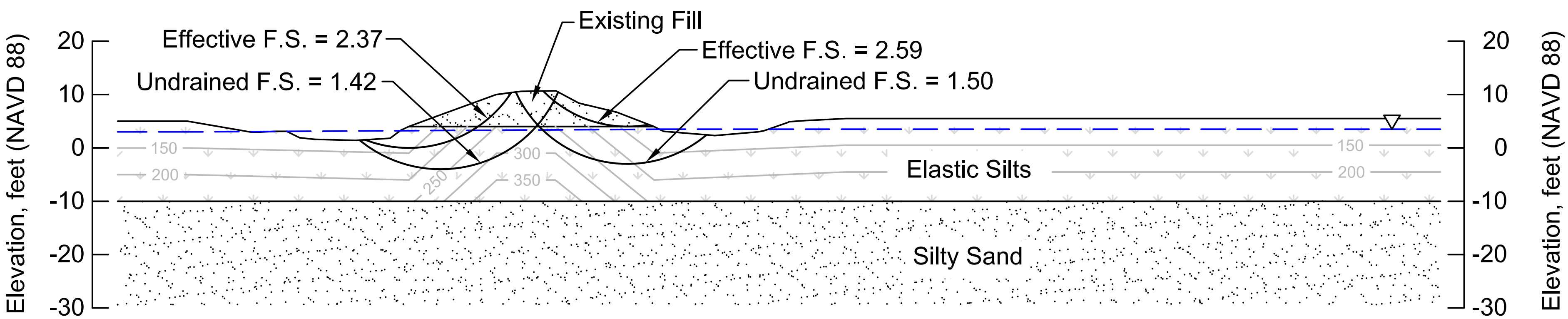
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 26+48

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-10



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

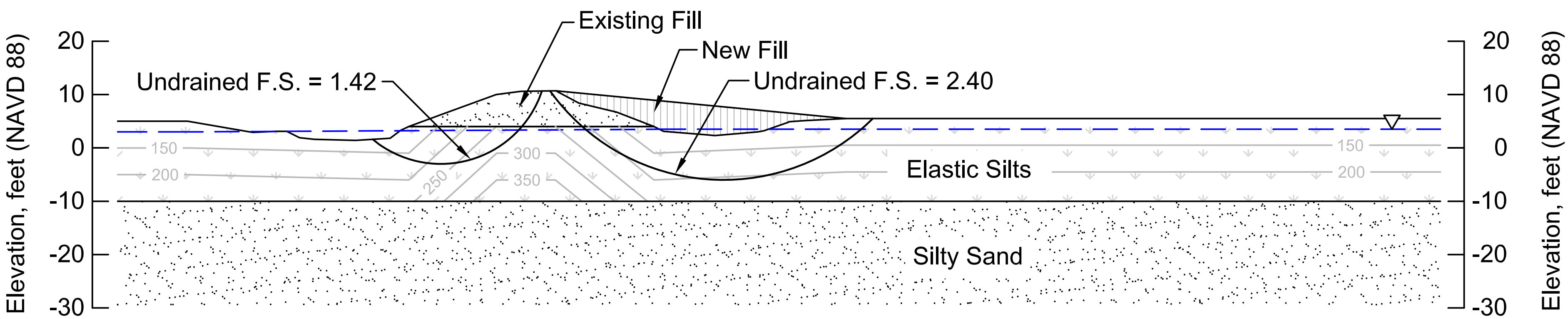
Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 46+89

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-11



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

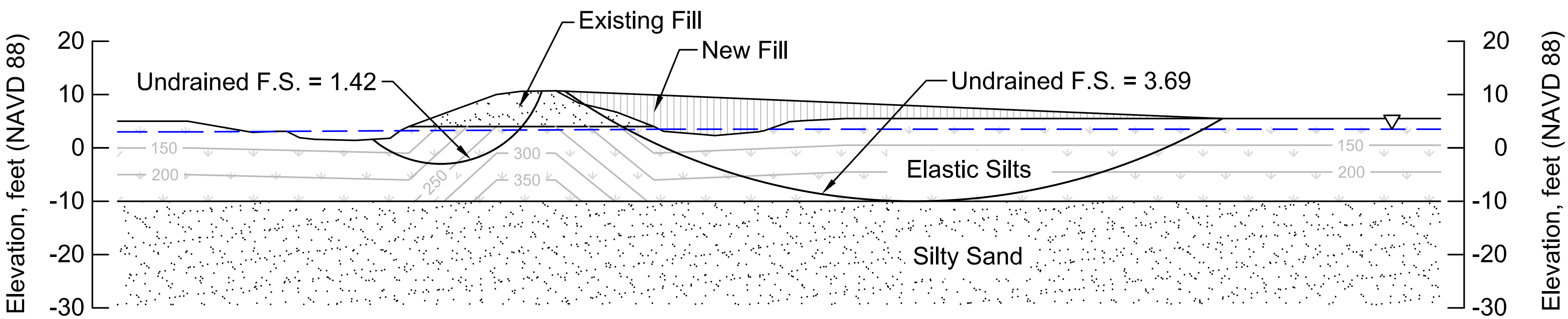
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 46+89

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-12



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

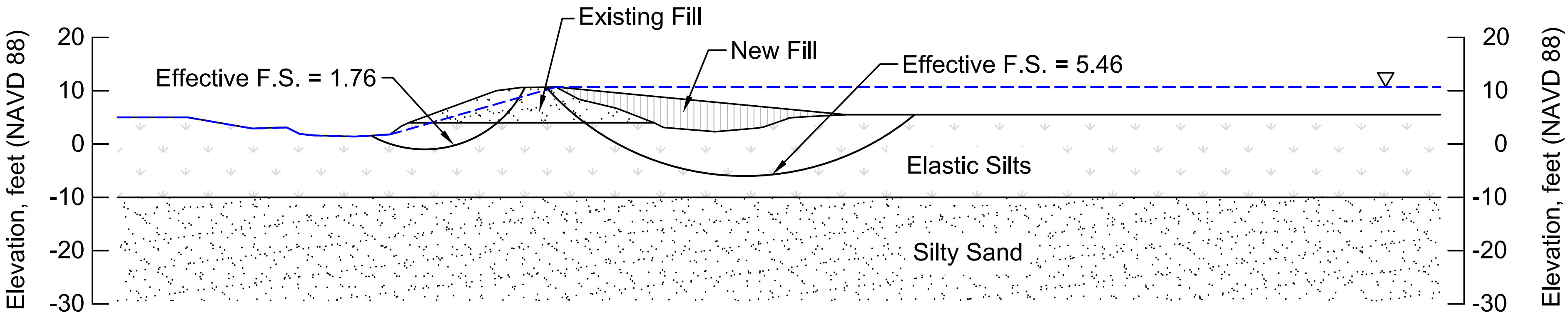
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 46+89

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-13



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

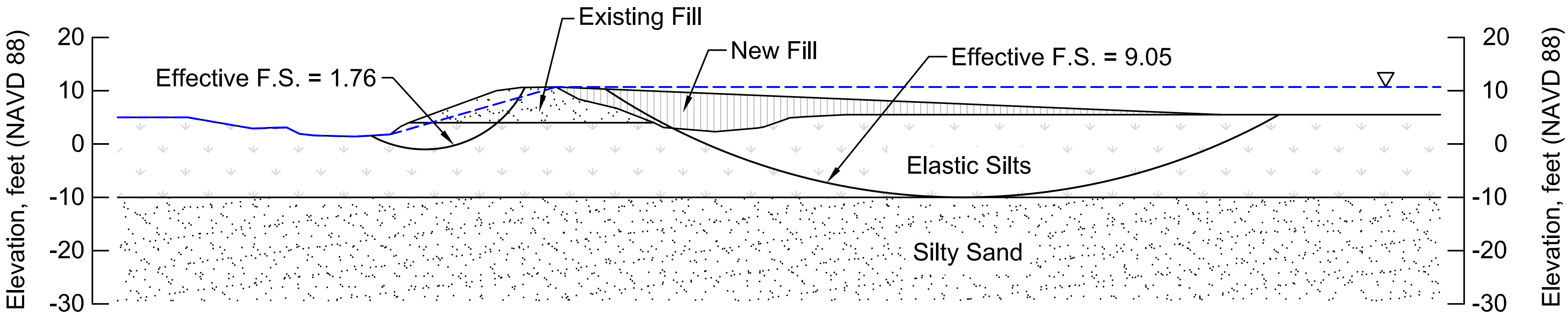
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 46+89

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-14



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

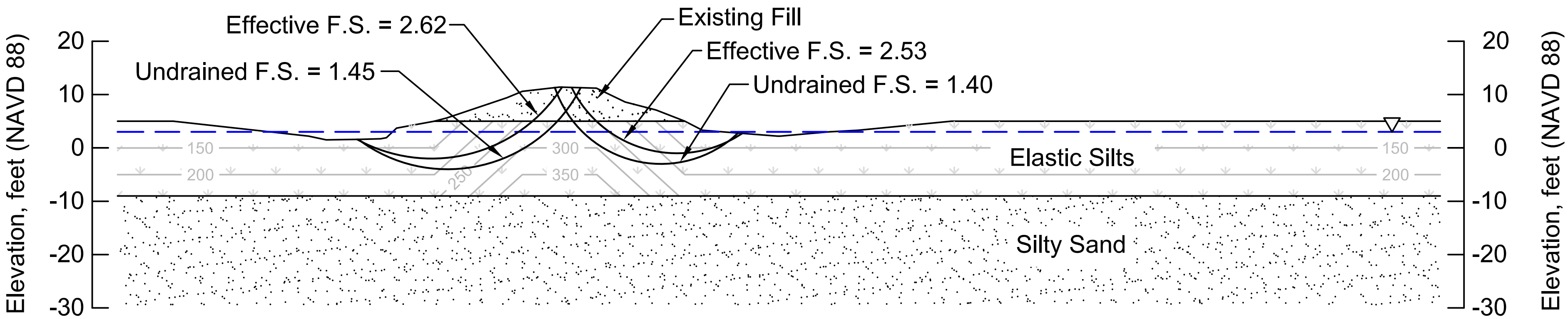
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 46+89

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-15



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

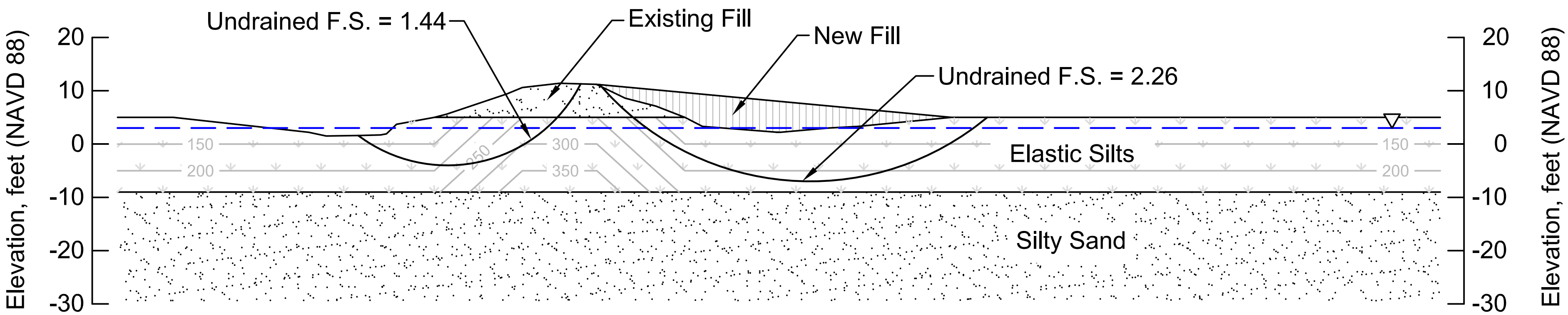
Tule Red
Solano County, California

Slope Stability Results
ExistingLevee
Station 65+86

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-16



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

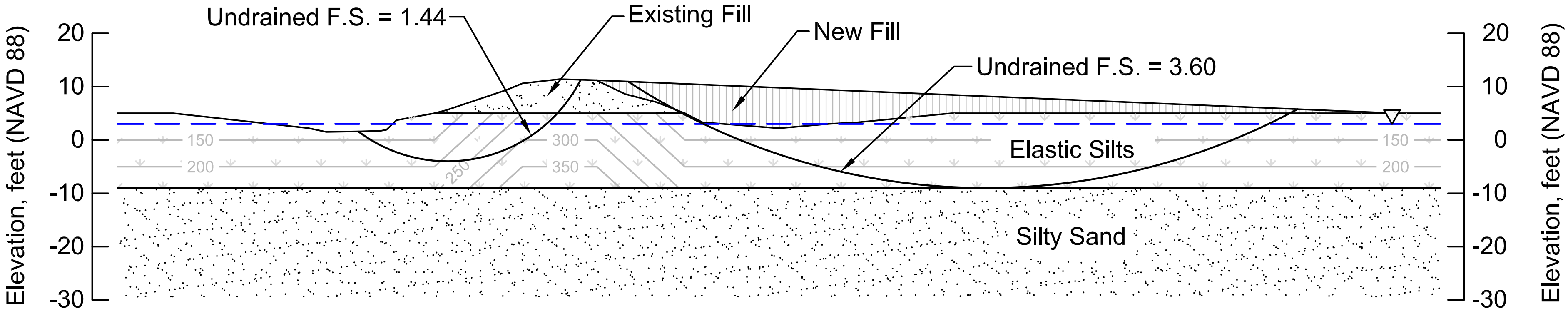
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 65+86

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-17



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

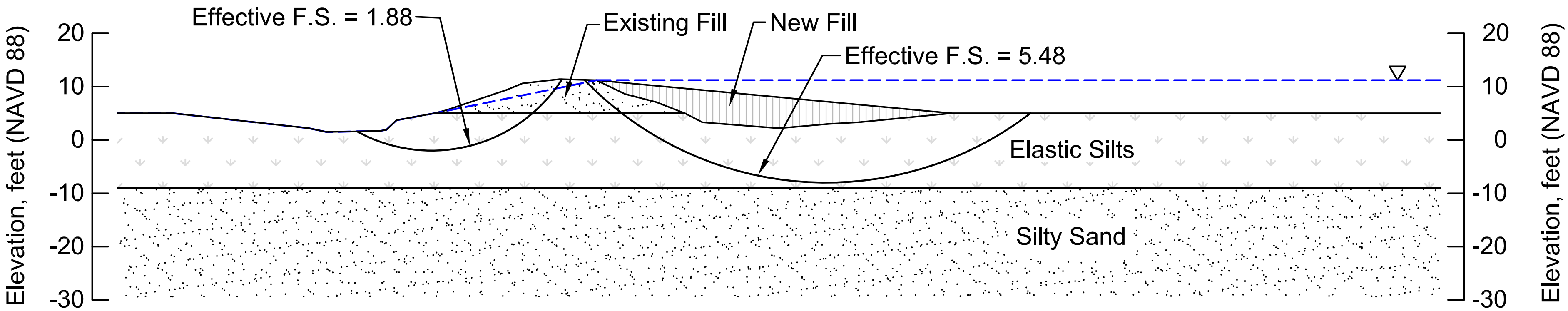
*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 65+86

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. C-18



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

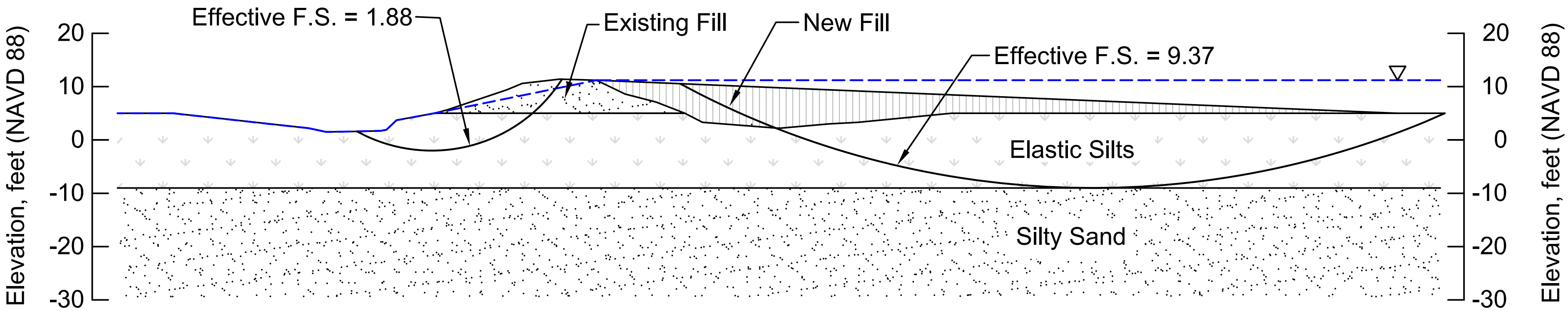
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 65+86

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-19



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

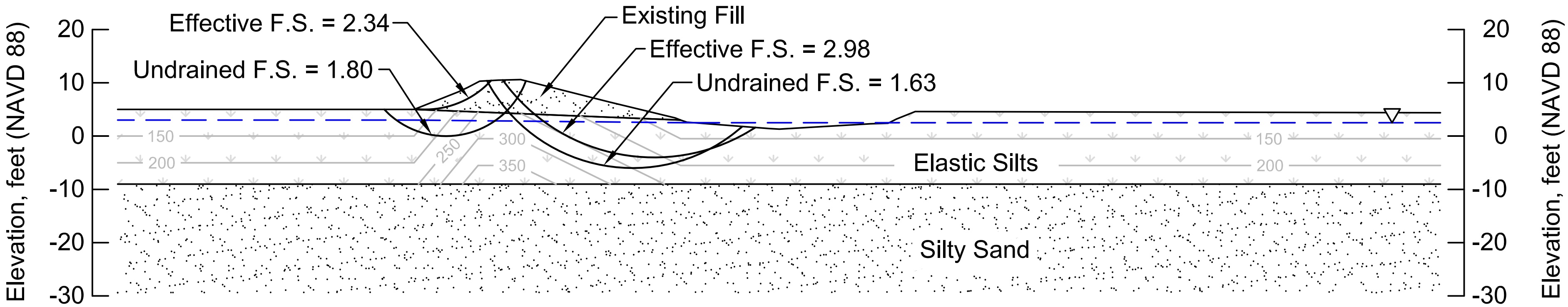
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 65+86

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-20



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

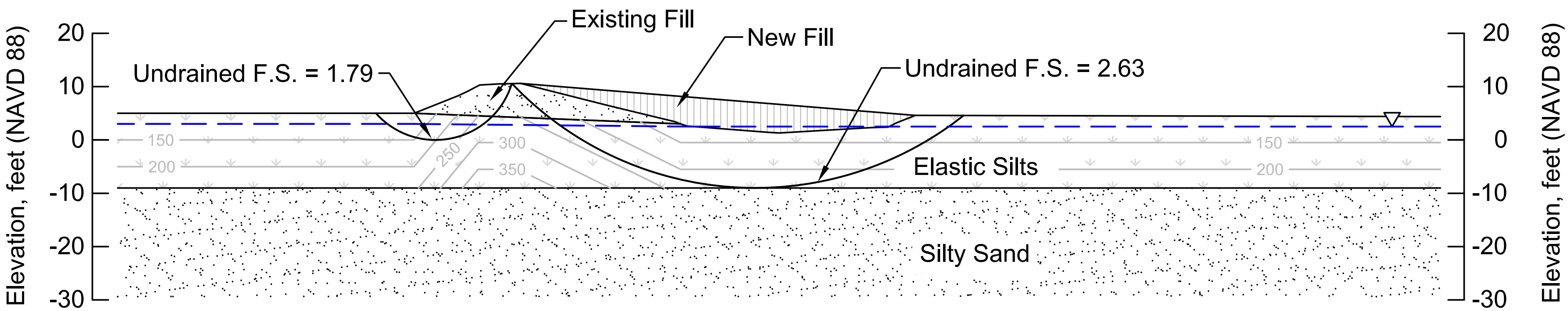
Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 105+59

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-21



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

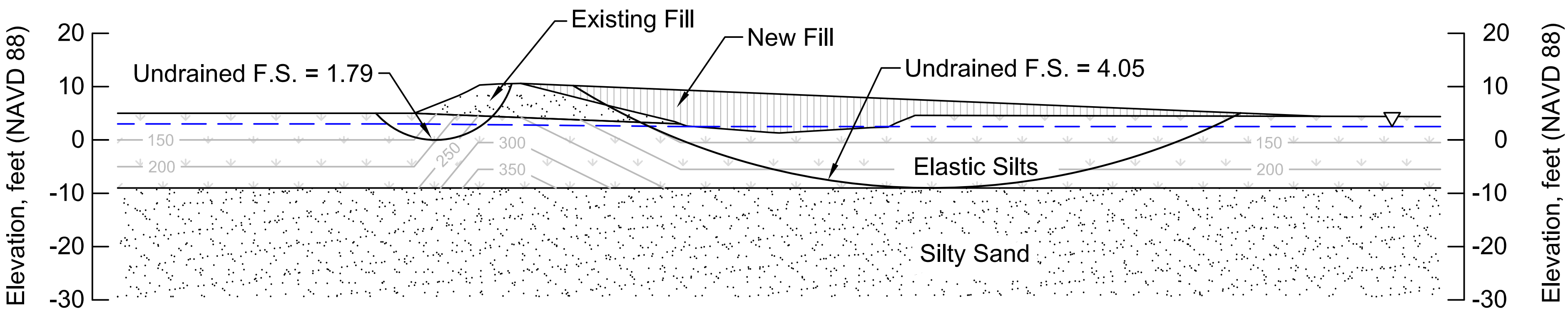
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 105+59

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-22



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

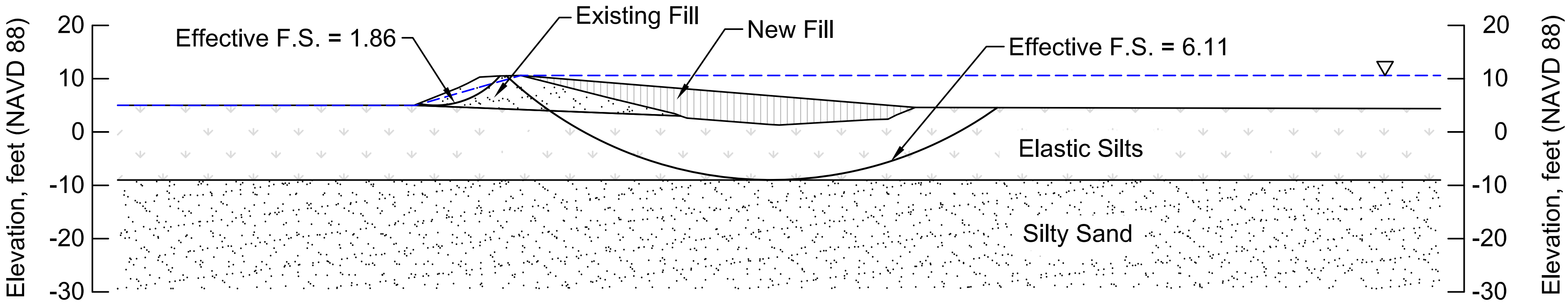
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 105+59

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-23



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

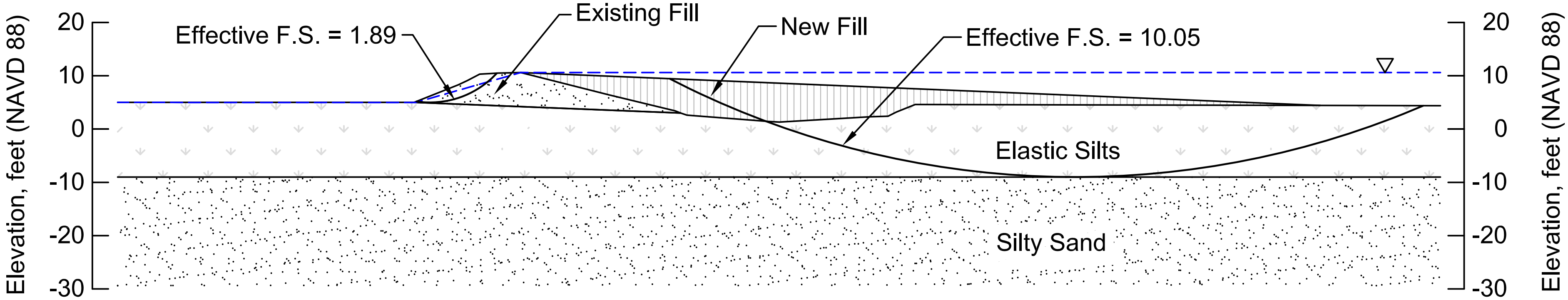
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 105+59

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-24



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

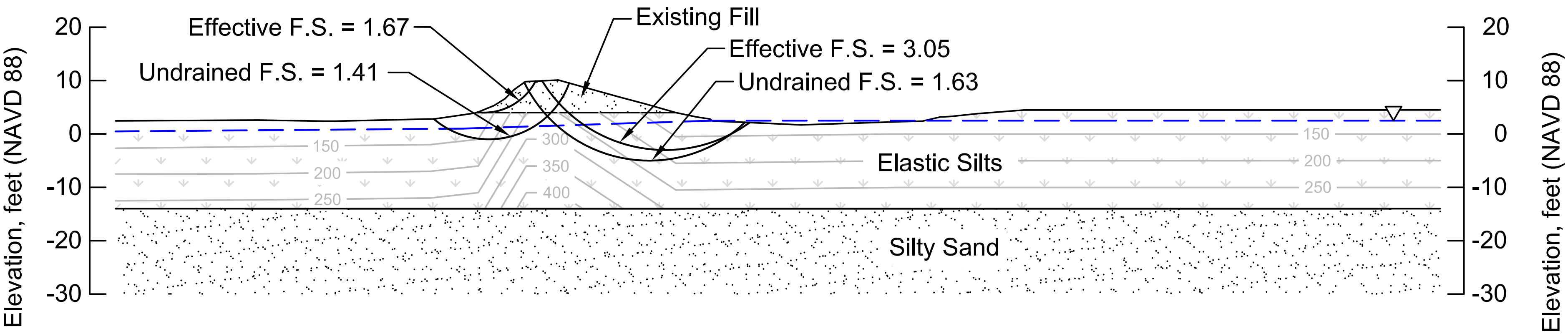
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 105+59

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-25



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

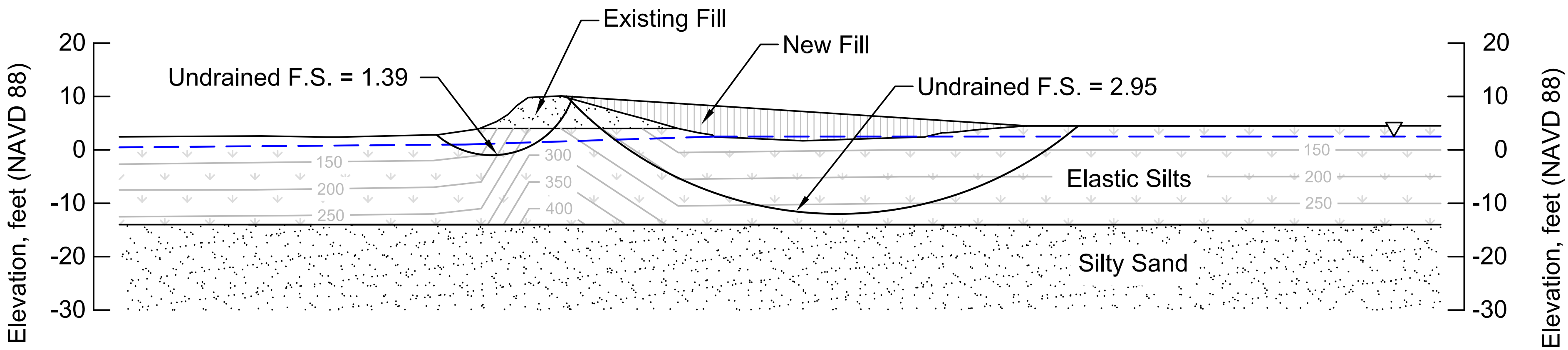
Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 121+95

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-26



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

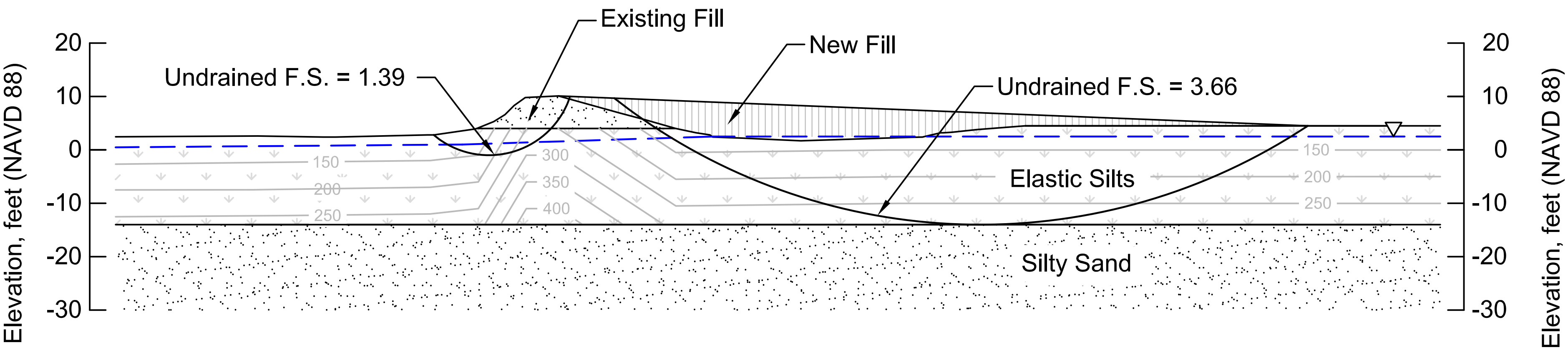
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 121+95

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-27



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

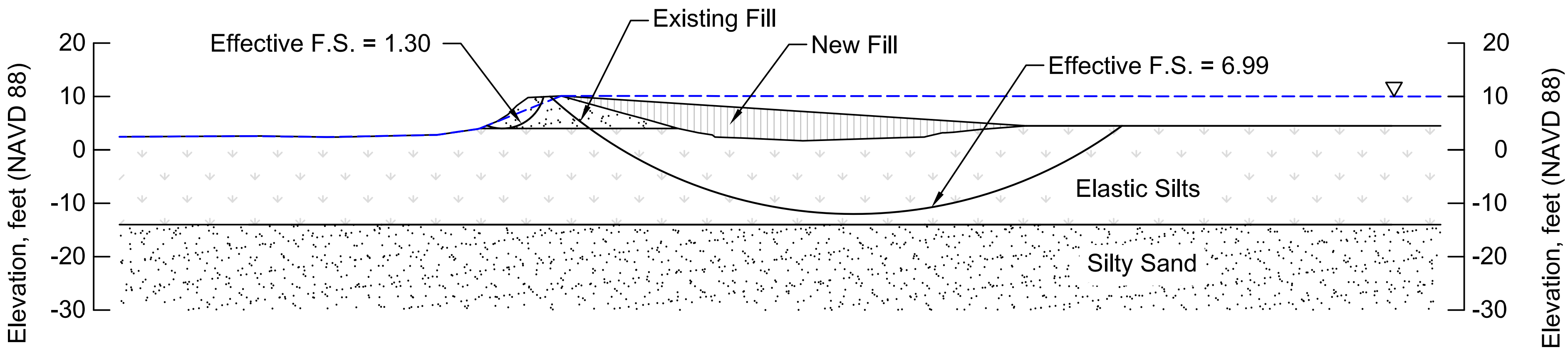
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 121+95

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-28



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

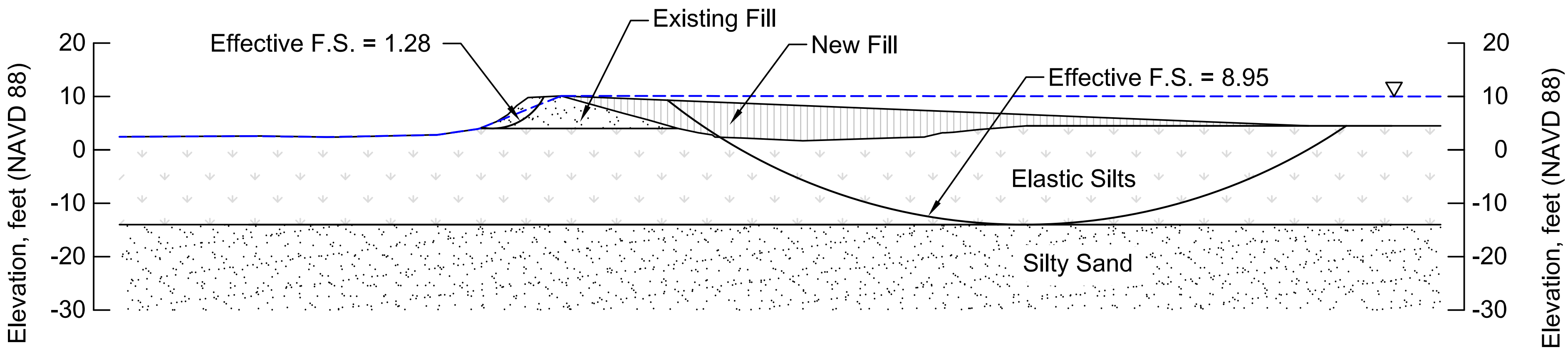
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 121+95

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-29



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
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Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

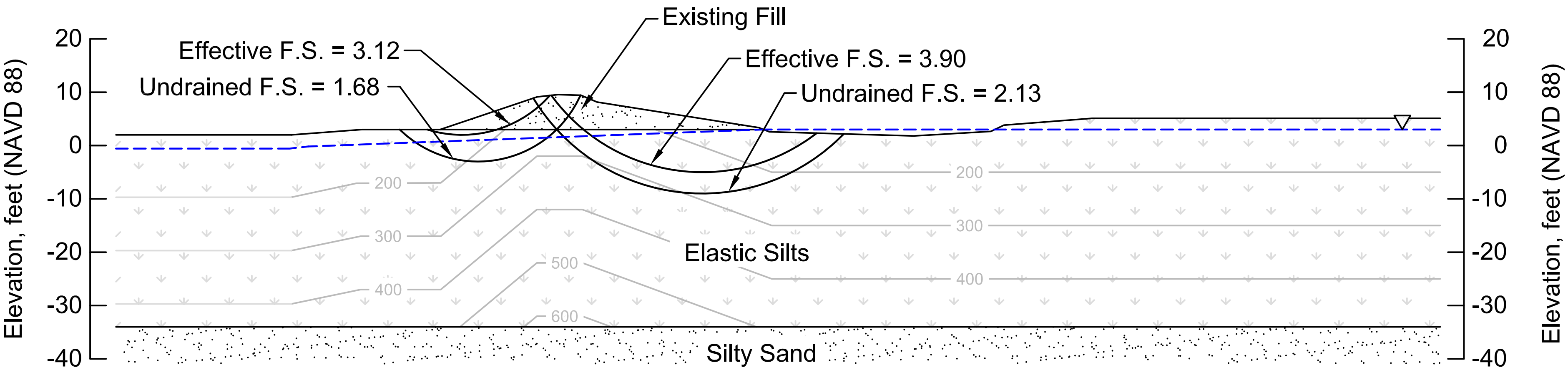
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 121+95

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-30



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

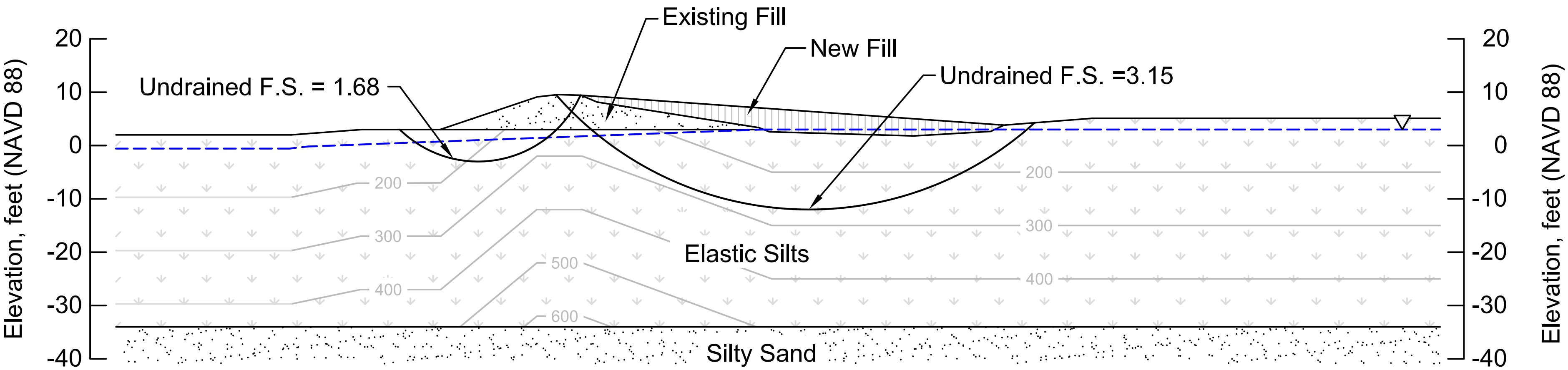
Tule Red
Solano County, California

Slope Stability Results
Existing Levee
Station 145+03

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-31



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

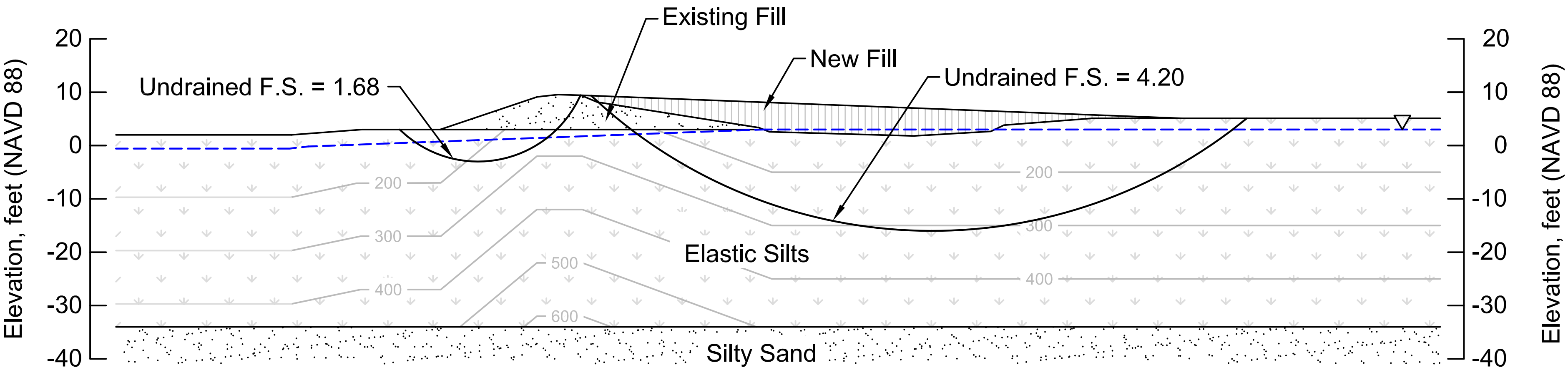
*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 1
Station 145+03

Hultgren - Tillis Engineers | Project No. 816.01 | Plate No. C-32



SOIL PARAMETERS

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		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	*	0	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

*See Undrained Strength Contours Above

SCALE
0 30 feet
1 inch = 30 feet

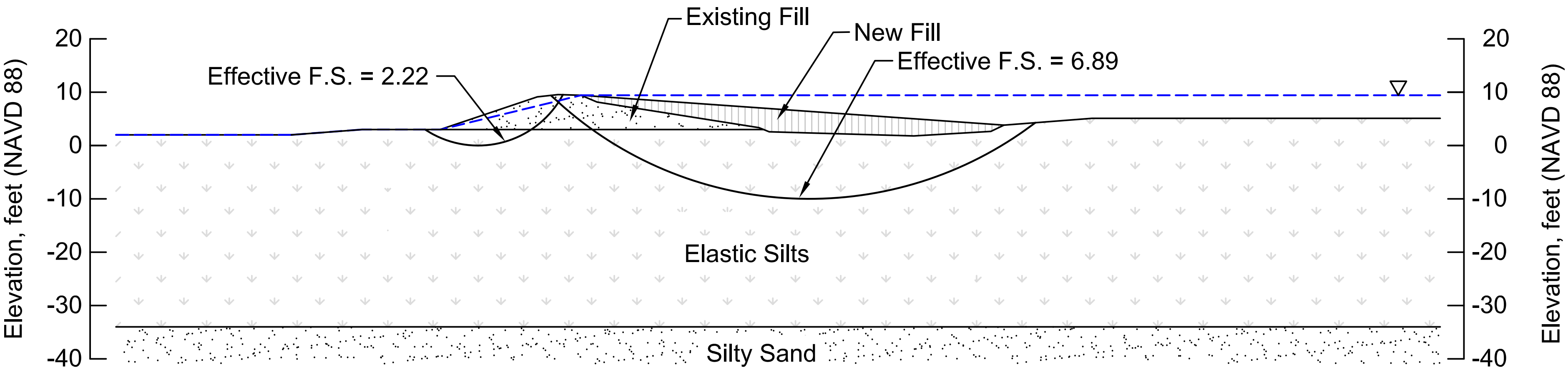
Tule Red
Solano County, California

Slope Stability Results
After Construction - Configuration 2
Station 145+03

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-33



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Fill	120	-	-	50	28
Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

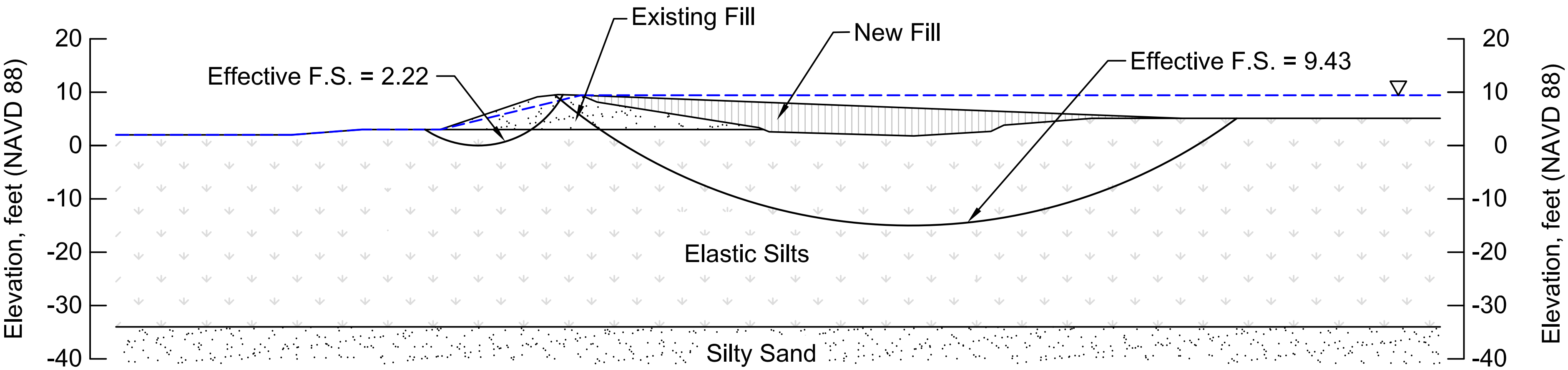
Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 1
Station 145+03

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-34



SOIL PARAMETERS

Material Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
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Elastic Silts	102	-	-	100	32
Silty Sand	120	-	-	50	38
New Fill	120	-	-	50	28

SCALE
0 30 feet
1 inch = 30 feet

Tule Red
Solano County, California

Slope Stability Results
Long-Term - Configuration 2
Station 145+03

Hultgren - Tillis Engineers

Project No. 816.01

Plate No. C-35

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CEQA Addendum

Tule Red Restoration Project

State Clearinghouse Number 2003112039

Lead Agency:

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Sacramento, CA 95834
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916.646.3644

February 2016

SFCWA State and Federal Contractors Water Agency

ICF International. 2016. Tule Red Restoration Project. CEQA Addendum. February. (ICF 00347.15.) Solano County, California. Lead Agency: State and Federal Contractors Water Agency, Sacramento, California.

Contents

Tables and Figures

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Chapter 2

Chapter 3

Acronyms and Abbreviations

AMAT	Adaptive Management Advisory Team
BAAQMD	Bay Area Air Quality Management District
BCDC	Bay Conservation and Development Commission
BMPs	best management practices
CAC	California Administrative Code
CALFED	CALFED Bay-Delta Program
CCWD	Contra Costa Water District
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CMC	Construction Management Center
CNDDB	California Natural Diversity Database
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
CRHR	California Register of Historic Resources
CVP	Central Valley Project
DO	dissolved oxygen
DWR	Department of Water Resources
ECs	environmental commitments
EFH	essential fish habitat
ERPP	Ecosystem Restoration Program Plan
ESA	Endangered Species Act
FAST	Fishery Agency Strategy Team
fps	feet per second
FRPA	Fish Restoration Program Agreement
GHGs	greenhouse gases
GPS	global positioning system
Hg	mercury
HMMP	Hazardous Materials Management Plan
Marsh	Suisun Marsh
MeHg	methylmercury
mg/kg	milligram per kilogram
MMs	mitigation measures
MT/yr	metric tons per year
NAHC	Native American Heritage Commission

NEPA	National Environmental Policy Act
ng/L	nanograms per liter
NMFS	National Marine Fisheries Service
NO_X	oxides of nitrogen
NRHP	National Register of Historic Places
PM10	particulate matter 10 microns in diameter or less
PM2.5	particulate matter 2.5 microns in diameter or less
ppm	parts per million
PRC	Public Resources Code
Principals	Suisun Principal Agencies
proposed project	Tule Red Restoration Project
Reclamation	Bureau of Reclamation
ROG	reactive organic gas
RPA	Reasonable and Prudent Alternative
RWQCB	Regional Water Quality Control Board
Service or USFWS	U.S. Fish and Wildlife Service
SFCWA	State and Federal Contractors Water Agency
SMHM	salt marsh harvest mouse
SMP	Suisun Marsh Plan
SMP EIS/EIR	Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/Environmental Impact Report
SMPA	Suisun Marsh Preservation Agreement
SMSCG	Suisun Marsh Salinity Control Gates
SRCD	Suisun Resource Conservation District
State Water Board	State Water Resources Control Board
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
WES	Westervelt Ecological Services

Chapter 1
Introduction

This chapter presents background and introductory information to amend the *Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/Environmental Impact Report* (SMP EIS/EIR) and implement the Tule Red Restoration Project (proposed project).

1.1 Overview

The SMP EIS/EIR was certified by the California Department of Fish and Wildlife (CDFW) in December 2011 and the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service) in April 2014. The Suisun Marsh Plan (SMP) provides a comprehensive 30-year plan for the management of activities within the Suisun Marsh (Marsh), including tidal restoration activities.

The SMP was prepared by the Suisun Principal Agencies (Principals), a group of agencies with primary responsibility for Marsh management. The intention of the SMP is to balance the benefits of tidal wetland restoration with other habitat uses in the Marsh by evaluating alternatives that provide a politically acceptable change in Marsh-wide land uses, such as salt marsh harvest mouse habitat, managed wetlands, public use, and upland habitat. The SMP relies on the incorporation of existing science and information developed through adaptive management.

The Principals are the Service, Reclamation, CDFW, California Department of Water Resources (DWR), National Marine Fisheries Service (NMFS), Suisun Resource Conservation District (SRCD), and CALFED Bay-Delta Program (CALFED). The Principals have consulted with other participating agencies, including the U.S. Army Corps of Engineers (Corps), San Francisco Bay Conservation and Development Commission (BCDC), the Regional Water Quality Control Board (RWQCB), and the State Water Resources Control Board (State Water Board), in developing the SMP.

The Principal agencies prepared the SMP EIS/EIR and analyzed the potential environmental impacts of implementing the SMP (the preferred project of the EIR/EIS). The SMP EIR/EIS programmatically evaluated the conversion of 5,000 to 7,000 acres of managed wetlands to tidal habitat over the next 30 years. The proposed project would be the first tidal restoration project within the Marsh that was planned for by the SMP and programmatically evaluated in the SMP EIS/EIR. Accordingly, the State and Federal Contractors Water Agency (SFCWA) is proposing to prepare an addendum to the SMP EIS/EIR to implement the proposed project and document potentially significant environmental impacts per the California Environmental Quality Act (CEQA).

1.2 Project Location and Proposed Project

Historically, the Marsh was a tidal marsh system, with the range of salinity, vegetation composition, and species utilization based on local geography and Sacramento and San Joaquin River inputs. In the late 1800s, the Marsh was diked for water management to support agriculture and duck hunting club activities.

The proposed project is adjacent to Grizzly Bay, within Suisun Marsh, in Solano County, California. The property on which the project is proposed is currently, and has been historically, managed as the Tule Red Duck Club. It is located in SMP Region 4 of the Marsh and adjacent to the Grizzly King Duck Club, the DFW Grizzly Island Wildlife Area, and Grizzly Bay. The vast majority of the site is managed marsh, with a small area of tidal marsh at the northern end of the site and along the bayside margin of the natural berm. Upland habitat is located along the uppermost crowns of the adjacent levees.

The proposed project would restore approximately 420 acres of existing managed brackish wetlands to tidal habitat, which would directly benefit federally and state-listed delta smelt, longfin smelt, and salmonids. The proposed project would introduce full daily tidal exchange to existing managed marsh habitat owned by Westervelt Ecological Services (WES) and CDFW. The proposed project is consistent with the SMP and the evaluation in the SMP EIS/EIR. The proposed project would partially fulfill the 8,000-acre tidal restoration obligations of the Fish Restoration Program Agreement (FRPA), satisfying the requirements of the Service's 2008 Biological Opinion for Delta Smelt, the 2009 NMFS Biological Opinion for the Coordinated Operations of the State Water Project (SWP) and the Federal Central Valley Project (CVP), and the Longfin Smelt Incidental Take Permit for the SWP. The proposed project is also identified as a priority restoration project under the California EcoRestore program.

1.3 CEQA and Addendums

The SFWCA has prepared this addendum to the final EIS/EIR for the SMP to assess the impacts associated with the proposed project that could occur since the final EIS/EIR was certified. According to Section 15164(a) of the State CEQA Guidelines, the lead agency or the responsible agency will prepare an addendum to a previously certified EIR if changes or additions are necessary but none of the conditions described in Section 15162, calling for the preparation of a subsequent or supplemental EIR, have occurred. An addendum need not be circulated for public review but can be included in or attached to the final EIR. The decision-making body considers the addendum with the final EIR prior to making a decision on the project.

Section 15162 of the State CEQA Guidelines states that, for a project covered by a certified EIR, preparation of a subsequent or supplemental EIR ***rather than*** an addendum is required only if one or more of the following conditions occur:

1) Substantial changes are proposed in the project that will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects.

2) Substantial changes occur with respect to the circumstances under which the project is undertaken that will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects.

3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR was certified as complete or the negative declaration was adopted, shows any of the following:

   a) The project will have one or more significant effects not discussed in the previous EIR or negative declaration;

b) Significant effects previously examined will be substantially more severe than shown in the previous EIR;

c) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or

d) Mitigation measures or alternatives that are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

The addendum is prepared in accordance with CEQA Public Resources Code (PRC) Section 21000 et seq. and the State CEQA Guidelines (California Administrative Code [CAC] Section 15000 et seq.).

1.4 Scope of Addendum

Section 15063(c)(3)(D) of the State CEQA Guidelines states that earlier analyses may be used where, pursuant to tiering, a program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR. The scope, content, and organization of this addendum to the SMP EIS/EIR meet the current requirements of CEQA and the State CEQA Guidelines. Although an addendum need not be noticed or circulated, SFWCA circulated a notice of the preparation of this addendum for 30 days on October 9, 2015, to the State Clearinghouse and public agencies and interested stakeholders. The notice requested written comments regarding the scope of the addendum to ensure that the appropriate range of environmental issues related to the proposed project was identified and evaluated. A total of four comments were received. These comments are included in Appendix A, *Public Comments Regarding the Notice of Preparation of an Addendum*, of this document. The comments were reviewed, and information related to the comments is incorporated in this addendum.

The addendum describes the affected environmental resources and evaluates the potential changes in the impacts that were previously described in the SMP EIS/EIR with respect to constructing and operating the proposed project. The scope of analysis in the addendum addresses each of the environmental resource areas previously analyzed in the SMP EIS/EIR, and identified in Appendix G of the State CEQA Guidelines, as listed below.

- Water Quality, Surface Hydrology, and Water Supply (groundwater, flooding, and sediment transport)
- Biological Resources (fish, vegetation and wetlands, wildlife)
- Air Quality, Greenhouse Gases, and Climate Change
- Cultural Resources
- Land Use
- Aesthetics
- Agricultural Resources
- Geology, Soils, and Mineral Resources (levee stability)
- Hazards and Hazardous Materials (Public Health, Environmental Hazards and Transportation)
- Noise
- Recreation
- Transportation and Navigation
- Utilities and Public Services
- Population and Housing

The addendum substantiates why it is appropriate to use the SMP EIS/EIR and that no significant impacts on the environment that were not previously disclosed in SMP EIS/EIR would occur under the proposed project. Details from the project description and the SMP EIS/EIR support these conclusions.

Technical information used in the addendum to support conclusions includes the following:

- Hydraulic modeling, evaluating flow rate, velocity, and water-surface elevation
- Hydrodynamic and salinity modeling, evaluating salinity changes
- Geotechnical modeling, evaluating soil stability for the existing perimeter berm and the designed habitat levee
- Sensitive-species surveys
- Air quality analysis
- Cultural resource evaluation, documenting known cultural resources and identifying the potential for undiscovered cultural resources within the project area

The criteria for determining the significance of environmental impacts in the addendum analysis are generally the same as those used in the SMP EIS/EIR and are consistent with those described in Appendix G of the State CEQA Guidelines.

1.5 Addendum Organization

This addendum includes the certified final SMP EIS/EIR by reference and addresses the impacts of the changes to the project description/concept design. Section 15063(c)(3)(D) of the State CEQA Guidelines states that earlier analyses may be used where, pursuant to tiering, a program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR. The content and organization of this addendum to the previously certified final EIS/EIR are designed to meet the current requirements of CEQA and the State CEQA Guidelines.

This addendum is organized as described below.

- Chapter 1, "Introduction and Overview," includes background and introductory information regarding the proposed modifications, the background of the project, the purpose of the addendum, and the scope and content of the document.
- Chapter 2, "Project Description and Location," provides the location, details, and objectives of the proposed project.
- Chapter 3, "Environmental Analysis Determination," compares the potential changes in the impacts of the proposed project to the impacts that were previously analyzed as part of the certified final EIS/EIR. This chapter identifies which effects were within the scope of and adequately analyzed in the previously certified final EIS/EIR and whether such effects were addressed by mitigation measures, based on the earlier analysis. Where appropriate, mitigation measures that are incorporated or refined from the final EIS/EIR are discussed to distinguish the extent to which they address site-specific conditions for the proposed project.

- Chapter 4, "References Cited," identifies the documents (printed references), web sites, and individuals (personal communications) that were consulted during preparation of this addendum.
- Chapter 5, "List of Preparers," lists the individuals who were involved in preparing this addendum.
- Appendices A through H contain detailed technical information that substantiates the claims in Chapter 3.

1.6 Previous Environmental Documents Incorporated by Reference

Consistent with Section 15150 of the State CEQA Guidelines, the following document was used in preparation of this addendum and is incorporated herein by reference.

- Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Fish and Game. 2011. *Suisun Marsh Habitat Management, Preservation, and Restoration Plan Final Environmental Impact Statement/Environmental Impact Report*. November. SCH#2003112039 (Reclamation 2011).

This document available at: http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=781

1.7 Permitting Agencies

Several agencies would be involved in permitting activities for the construction and operation of the proposed project. Table 1-1 summarizes these permitting agencies and their currently expected roles.

Table 1-1. Permitting Agencies

Agency	Role
U.S. Army Corps of Engineers	Issue a Section 404/10 permit under the Clean Water Act for activities within wetlands and waters of the U.S.
U.S. Coast Guard	Coordinate with Corps on Section 10 of the Clean Water Act
U.S. Fish and Wildlife Service	Review compliance of proposed project with existing programmatic Biological Opinion for the Suisun Marsh Plan
California Department of Fish and Wildlife	Issue incidental take permit (if necessary)
State Water Resources Control Board	Issue construction general permit and approve Stormwater Pollution Prevention Plan
Regional Water Quality Control Board (#5)	Issue 401 Water Quality Certification to control pollutant discharges to water bodies
Bay Conservation and Development Commission	Issue Suisun Marsh permit
Delta Stewardship Council	Issue consistency determination regarding the Delta Plan
Solano County	Issue grading permit for construction activities and use/Marsh development permit

Chapter 2
Project Description

2.1 Introduction

In accordance with the California Environmental Quality Act (CEQA), the State and Federal Contractors Water Agency (SFCWA) is proposing to prepare an addendum to the *Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/Environmental Impact Report* (SMP EIS/EIR) and implement the Tule Red Restoration Project (proposed project). The SMP EIS/EIR was certified by the California Department of Fish and Wildlife (CDFW) in December 2011 and the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service) in April 2014. The Suisun Marsh Plan (SMP) provides a comprehensive 30-year plan for management of activities within Suisun Marsh (Marsh), including tidal restoration activities. The SMP EIS/EIR programmatically evaluated the conversion of 5,000 to 7,000 acres of managed wetlands to tidal habitat over the next 30 years. The proposed project would be the first tidal restoration project within the Marsh that was planned for by the SMP and programmatically evaluated in the SMP EIS/EIR. Accordingly, SFCWA will prepare an addendum to the SMP EIS/EIR to document potentially significant environmental impacts.

2.2 Background

Historically, the Marsh was a tidal marsh system, with the range of salinity, vegetation composition, and species utilization based on local geography and Sacramento and San Joaquin River inputs. In the late 1800s, the Marsh was diked for water management to support agriculture and duck hunting club activities. Figure 1 shows the location of Suisun Marsh.

The SMP was prepared by the Suisun Principal Agencies (Principals), a group of agencies with primary responsibility for Marsh management. The intention of the SMP is to balance the benefits of tidal wetland restoration with other habitat uses in the Marsh by evaluating alternatives that provide a politically acceptable change in Marsh-wide land uses, such as salt marsh harvest mouse habitat, managed wetlands, public use, and upland habitat. The SMP relies on the incorporation of existing science and information developed through adaptive management.

The Principals are the Service, Reclamation, CDFW, California Department of Water Resources (DWR), National Marine Fisheries Service (NMFS), Suisun Resource Conservation District (SRCD), and CALFED Bay-Delta Program (CALFED). The Principals have consulted with other participating agencies, including the U.S. Army Corps of Engineers (Corps), San Francisco Bay Conservation and Development Commission (BCDC) the Regional Water Quality Control Board (RWQCB), and the State Water Resources Control Board (State Water Board), in developing the SMP.

2.2.1 SMP

The SMP is a comprehensive plan that has been designed to address various conflicts regarding the use of Marsh resources, with a focus on achieving an acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of wetlands and their functions. As such, the SMP is intended to be a flexible, science-based management plan for Suisun Marsh, consistent with the revised Suisun Marsh Preservation Agreement and CALFED. It also is intended to set the regulatory foundation for future actions within the Marsh. The need for the SMP was based on four major Marsh resources and functions, which are linked directly to the purpose and objective of the SMP EIS/EIR. The resources and functions are listed below.

- **Habitat and Ecological Processes** – Restore lost tidal wetlands by implementing the CALFED Ecosystem Restoration Program Plan (ERPP) restoration target for the Suisun Marsh ecoregion (5,000 to 7,000 acres of tidal marsh) and protecting and enhancing 40,000 to 50,000 acres of managed wetlands.
- **Public and Private Land Use** – Maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of Suisun Marsh.
- **Levee System Integrity** – Maintain and improve the Suisun Marsh levee system's integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding.
- **Water Quality** – Protect and, where possible, improve water quality for beneficial uses in Suisun Marsh, including estuarine, spawning, and migrating habitat uses for fish species, as well as recreational uses and associated wildlife habitat.

These resources and functions are interrelated and interdependent and, to some extent, objectives of all SMP actions. For example, the restoration of certain properties (i.e., the proposed project) may help to protect or improve water quality; habitat and ecological processes would help to achieve private and public land use objectives. Given these relationships, the SMP is proposed to contribute to meeting each objective in parallel over the 30-year planning period.

2.2.2 SMP EIS/EIR

Multiple agencies were involved in preparing the SMP EIS/EIR, including all the Principals. The EIS/EIR evaluated the SMP as the proposed project and documented all potentially significant environmental impacts that could result from implementing the SMP and activities associated with managed wetlands and tidal restoration.

2.2.2.1 Agency Involvement

The SMP EIS/EIR describes the agencies involved in preparing the SMP and the SMP EIS/EIR as well as those that are expected to use the SMP EIS/EIR (Chapter 1). These agencies assume roles and responsibilities either through their agency's authority or through their participation in the National Environmental Policy Act (NEPA) and CEQA process. These agencies include:

- The Service and Reclamation as NEPA lead agencies, responsible primarily for preparing and certifying the EIS.
- NMFS and the Corps as NEPA cooperating agencies, responsible primarily for providing special expertise related to the project and holding jurisdiction over the project.
- CDFW as CEQA lead agency and trustee agency, responsible primarily for preparing and certifying the EIR and managing certain resources that are held in trust for the people of the state of California.

Table 2-1 summarizes additional responsible and trustee agencies.

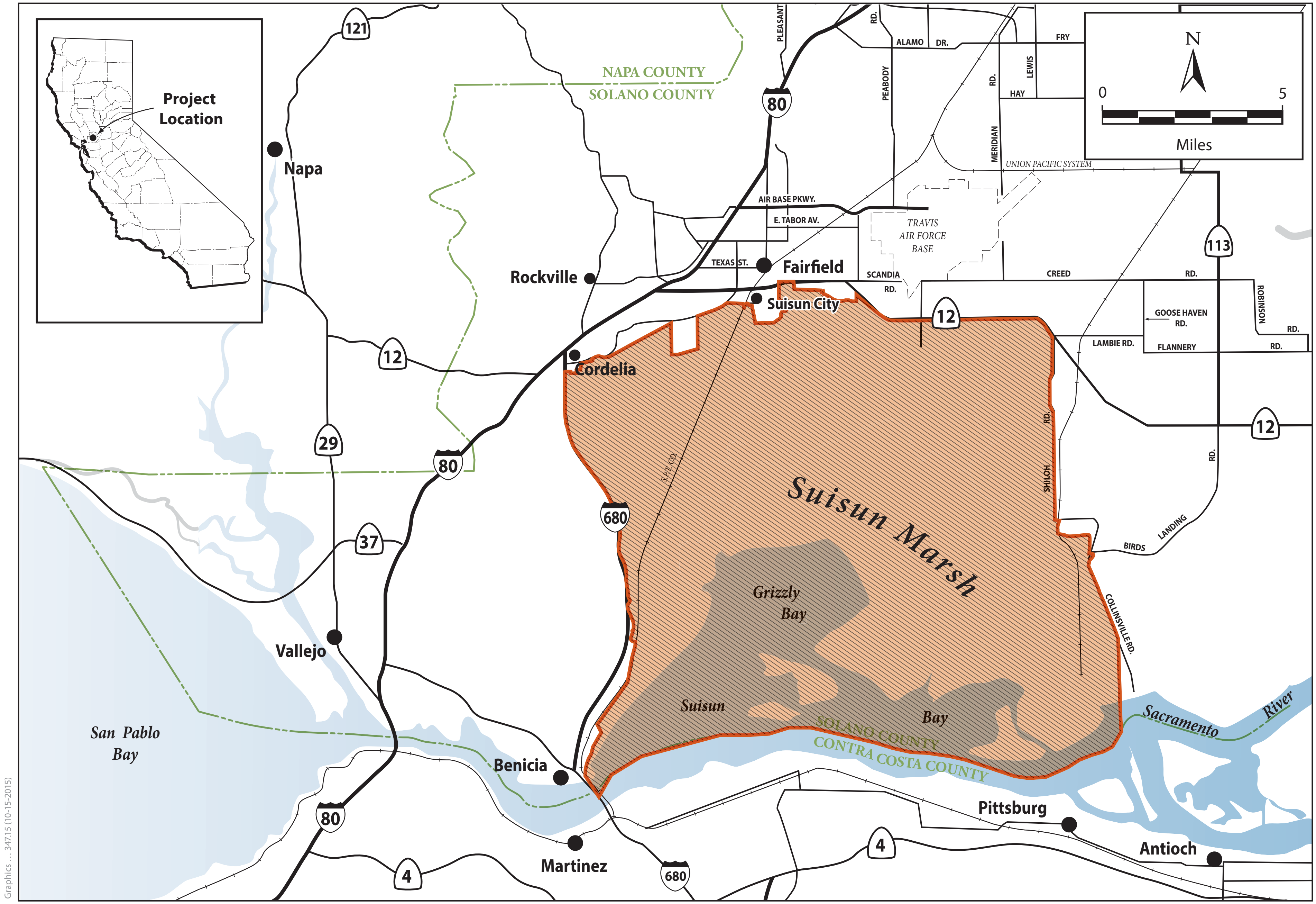

Figure 1
Suisun Marsh Location

Table 2-1. Additional Responsible and Trustee Agencies

Agency	Jurisdiction
Trustee	
State Lands Commission	State-owned "sovereign" lands
Responsible	
California Department of Fish and Wildlife	Streambed alteration and impacts on state-listed species
Office of Historic Preservation	Historic and cultural resources
California Department of Water Resources	Delta Levees Program, SMPA funding, water management facilities
Suisun Resource Conservation District	Managed wetland management
California Air Resources Board	Air quality
Regional Water Quality Control Board (#5)	Pollutant discharges to water bodies
Bay Conservation and Development Commission	Dredging; any development activity that occurs below the 10-foot contour level
Solano County	Construction

SMPA = Suisun Marsh Preservation Agreement.

Trustee Agency: One that has jurisdiction over certain resources that are held in trust for the people of California but does not necessarily have legal authority with respect to approving or carrying out the project.

Responsible Agency: One that has responsibility for carrying out or approving the project.

2.2.2.2 Impact Analysis

The SMP EIS/EIR provided a programmatic evaluation of the restoration of tidal habitat in the Marsh and associated activities regarding a wide variety of environmental resources. As part of the SMP, environmental commitments were developed, which are to be implemented during restoration activities within the Marsh. These environmental commitments are summarized in Chapter 2 of the SMP EIS/EIR and in Appendix F, *Mitigation Monitoring and Reporting Program*, of the SMP EIR/EIS. A general list is provided below.

- Standard Design Features and Construction Practices
- Limits on Access Points and Staging Areas
- Erosion and Sediment Control Plan Requirements
- Stormwater Pollution Prevention Plans
- Noise Compliance
- Traffic and Navigation Control Plan and Emergency Access Plan
- Recreation Best Management Practices
- Mosquito Abatement Best Management Practices
- Hazardous Materials Management Plans
- Air Quality Best Management Practices

- Visual/Aesthetic Best Management Practices
- Inadvertent Discovery of Cultural Resource Requirements
- Cultural Resources
- Biological Resources Best Management Practices - General Best Management Practices
- Biological Resources Best Management Practices - Worker Training
- Biological Resources Best Management Practices – Special-Status Plant Species
- Biological Resources Best Management Practices - Protection of Special-Status Wildlife Species: Birds
- Biological Resources Best Management Practices - Protection of Special-Status Wildlife Species: Raptors
- Biological Resources Best Management Practices - Protection of Special-Status Wildlife Species: Western Pond Turtle
- Biological Resources Best Management Practices - Protection of Special-Status Wildlife Species: Western Pond Turtle
- Biological Resources Best Management Practices - Protection of Special-Status Wildlife Species: Western Pond Turtle
- Biological Resources Best Management Practices - Protection of Special- Protection of Special-Status Wildlife Species: California Least Tern
- Biological Resources Best Management Practices – Special-Status Wildlife Species Protection: Mammals
- Biological Resources Best Management Practices – Special-Status Wildlife Species Protection: California Clapper Rail and California Black Rail
- Biological Monitoring
- Non-Native Plant Control
- Construction Period Restrictions

The SMP EIS/EIR disclosed that impacts on most environmental resources as a result of tidal restoration activities were either less than significant or did not occur (i.e., no impact). To reduce significant impacts to a less-than-significant level, mitigation was incorporated in the SMP EIS/EIR with respect to the effects of restoration activities on two environmental resources, as summarized in Table 2-2. It was determined that restoration activities could significantly and unavoidably affect known and as-yet-unidentified cultural resources by damaging or destroying them. Although mitigation measures are included in the SMP EIS/EIR (as summarized in Table 2-2), it was determined that the measures would not reduce the impact to less than significant

Table 2-2. Resources Requiring Mitigation

Resource	Mitigation in the SMP EIS/EIR
Air Quality	AQ-MM-1: Limit Construction Activity during Restoration AQ-MM-2: Reduce Construction NO_X Emissions AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures AQ-MM-4: Limit Construction Activity during Restoration and Management
Cultural Resources	CUL-MM-1: Document and Evaluate the Montezuma Slough Rural Historic Landscape, Assess Impacts, and Implement Mitigation Measures to Lessen Impacts CUL-MM-2: Evaluate Previously Recorded Cultural Resources and Fence NRHP- and CRHR-Eligible Resources prior to Ground-Disturbing Activities CUL-MM-3: Protect Known Cultural Resources from Damage Incurred by Inundation through Plan Design (Avoidance) CUL-MM-3: Protect Known Cultural Resources from Damage Incurred by Inundation through Plan Design (Avoidance) CUL-MM-4: Resolve Adverse Effects prior to Construction CUL-MM-5: Conduct Cultural Resource Inventories and Evaluations and Resolve Any Adverse Effects
Utilities and Public Services	UTL-MM-1: Relocate Overhead Power Lines or Other Utilities that Could Be Affected by Construction UTL-MM-2: Avoid Ground-Disturbing Activities within Pipeline Right-of-Way UTL-MM-3: Relocate or Upgrade Utility Facilities that Could Be Damaged by Inundation UTL-MM-4: Test and Repair or Replace Pipelines that Have the Potential for Failure

NO_X = nitrogen oxides; BAAQMD = Bay Area Air Quality Management District

2.3 Proposed Project

This section provides a summary of the location and a description of the proposed project, including its relationship to the SMP EIS/EIR and the CEQA objectives of the proposed project.

Westervelt Ecological Services (WES) is developing the proposed project on behalf of SFCWA. The proposed project is adjacent to Grizzly Bay, within the Suisun Marsh of Solano County, California. It would restore approximately 420 acres of existing managed brackish wetlands to tidal habitat, which would directly benefit federally and state-listed delta smelt, longfin smelt, and salmonids. The proposed project would introduce full daily tidal exchange to existing managed marsh habitat owned by WES and CDFW. The proposed project is consistent with the SMP and the evaluation in the SMP EIS/EIR.

Table 2-3 summarizes the consistency of the proposed project with the SMP's purpose and objectives.

Table 2-3. Proposed Project Consistency with Suisun Marsh Plan Purpose and Objectives

Suisun Marsh Plan Purpose and Objectives	Proposed Project
Habitats and Ecological Processes—Implement the CALFED ERPP restoration target for the Suisun Marsh ecoregion (5,000 to 7,000 acres of tidal marsh) and protect and enhance 40,000 to 50,000 acres of managed wetlands.	The proposed project would restore approximately 420 acres of tidal marsh and tidal channel habitat.
Public and Private Land Use—Maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of Suisun Marsh.	The proposed project would maintain the heritage of waterfowl hunting. Tidal areas below the ordinary high-water mark are public access areas. Additionally, the Grizzly Island Wildlife Area may run hunting through its reservation system.
Levee System Integrity—Maintain and improve the Suisun Marsh levee system integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding.	The proposed project design has been reviewed for levee system integrity, including protection of the Roaring River Distribution System and incorporation of a habitat berm to protect the managed wetlands on the east side of the site.
Water Quality—Protect and, where possible, improve water quality for beneficial uses in Suisun Marsh, including estuarine, spawning, and migrating habitat uses for fish species, as well as recreational uses and associated wildlife habitat.	The proposed project design is being modeled to protect water quality.

The proposed project also promotes the restoration of tidal wetlands, as discussed in the SMP EIS/EIR and as follows:

- It consists of converting managed wetlands to tidal wetlands, channels, tidal pannes, and transitional habitat
- It will contribute to the recovery of special-status species, including the delta smelt, longfin smelt, salt marsh harvest mouse, and clapper rail
- It has a sufficient sediment budget and appropriate elevations for accommodating sea level rise
- It has proximity to open-water habitats that provide connections to other habitats
- It will provide food-web support to native fish through the production and export of phytoplankton, zooplankton, and benthic invertebrates

2.3.1 Proposed Project Objectives

The proposed project would partially fulfill the 8,000-acre tidal restoration obligations of the Fish Restoration Program Agreement (FRPA), satisfying the requirements of the Service's 2008 Biological Opinion for Delta Smelt, the 2009 NMFS Biological Opinion for the Coordinated Operations of the State Water Project (SWP) and the Federal Central Valley Project (CVP), and the Longfin Smelt Incidental Take Permit for the SWP. The proposed project is also identified as a priority restoration project under the California EcoRestore program.

The objectives of the proposed project are:

- Enhance regional food-web productivity and export to Grizzly Bay in support of delta smelt and longfin smelt recovery
- Provide rearing habitats for out-migrating juvenile salmonids
- Provide rearing, breeding, and refugia habitats for a broad range of other aquatic and wetland-dependent species that utilize or depend on the combination of brackish aquatic/tidal marsh habitat
- Provide ecosystem functions associated with the Delta brackish aquatic, tidal marsh, and upland interfaces that these species required
- Provide topographic variability to allow for habitat succession and resilience against future climate change and sea level rise

2.3.2 Location

The property on which the project is proposed is currently, and has been historically, managed as the Tule Red Duck Club. It is located in SMP Region 4 of the Marsh. The vast majority of the project site is managed marsh, with a small area of tidal marsh at the northern end of the project site and along the bayside margin of the existing natural berm. The upper limit of the natural berm is approximately 6 feet in elevation and located on the western edge of the property; daily tidal sediment accretion occurs along the berm. The project site gradually slopes eastward to an elevation of 3 to 4 feet; the eastern boundary is defined by levees established for water management on the adjacent Grizzly King Duck Club and Grizzly Island Wildlife Area. A majority of the project site is now disconnected from daily tidal influence, and water levels are managed on a seasonal basis. Upland habitat is located along the uppermost tops of the adjacent levees. A water supply and drainage channel parallels the levee on the eastern boundary of the project site, and this channel connects to the bay on both the north and south end through dual combination flap gate water control structures. Water elevations and site drainage are managed through these tide gates, the channel, and numerous internal distribution ditches. The project site is typically kept flooded at a stable water level from October to February for duck hunting, then repeatedly drained and re-flooded through the spring to leach salts from the soil, and is then fully drained through summer and early fall for disking, mowing, and any maintenance of ditches or water control levees and structures. Figure 2 shows the proposed project location within Suisun Marsh, and Figure 3 shows the project area.

2.3.3 Description

The proposed project would restore approximately 420 acres of existing managed wetlands to tidal habitat. The proposed project would be designed to be a naturally self-regulating system that would not require active management or intervention, which is the intent of the SMP for restoration projects. The proposed project would provide four primary habitat features: 1) a breach of the natural levee at the northern part of the project area to allow for full daily tidal exchange through the interior of the project site, 2) a network of distribution channels to convey water across the marsh plain, 3) a series of tidal pans and basins to retain water for periods of up to 2 weeks and maximize aquatic food production, and 4) a continuous habitat berm along the eastern perimeter of the property to provide a more gradual transition from marsh to upland habitat and maintain the existing levels of flood protection for adjacent properties.

Figure 4 shows the conceptual plan for the proposed project, and Figures 5a and 5b show a cross section of the proposed habitat berm. The four habitat features would support the interrelated resources and functions described in the SMP.

The proposed project would support approximately 460 acres of tidal wetlands and associated jurisdictional habitats and approximately 18 acres of uplands (compared with approximately 54 acres of existing tidal wetlands and 10 acres of uplands). This would represent a gain in tidal wetlands of approximately 334 acres. Implementation of the proposed project would result in a permanent net loss of approximately 7.5 acres of wetlands or other waters of the United States. The proposed project would also include demolishing several existing structures within the project site and removing the on-site northern and southern water control structures, as well as modifying the existing CDFW drain to improve dissolved oxygen (DO) on the project site. Figure 6 shows the location of the existing CDFW drain and other water control structures on the project site.

The existing CDFW drain outfall allows CDFW to pump discharged drain water from the managed wetlands of the Grizzly Island Wildlife Area onto the project site. WES has collected continuous water quality data using in situ monitors at this location; during certain conditions, the discharge water has low DO levels. When this water is concentrated in channels, it has the potential to negatively affect aquatic life. The proposed project includes two approaches for resolving the low DO levels: retrofit the existing outlet pipe or construct a pooling area. Retrofitting the existing drainage pipe would consist of fitting a spray aeration device on the existing pipe to aerate water as it drains and increase the DO levels. Constructing a pooling area would consist of excavating an area around the existing pipe to control discharges of CDFW drain water onto the project site. As part of this approach, WES would conduct continuous water quality monitoring using in situ monitors to determine the effectiveness of the spray aeration fitting. The water would be retained or discharged, depending on tides and the DO content of the drain water.

The proposed project would incorporate the appropriate environmental commitments (or equivalent measures) and mitigation measures, as identified in the SMP EIS/EIR (Section 2.5, *Environmental Commitments and Mitigation Measures*) and Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*.

2.4 Construction

The proposed project would restore the project site to tidal wetlands. Construction activities to restore the project site, including phasing, scheduling, and the workforce and equipment required are described below.

2.4.1 Phasing and Schedule

This section describes the proposed phasing and schedule, workforce and equipment required, and activities that would occur during the two phases of construction to restore the existing managed wetlands to tidal habitat. Phase 1 would consist of site preparation, grading, revegetation, and associated activities on the land side of the natural berm, including modification of the CDFW drain. After Phase 1 is complete, the project site would be managed for 1 to 2 years to revegetate the disturbed soils and thereby minimize potential erosion during the subsequent Phase 2 when the site would be exposed to tidal action. Phase 2 would consist of demolishing several on-site structures and breaching the natural berm to restore tidal action to the project site.

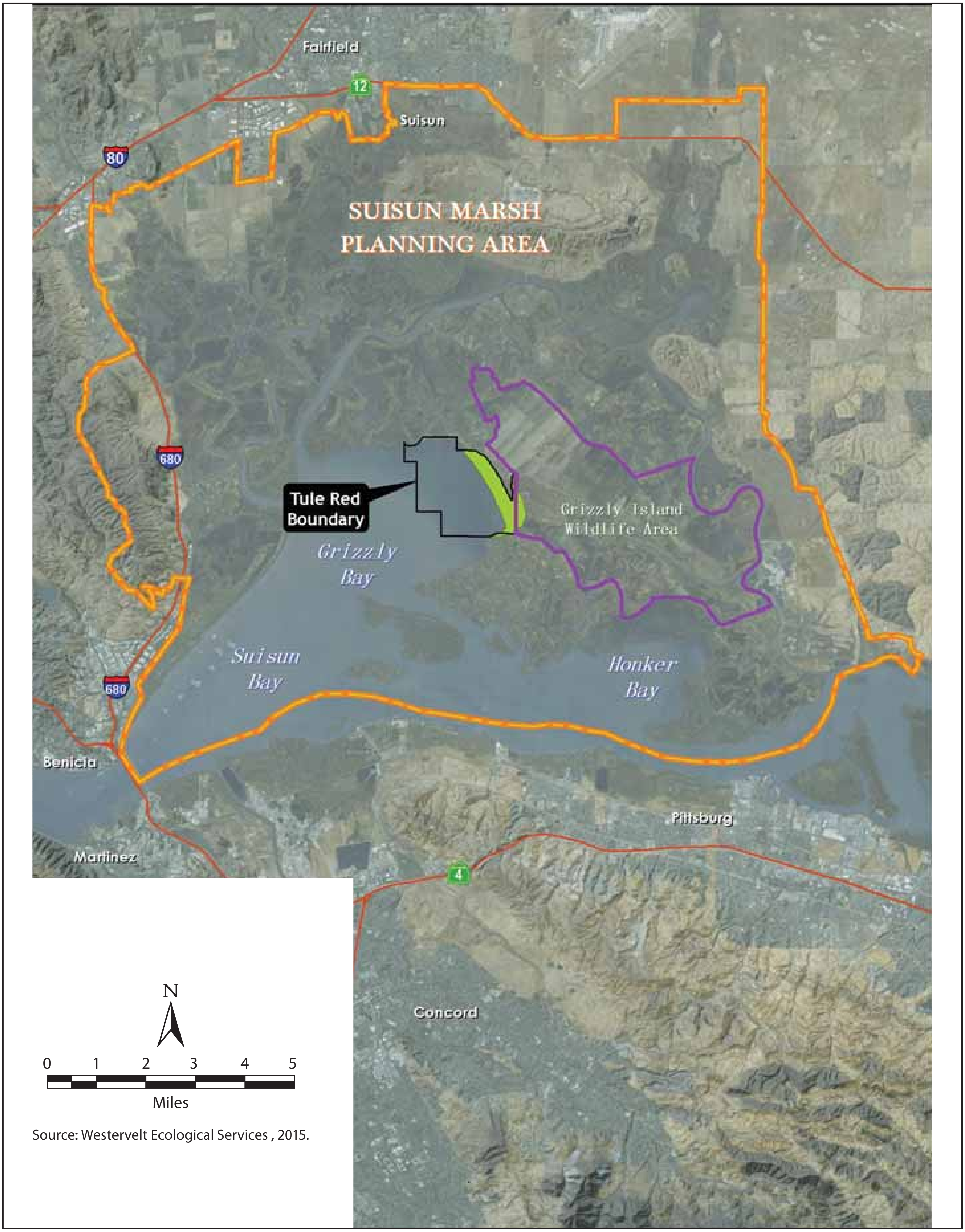

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Figure 2
Proposed Project Location

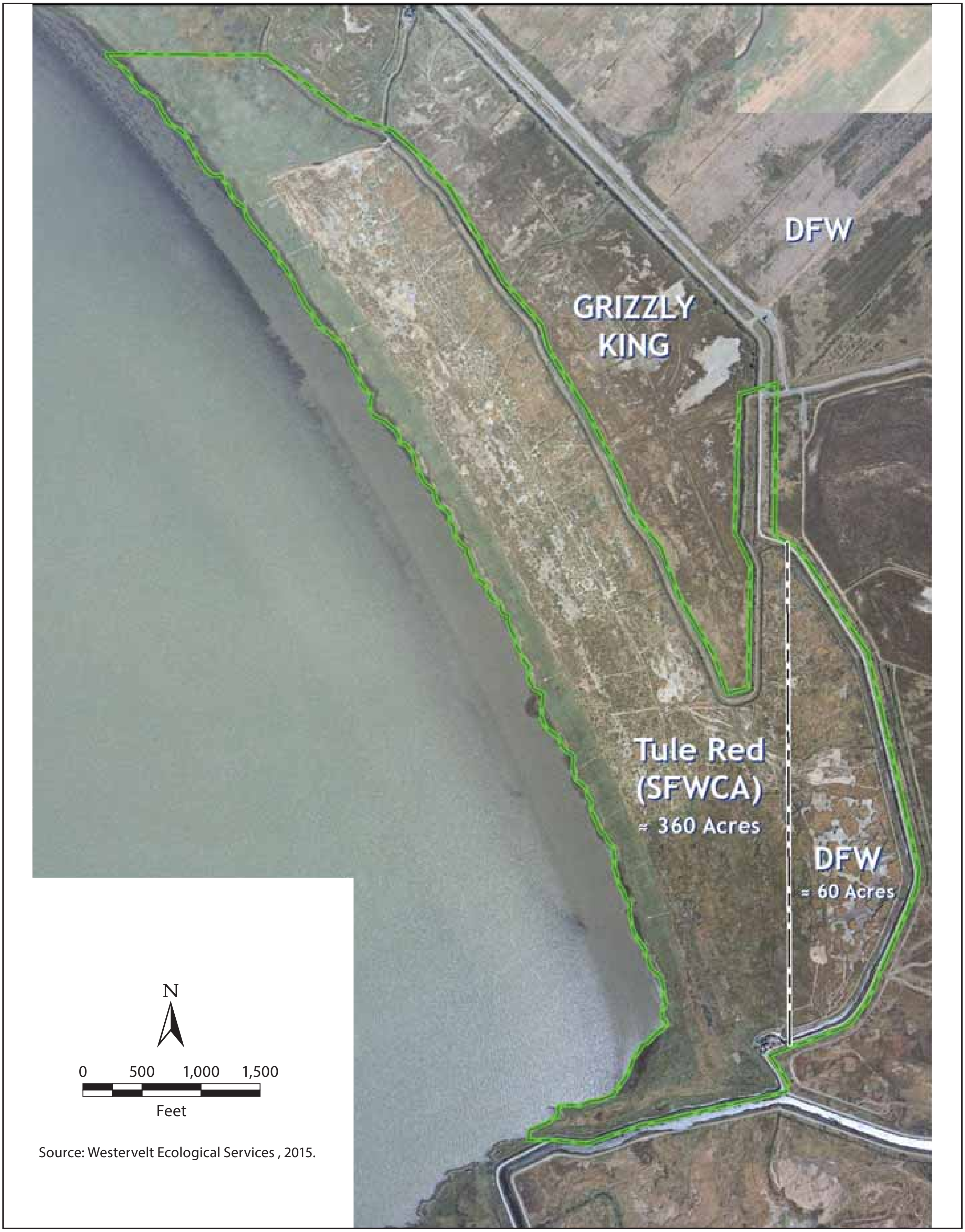

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Figure 3
Proposed Project Area

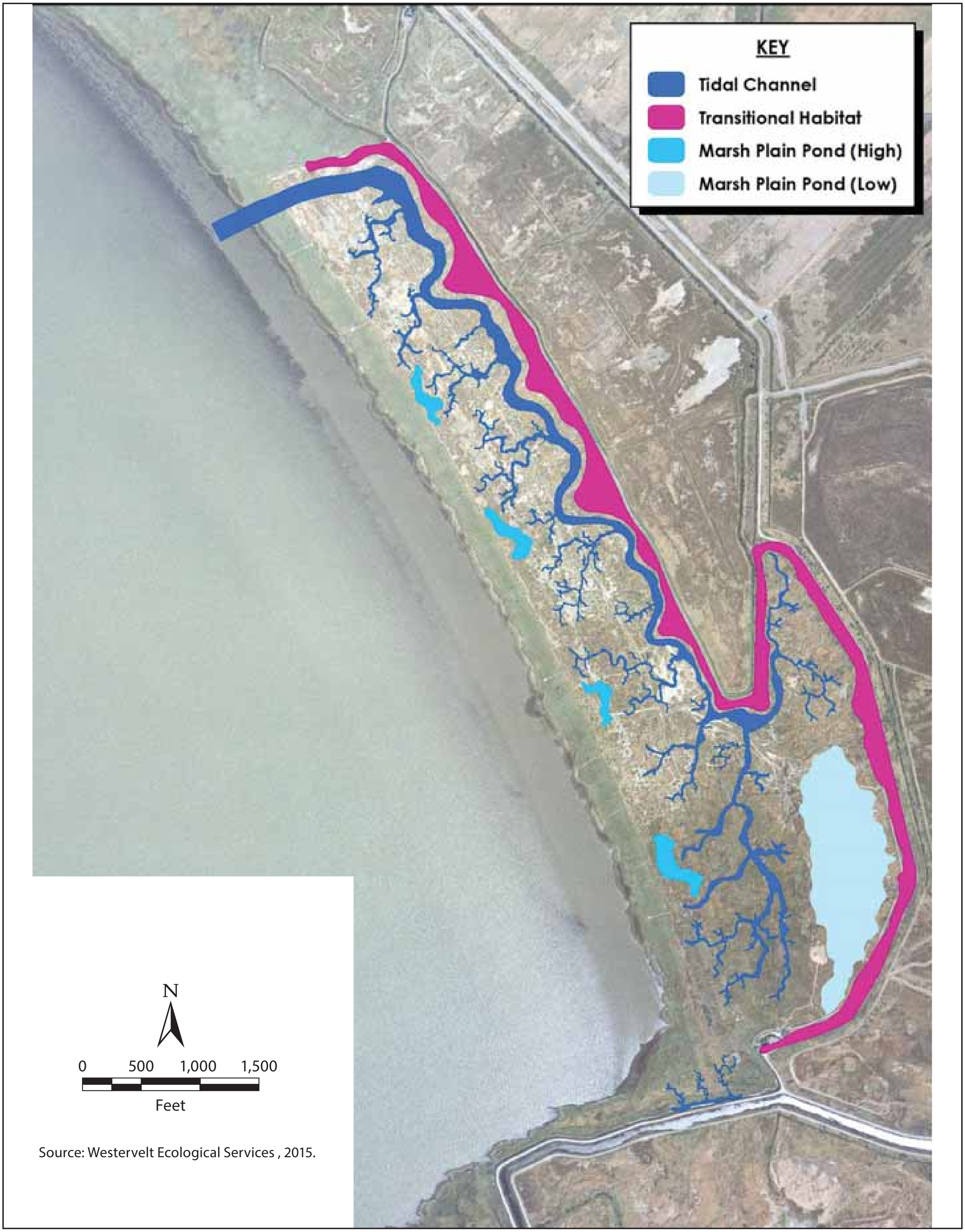

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Figure 4
Concept Plan

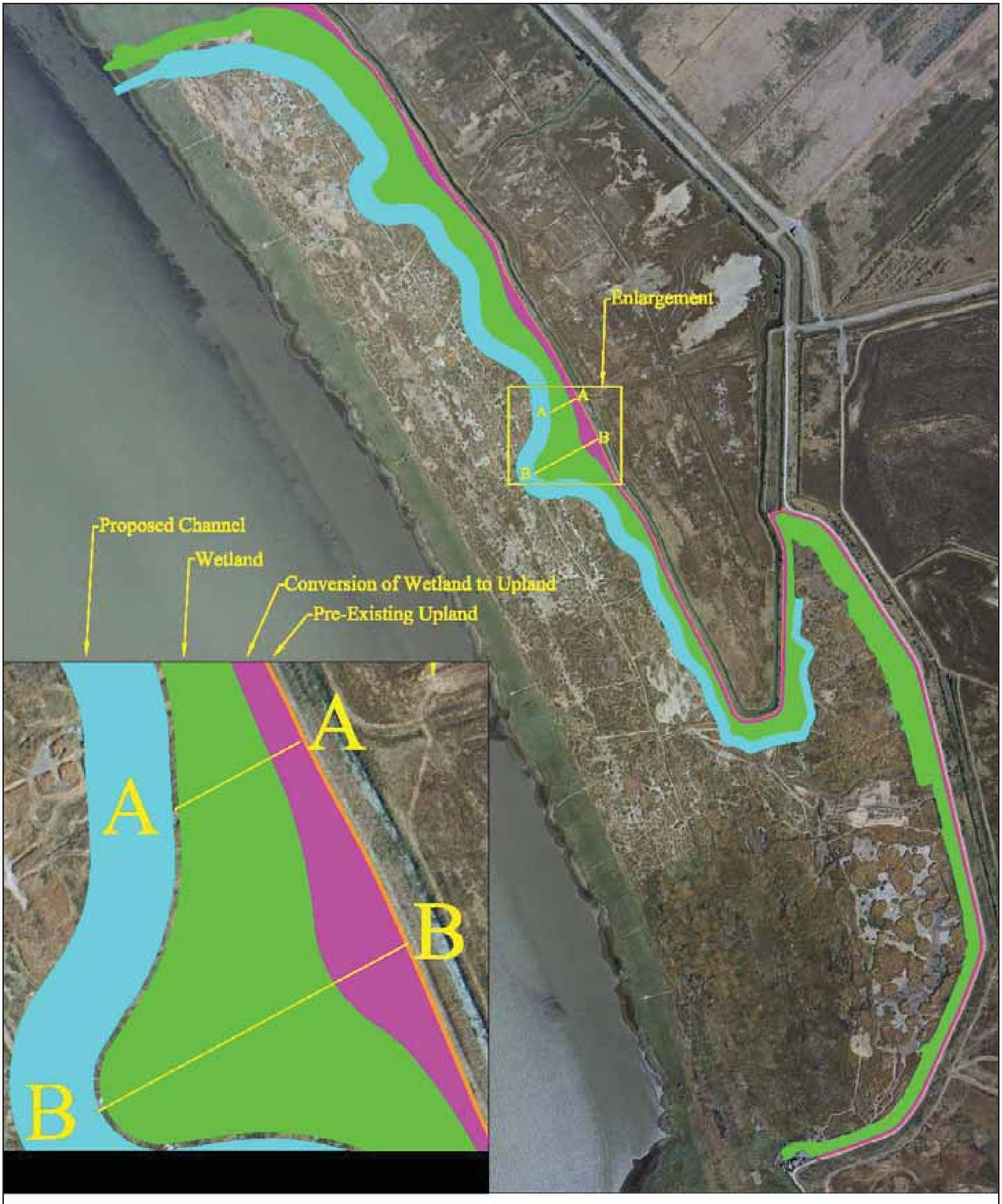

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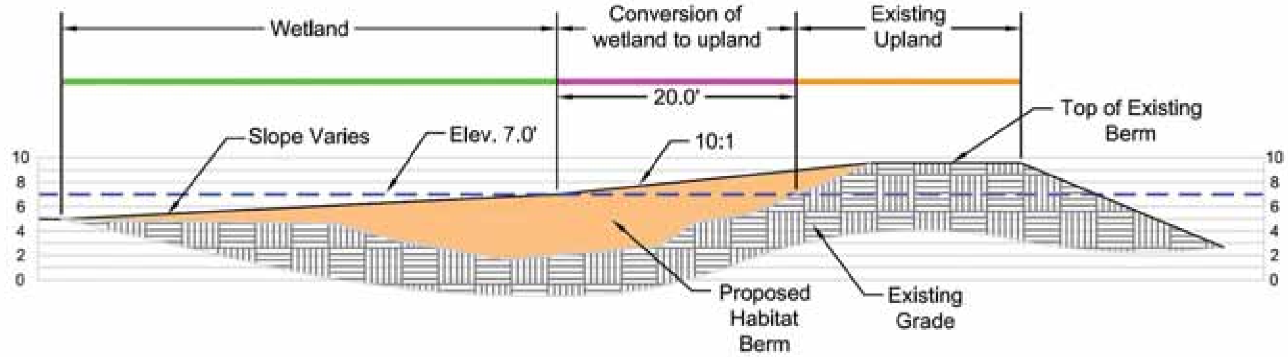
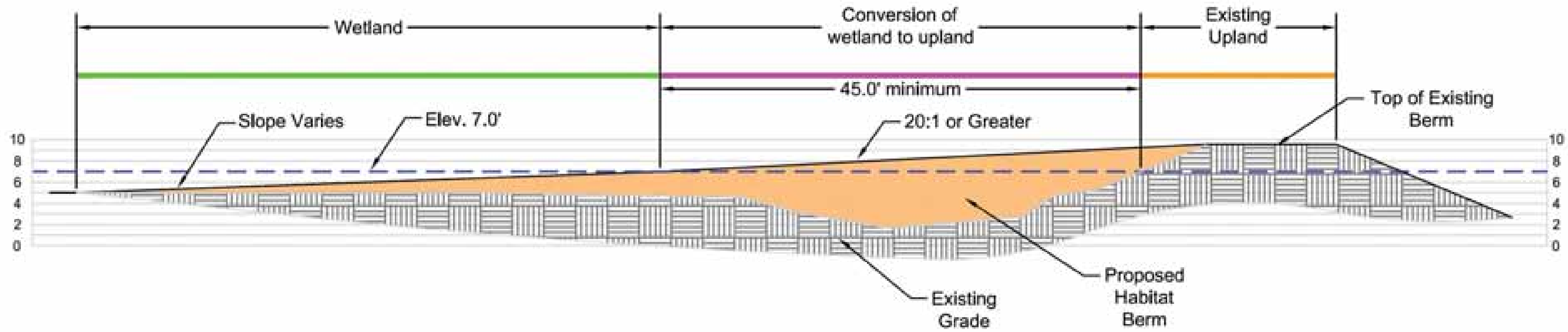
Figure 5a
Habitat Berm



10:1 - Proposed Habitat Berm
Section A - A



20:1 or Greater - Proposed Habitat Berm
Section B - B

Source: Westervelt Ecological Services , 2015.

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Figure 5b
Cross Section View of Habitat Berm

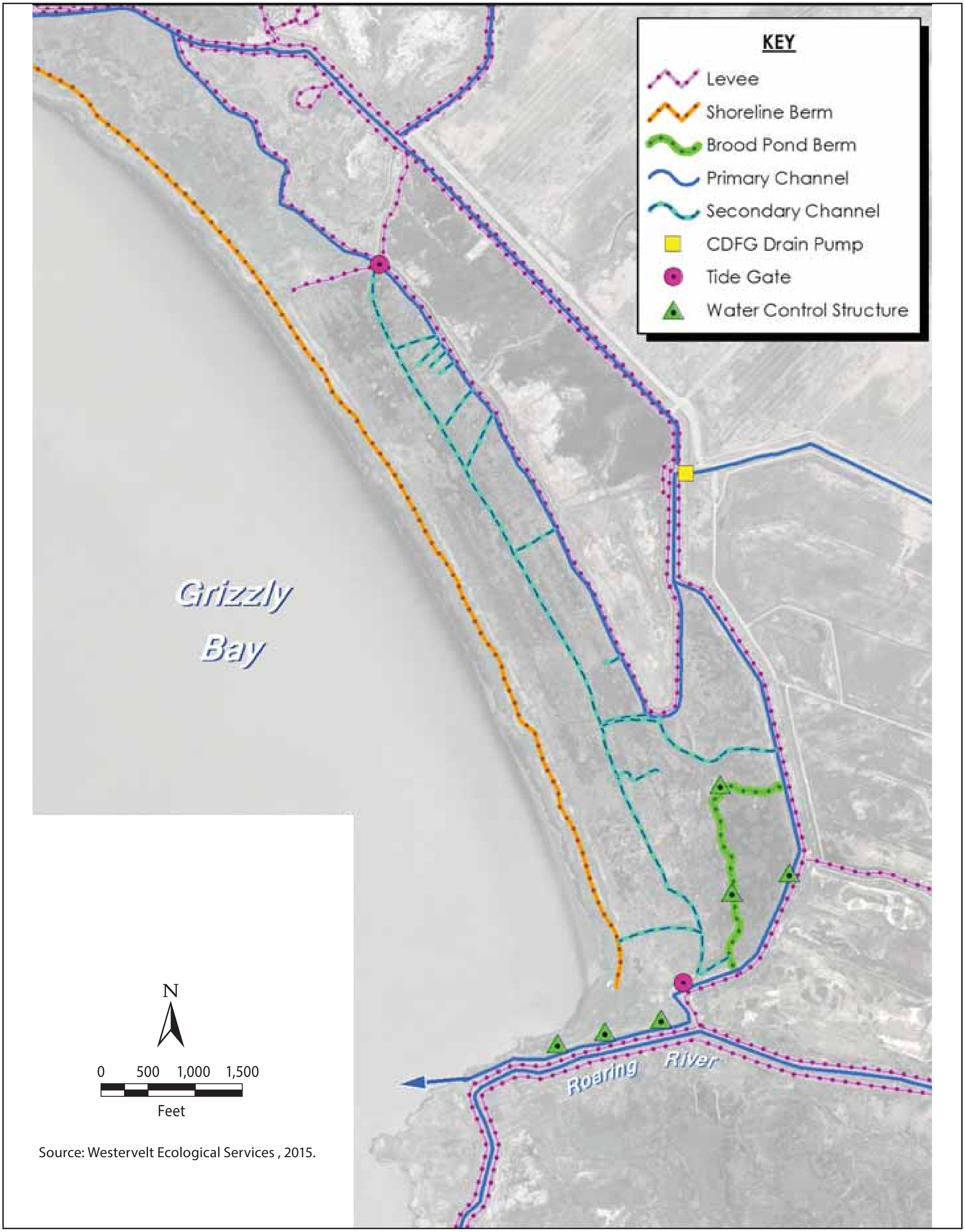

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Figure 6
Existing Water Management Infrastructure

Phase 1 is scheduled to begin in 2016, pending receipt of project approvals, associated permits and authorizations, and funding. All construction activities would occur on the managed marsh portion of the site and landward of the existing natural berm. Depending on soil conditions within the site and when permits are issued, work could start as early as June 1 and may continue until October 15 or the onset of the rainy season. Depending on permit requirements and allowable hours of operation, shift work and/or weekend work may take place. However, given potential working conditions and the different activities that would need to occur on any given day, it is reasonable to assume for the purposes of analysis that work would typically occur 8 to 10 hours a day, 5 days a week, for an estimated duration of 40 to 80 working days under Phase 1.

Phase 2 construction is scheduled to occur in 2017 or 2018 and would consist of demolishing several on-site structures, removing the two existing water control structures (combination gates and bulkheads), and excavating the primary tidal channel through the bayside berm out into the mudflats to allow for tidal exchange. Depending on permit requirements and allowable hours of operation, shift work and/or weekend work may take place. However, given potential working conditions and the different activities that would need to occur on any given day, it is anticipated work would typically occur 8 hours a day, 5 days a week, for a period of 50 working days within a 3-month timeframe under Phase 2. Demolishing the on-site structures would generally occur between the beginning of September and middle of October. Demolition would occur prior to the breach and removal of the water control structures, and would take several weeks to complete. In-water activities related to breaching the exterior natural berm would be conducted during the months of September through November and take approximately 1 week to complete. Removal of the two water control structures would take approximately 2 weeks. The timing of all Phase 2 in-water activities would be consistent with the special-status fish species work windows (September 1 through November 30 for delta smelt and August 1 through November 30 for salmonids).

2.4.1.1 Workforce and Equipment

Temporary construction staffing for the proposed project would consist of approximately 10 to 20 personnel during Phase 1 and fewer personnel during Phase 2. Contractors working on-site would be properly trained and certified for construction activities, best management practices, and recognizing special-status plants and animals that may be encountered during construction.

Restoration of the project site would require many different equipment types. Conditions in the field at the time of construction would influence the type of equipment that would be best suited for the work and ultimately would be chosen by the construction contractor. Equipment would be delivered to the project site by flatbed truck and transported to the work areas via existing access roads.

Six different types of equipment are anticipated to be used through the duration of Phase 1 (40 to 80 working days). The mix and number of pieces of equipment that would actually be used would depend on the activities that would occur within the phase and the conditions of the project site. The following types of equipment are expected to be used during Phase 1: scraper, dozer, excavator, grader, backhoe, front-end loader, and dump truck/water truck. All scrapers, dozers, and excavators (e.g., the high horsepower equipment) used during Phase 1 would have a Tier 3 engine or greater.

Five different types of equipment are anticipated to be used through the duration of Phase 2 (50 working days). The mix and number of pieces of equipment actually be used would depend on the activities that would occur within the phase and the conditions of the site. The following types of equipment are expected to be used during Phase 2: dozer, excavator, backhoe, front-end loader, and dump truck/water truck. Dump trucks would be required for hauling away debris generated through the demolition of the structures. All scrapers, dozers, and excavators (e.g., the high horsepower equipment) used during Phase 2 would have a Tier 3 engine or greater.

2.4.1.2 Phase 1

Phase 1 consists of site preparation, earthwork, modification of the CDFW drain, and site stabilization. Only the site preparation, earthwork, and the second component to modifying the CDFW drain would require active construction and construction equipment. Site stabilization includes seeding and mulching the upland areas and managing water to facilitate revegetation within the marsh interior prior to breaching the exterior natural berm. Phase 1 work would be conducted on the WES parcel and the CDFW parcel at the same time. As described in Section 2.4.1, *Phasing and Schedule*, Phase 1 is scheduled to begin in 2016, pending receipt of project approvals, associated permits and authorizations, and funding.

Site Preparation

Several site preparation activities would occur on-site as part of Phase 1. These activities are either currently occurring on-site and part of baseline management or would be part of the proposed project to prepare the site for Phase 2. Site preparation activities that are not part of baseline management include improving existing access roads and setting up a construction management center and equipment staging area(s), including a location for managing hazardous materials. Figure 7 shows the approximate location of staging areas. Site preparation activities that are currently part of baseline management include the removal of vegetation. The total footprint of all excavations, staging areas, access roads, and fill areas, including buffers, is approximately 150 acres.

Prior to earthwork, the site would be prepared by clearing existing vegetation, using standard practices that are currently used for managed wetlands within Suisun Marsh and have been used on the project site. Biologists would conduct pre-construction surveys for special-status species before vegetation clearing to ensure no listed species are present, as described in SMP EIS/EIR Section 2.5, *Environmental Commitments and Mitigation Measures*, and Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*. Vegetation removal would first be accomplished by using mowers towed behind wheeled tractors and bulldozer tractors, as used under baseline conditions. Depending on the slope, an articulated arm powered by an excavator may be used to remove vegetation. These methods diverge from the covered action of hand removal of salt-marsh harvest mouse habitat (i.e., pickleweed) in the SMP U.S. Fish and Wildlife Service (USFWS) Programmatic Biological Opinion (BO); however, as described in Chapter 3, *Environmental Analysis*, the SMP EIS/EIR and USFWS BO allow modification of the methods approved by the resource agencies.

Existing levee roads would be utilized to access the project site from Grizzly Island Road. Equipment travel routes and excavated material transport would occur primarily along temporary access roads within the cut-and-fill footprint of the project. The final decision on access and haul routes would be reached through collaboration among the contractor and design team, in compliance with applicable regulatory permitting requirements, prior to construction.

Approximately four staging areas and one Construction Management Center (CMC) would be established to support project implementation. Each staging area would be approximately 1 acre in size; the CMC would be established at an existing gravel parking lot and also measure approximately 1 acre. Because the temporary staging areas would be located within the habitat berm footprint, they would be covered over successively by fill as work moves along the length of the project.

Figure 7
Proposed Project Area Staging and Access

Earthwork

Earthwork (grading, excavation, and redistribution of material) would be necessary to construct the tidal channel network, create a series of tidal pannes and basins, and construct the habitat berm. Prior to earthmoving, the topsoil layer (less than 6 inches) with detritus from mowing, would be stripped back by bulldozer with blade and stockpiled in the construction areas. This would be used later as mulch for exposed mineral soils. Grading includes excavating tidal channel networks and basins throughout the site and transporting excavated materials to construct the habitat berm. Equipment utilized may include a scraper, bulldozer, excavator, and grader.

Overall, grading for the new tidal channels and depressions would require excavation of up to 300,000 cubic yards of soil within 150 acres of the project site. The proposed project is designed as a balanced cut-and-fill project. For the purposes of this analysis, no soil would be brought to the site or hauled off the site. Material excavated from the primary tidal channel (and from the tidal pannes and basins) would be transported within the project site to construct the habitat berm, which would have a gradual and varying slope (10:1 to 50:1); primarily wetland vegetation would be grown on the berm. Material would be picked up and transported within the project site, then spread with a variety of equipment, depending on the moisture content of the material and the haul distance within the project site. Additionally, some of this excavated material would first be used to improve and/or construct staging areas and haul routes throughout the project site. Material excavated from the lower order tidal channels would be side cast in a diffuse pattern or mounded in the area immediately surrounding the channel network, allowing wetland vegetation to colonize the spoils within a single growing season.

Modifying CDFW Drain

WES would implement an approach to improving the low DO experienced at the CDFW drain. This would involve two components: (1) installation of a spray aeration structure on the existing outlet pipe and (2) constructing a pooling area. WES would retrofit the existing drain outlet pipe where it enters the Tule Red property with a spray aeration fitting, engineered to bring the DO in the drain discharge water to within ecologically acceptable tolerances. WES would conduct continuous downstream water quality monitoring using in-situ monitors. Retrofitting the existing outlet pipe of the CDFW drain pump with a spray aeration structure would require no earthwork or construction equipment. Additionally, a pooling area would be constructed to control the discharge of the CDFW drain water into the restoration area. The new pooling area would be created downstream of the existing discharge by constructing a new crossing between the two existing levees. The crossing would include a new water control structure that would allow water to be retained within the pooling area or discharged into the restoration site, depending on tides and DO content of the drain water. This would allow water to be released upon outgoing tides, ensuring a well-mixed water column and eliminating any low DO concentrations. This component would require construction of a road, approximately 10 feet wide, to connect both levees. The amount of fill associated with the road and levee would be less than 0.1 acre (Figures 8a–8c show the locations of the new road crossing and levee cross sections). Construction of the road and levee would be included in all permit applications. Implementation of the second alternative would require the construction equipment described in Section 2.4.1.1, *Workforce and Equipment*.

Site Stabilization

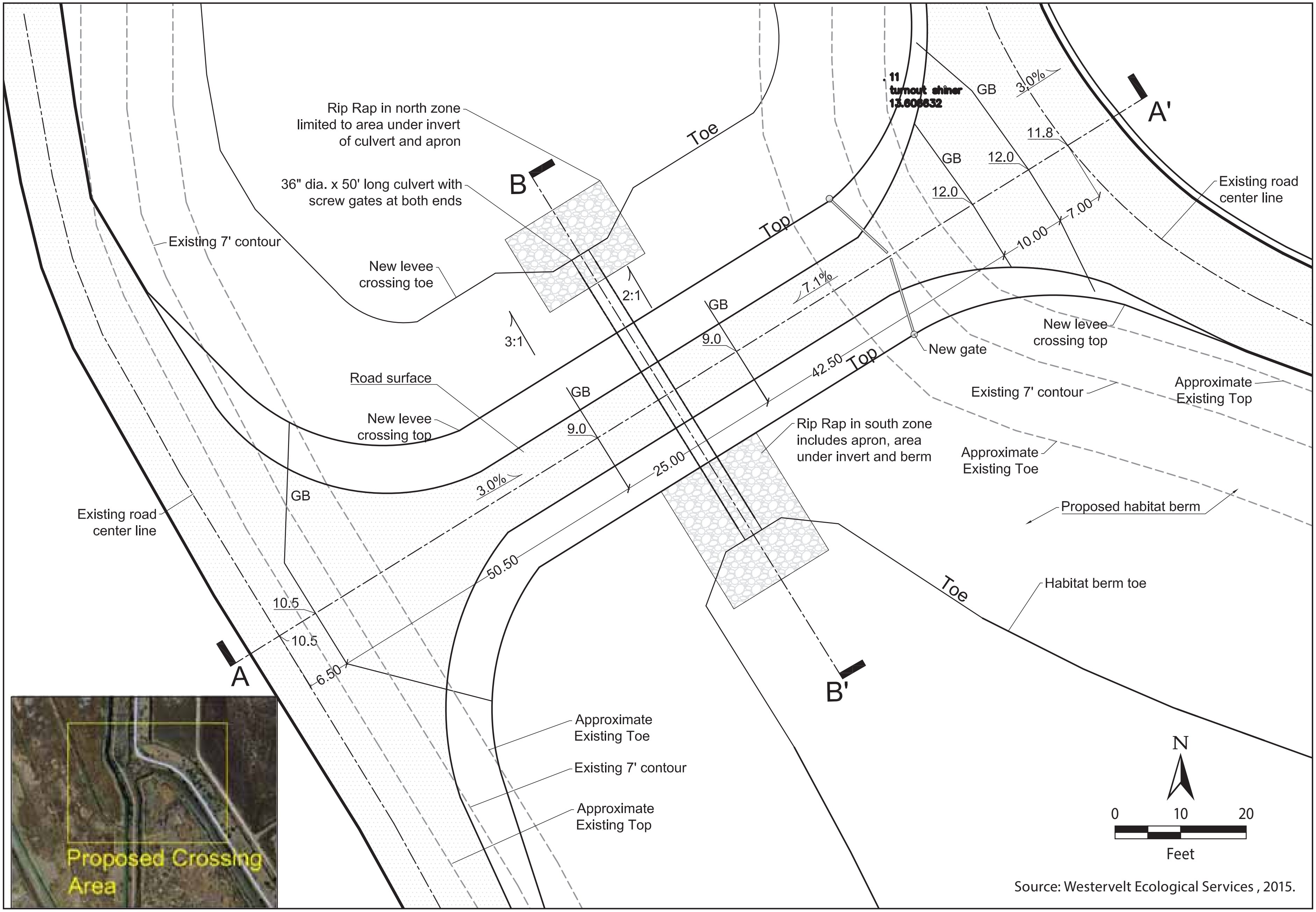
Upon completion of grading and excavation of marsh plains and tidal channels but prior to construction of the tidal connection, the site would be managed for 1 to 2 years to encourage revegetation and soil stabilization. Land management activities during the site stabilization period would include vegetation management, *Phragmites* control, and the installation of tules and other plants to help establish native vegetation on the site. These land management activities the same as the land management activities associated with managed marshland management activities for wetland maintenance activities within Suisun Marsh. Land within the project restoration area would continue to rely on RGP 3 authorization for land management activities until the site is breached, or approximately 1 to 2 years after project initiation.

2.4.1.3 Phase 2

Phase 2 consists of demolishing several onsite structures and then breaching the natural berm and removing the north and south water control structures. As described in Section 2.4.1, *Phasing and Schedule*, Phase 2 is expected to occur in 2018, but could occur earlier (2017), depending on vegetation establishment and invasive species management.

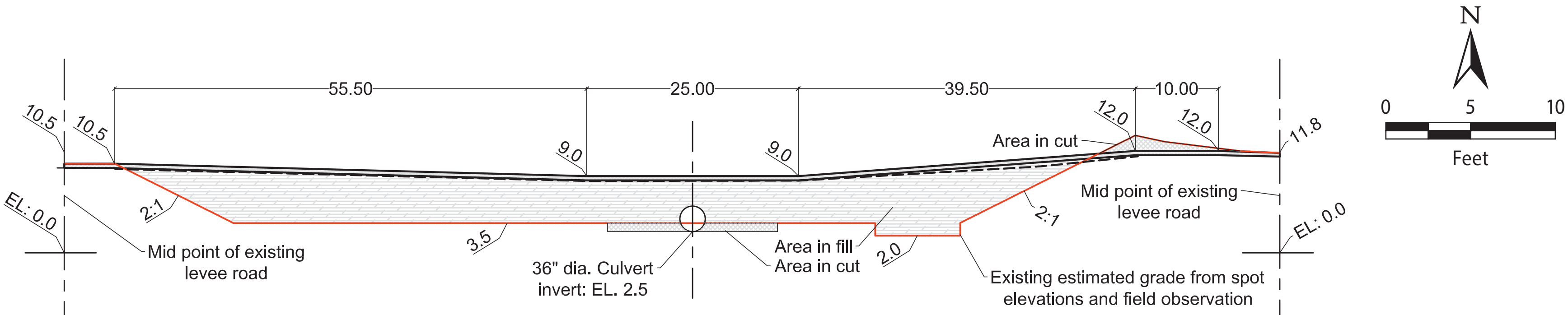
Demolition of Structures

Existing structures, including the current duck club residence, shop areas, and viewing platform, would be demolished as part of Phase 2, prior to breaching the existing natural berm. The use of the project site has changed over time, and activities that were dependent on these structures no longer occur at the project site or in the buildings; therefore, the buildings would be demolished because they are no longer in use. Five existing structures, totaling approximately 3,600 square feet, would be demolished. These structures are primarily constructed of wood, and while there is no known history of bat use, there is a history of birds nesting on the structures. As such, pre-demolition surveys would be required prior to the demolition to ensure no bat or migratory bird presence. These pre-demolition surveys would be conducted by a qualified biologist, and would occur up to 3 days prior to demolition. This type of survey is similar to those pre-construction surveys required for various species in the SMP EIS/EIR and as described in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, and would occur in conjunction with nesting bird surveys. Windows and doors of the structures would be kept closed and sealed prior to demolition through the summer to prevent bats, migratory birds, or other species from inhabiting or roosting in the interior of the structures. Debris piles, material stored in and around the buildings, decorative panels and building furnishings will be removed prior to the preconstruction survey to ensure full survey access. If no live bats or sign (e.g., guano, staining, prey remains, bat carcasses) are found, and if no nests of protected bird species are active on or within the existing structures the structures may be demolished at any time. If live bats or indications of bat use are found, or if active protected bird nests are found, the demolition of the structures would be limited to the beginning of September to the middle of October, at which time the survey procedure described would be repeated, and demolition would be postponed until colonial bats or special status bats are evicted or leave of their own volition. Demolition would take several weeks prior to breaching the natural berm. Much of the work would be done by hand and some materials (i.e., wood) would be salvaged. It would require the same type of equipment used for breaching the existing natural berm (i.e., excavator, backhoe, dump truck, and grader) as described in Section 2.4.1.1, *Workforce and Equipment*. Less than 20 dump trucks (approximately 40 trips) would be required over a period of several weeks.

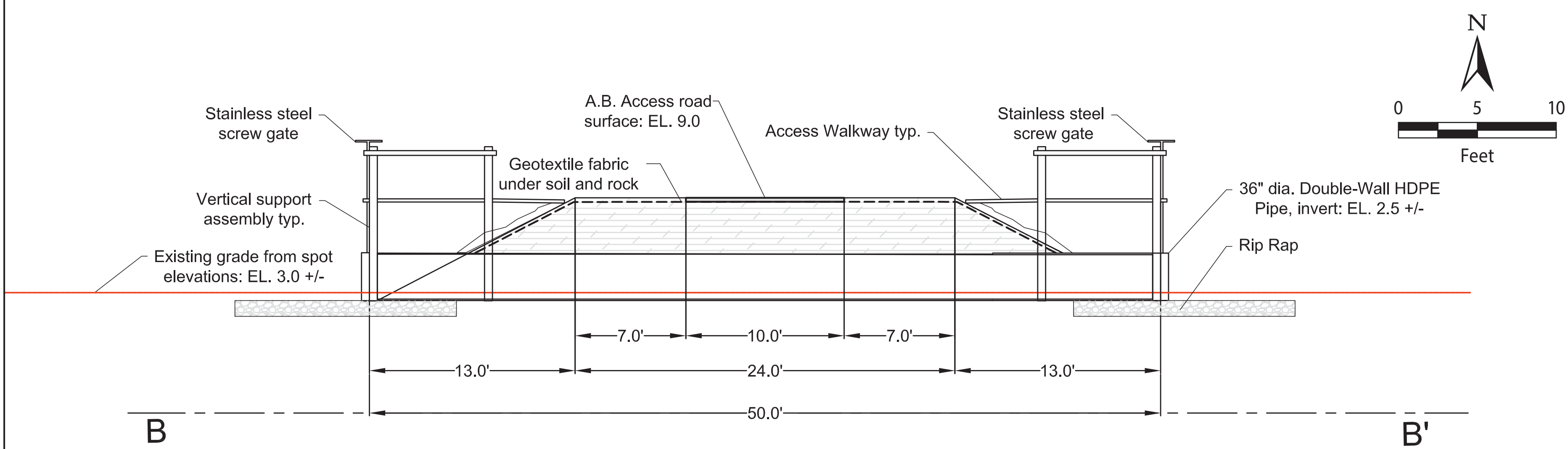


Source: Westervelt Ecological Services , 2015.

Figure 8a
Tule Red Proposed Levee Crossing Plan View



Longitudinal Section
Elevations Approximate



Cross Section
Elevations Approximate

Source: Westervelt Ecological Services , 2015.

Graphics ... 347.15 (10-15-2015)

Figure 8b
Tule Red Proposed Levee Sections

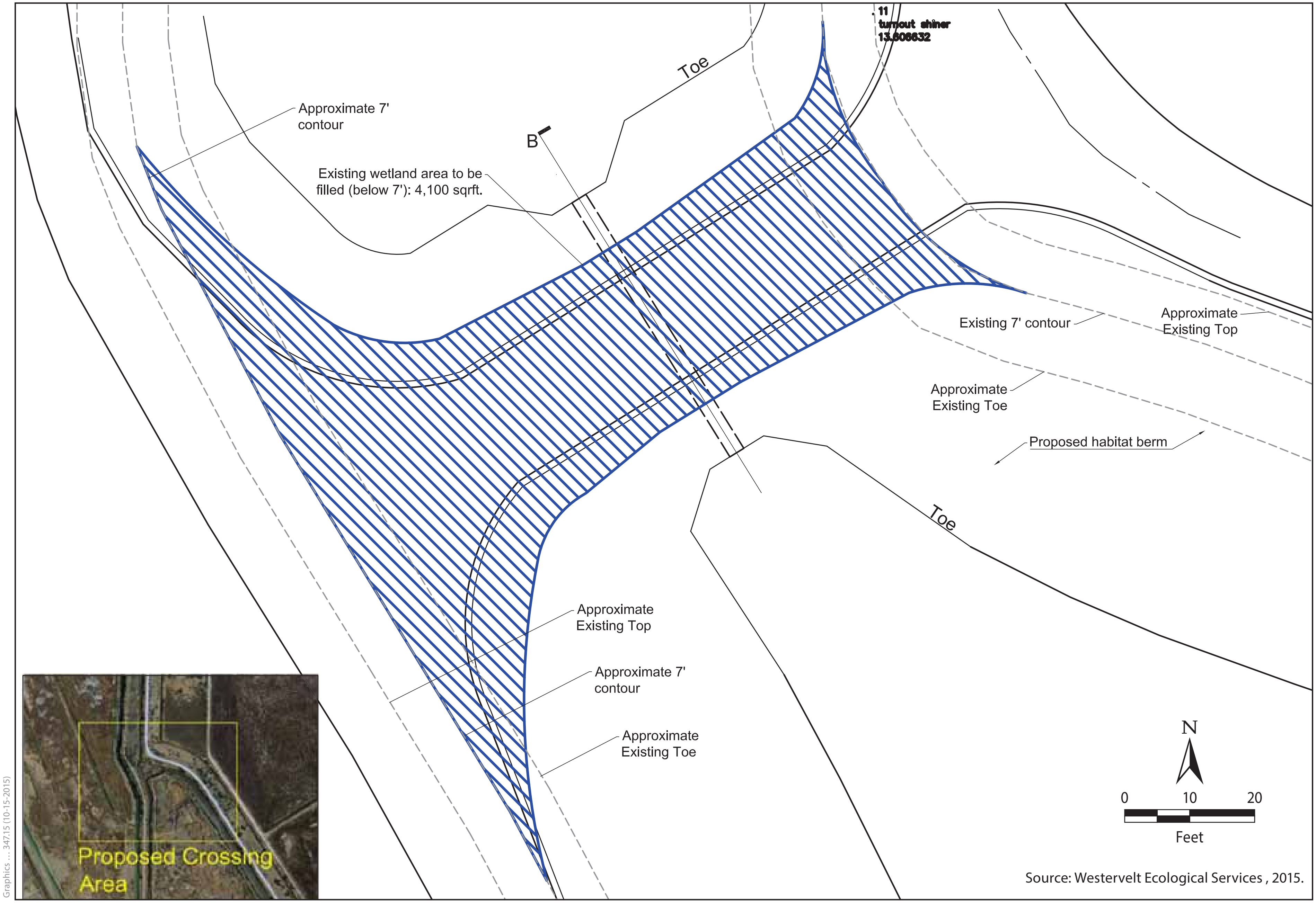


Figure 8c
Tule Red Proposed Levee Crossing Impacted 404 Area

Breach of the Natural Berm

A permanent tidal connection would be established during Phase 2 by breaching the existing natural berm on the project site to allow for full daily tidal exchange through the interior of the project site. The breach would occur approximately 1 to 2 years after the creation of habitat features (i.e., tidal channel network, a series of tidal pannes/basins, habitat berm) and site stabilization efforts.

The breach would be constructed by a long-reach excavator operating from the edge of the created channel. Side-cast material from the breach would be placed along the habitat berm. The breach would be conducted during low tide of a neap tidal cycle so that the first tidal action occurring from the breach would deliver any loose sediments into the site (on a rising tide) and not deliver them into Grizzly Bay. This would minimize initial sediment scour. Complete construction of the breach would take a maximum of 5 days. The breach would be approximately 50 feet wide and located at the north end of the project site. By maintaining isolation between the restoration area and Grizzly Bay during the first phase of construction (i.e., not breaching the levee during early project phases), the work area would remain as dry as possible during earthwork. This method would minimize impacts on aquatic organisms and the transport of silt and construction debris/contaminants into adjacent waterways. In addition, the existing north and south water control structures would be removed from the project site under Phase 2. This would take approximately 14 days and require several pieces of equipment, including an excavator, backhoe, dump truck, and grader.

Site Restoration

The temporary staging areas would all be located within the habitat berm footprint and, as such, covered over successively by the habitat berm as work moves along the length of the project from north to south. The habitat berm would be seeded following completion.

The CMC and the access road to the clubhouse area (existing gravel road) would receive a top dressing of gravel at project completion, returning them to pre-project conditions. The levee roads would receive a final top dressing of fill at the very end of the project to bring their elevations to pre-project elevations and compensate for any settling or compaction from vehicle travel during the construction phase. The levee road between Tule Red and Grizzly King will be seeded with a mix of perennial and annual native and naturalized grasses.

2.5 Project Site Monitoring and Management

The project would use an adaptive management approach with objective-driven monitoring as intended by the SMP (Appendix E, *Adaptive Management and Monitoring Plan*, of the SMP EIS/EIR). Pre-construction monitoring would take place for one to two years prior to breaching (pre-breach conditions). Post-breach monitoring would occur during the first five years after breaching (Interim Management Period) for at least three of the five years (e.g., Year 1, 3, and 5). The effectiveness monitoring program would be periodically evaluated during the first few years and adjustments would be made as necessary, based on interim findings and feedback on methods. Monitoring metrics would address physical habitat, hydrological regime and water quality, vegetation, aquatic food web (primary and secondary producers), fish community, and wetlands and vegetation. The actual schedule and sampling design (location and number of sampling sites and events) would be tailored to the project needs prior to construction, and in coordination with IEP and other regional monitoring programs. Fish monitoring would be coordinated with regional monitoring by IEP and UC Davis Suisun Marsh Fish Study, and other agency programs.

Once the project site is restored, habitat establishment would occur, starting in approximately 2018. Limited maintenance, monitoring, and management tasks would occur during this time, including development of tules and other native marsh vegetation, weed control within the habitat berm, inspection of erosion or settling with respect to habitat level, and patrolling for trash and trespass. Long-term management of the project area would begin once the habitat berm vegetation is established. Long-term management would include all habitat establishment activities, periodic biological monitoring of the project area, and periodic mapping of the marsh and channel. The breach location is expected to reach equilibrium at a width of approximately 120 feet during this time.

Ultimately, SFCWA is proposing a transfer of the project site to CDFW to be managed as part of the Grizzly Island Wildlife Area. CDFW would manage the restored property in perpetuity as part of the Grizzly Island Wildlife Area. Public access would be regulated through the Grizzly Island Wildlife Area public use plan.

2.6 Environmental Commitments and Mitigation Measures

The proposed project would incorporate the environmental commitments summarized in Chapter 2 and Appendix F, *Mitigation Monitoring and Reporting Program*, of the SMP EIS/EIR, where appropriate. In addition, the proposed project would incorporate applicable mitigation measures for air quality summarized in Table 2-2 of this chapter and identified in Appendix F of the SMP EIS/EIR. As such, Appendix B, *Tule Red Restoration Environmental Commitments and Mitigation Measures*, of this document describes all applicable and appropriate environmental commitments and mitigation measures for the proposed project. These environmental commitments and mitigation measures are then referenced and described in the impact analysis in Chapter 3, *Environmental Impact Analysis*, of this document.

Chapter 3
Environmental Impact Analysis

3.1 Introduction

This chapter examines the changes to the environmental setting (where appropriate), evaluates the potential changes to environmental impacts, and identifies whether the impacts of the project modifications fall within the scope of the previously certified *Final Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/Environmental Impact Report* (SMP EIS/EIR) with respect to implementing the Tule Red Restoration Project (proposed project). This chapter is organized such that it provides a summary of the impact conclusions first in Section 3.2, *Impact Conclusions*, and then provides specific resource analysis.

3.2 Impact Conclusions

The proposed project, as well as the analysis contained within this addendum, would not result in any new significant environmental effects or any substantial increases in the severity of environmental effects identified in the certified Final SMP EIS/EIR (Sections 15162.1 and 15162.2). The proposed project would not require mitigation measures that would be considerably different from those identified in the SMP EIS/EIR (Section 15162.3(d)). The level of overall activities analyzed as part of the certified SMP EIS/EIR for restoration projects and the location is comparable to that under the proposed project. The potential environmental impacts associated with the proposed project were adequately identified and addressed in the certified SMP EIS/EIR. All of the mitigation measures included in the certified SMP EIS/EIR were adopted for the previously approved SMP. Throughout this addendum, the mitigation measures, where applicable, would not be considerably different from those disclosed in the SMP EIS/EIR and would be adopted for the proposed project, where appropriate. In addition, some of the the environmental commitments described in the SMP EIS/EIR would be adopted, as appropriate, for the proposed project. The significant and unavoidable impacts related to utilities and cultural resources identified in the SMP EIS/EIR would not occur under the proposed project because of the location of the proposed project and because there are no utilities or significant cultural resources on the project site.

Table 3-1 summarizes the status of impact determinations and the need for mitigation measures by resource based on the analysis contained within this document and compared to the SMP EIS/EIR for restoration projects. Table 3-2 provides a comparison of the environmental commitments and best management practices between the proposed project and the SMP EIS/EIR that are incorporated throughout the analysis within this document.

Table 3-1. Status of Impacts by Resource of the Proposed Project Compared to the Final SMP EIS/EIR

Resource	Proposed Project Impact Findings[1]			Required Mitigation in SMP?	Requires Substantially Different or New Mitigation Measures for Tule Red?
	Same as SMP EIS/EIR	Changed from SMP EIS/EIR	Substantially More Severe than Disclosed in SMP EIS/EIR		
Water Quality, Surface Hydrology, and Water Supply	LS		—	No	—
Biological Resources – Fisheries	LS		—	No	—
Biological Resources – Vegetation and Wetlands	LS		—	No	—
Biological Resources – Wildlife		LS	No	No	No
Air Quality, Greenhouse Gases, and Climate Change	LS with MM		—	Yes	No
Cultural Resources		LS	No	Yes	No
Land Use	LS		—	No	—
Aesthetics	LS		—	No	—
Agricultural Resources		NI	No	No	—
Geology, Soils, and Mineral Resources	LS		—	No	—
Hazards and Hazardous Materials	LS		—	No	—
Noise		NI	—	No	—
Recreation		NI	No	No	—
Transportation and Navigation		NI	—	No	—
Utilities and Public Services		LS	No	Yes	No
Population and Housing		NI	No	No	—

NI = No Impact

LS = Less than significant impact

LS with MM = Less than significant impact with mitigation

[1] The impact determinations summarized in this table reflect the multiple thresholds analyzed in this document. Each resource was given the most severe impact determination.

Table 3-2. Comparison of Environmental Commitments and Best Management Practices of the Proposed Project to the Final SMP EIS/EIR

Similar ECs/BMPs	Different ECs/BMPs	ECs/BMPs Not Needed
Standard Design Features and Construction Practices	Mosquito Abatement Best Management Practices	Standard Design Features and Construction Practices[1]
Limits on Access Points and Staging Areas	Hazardous Materials Management Plans	Noise Compliance
Erosion and Sediment Control Plan Requirements	Biological Resources Best Management Practices – General Best Management Practices	Traffic and Navigation Control Plan and Emergency Access Plan
Stormwater Pollution Prevention Plans	Biological Resources Best Management Practices – Special-Status Plant Species Protection	Recreation Best Management Practices
Air Quality Best Management Practices	Biological Resources Best Management Practices – Special-Status Wildlife Species Protection: Mammals	Visual/Aesthetic Best Management Practices
Inadvertent Discovery of Cultural Resource Requirements	Biological Resources Best Management Practices – Special-Status Wildlife Species Protection: California Clapper Rail and California Black Rail	
Cultural Resources	Nonnative Plant Control	
Biological Resources Best Management Practices – Worker Training	Biological Monitoring	
Biological Resources Best Management Practices – Protection of Special-Status Wildlife Species: Raptors		
Biological Resources Best Management Practices – Protection of Special-Status Wildlife Species: Birds		
Biological Resources Best Management Practices – Protection of Special-Status Wildlife Species: Western Pond Turtle		
Biological Resources Best Management Practices – Protection of Special-Status Wildlife Species: California Least Tern		
Construction Period Restrictions		

[1] Constructing structures in accordance with California Building Code and County General Plan standards to resist seismic effects and meet the implementation standards outlined in the general plan.

Ensuring that changes within Suisun Marsh channels will not significantly affect navigation and emergency access by having the Rio Vista and Vallejo Coast Guard stations review plans to assess safety issues associated with changes when there is potential for in-channel work to affect access.

3.3 Resources

The analysis in this addendum focuses on the changes to impacts on the environment that could occur as a result of implementing the proposed project under the SMP EIS/EIR. The scope of analysis contained within this section addresses each environmental resource area that was previously analyzed in the certified Final SMP EIS/EIR. Table 3-7, at the end of this chapter, provides an impact-by-impact discussion of each resource. The subsections below provide a summary of the SMP EIS/EIR and proposed project analysis of specific resources.

3.3.1 Water Quality, Surface Hydrology, and Water Supply

The previously certified SMP EIS/EIR evaluated water quality, surface hydrology, and water supply impacts resulting from restoration activities within the marsh and determined that impacts on these resources would be less than significant, as described in Table 3-7. Impacts on these resources would also be less than significant under the proposed project, as described in Table 3-7.

3.3.1.1 Methylmercury and Dissolved Oxygen

SMP EIS/EIR

The SMP EIS/EIR determined that restoration activities would have less-than-significant impacts on methylmercury and dissolved oxygen (DO) because restoration would not increase the production and export of methylmercury when compared to baseline conditions in managed wetlands and could increase DO levels when compared to baseline conditions in managed wetlands, as described in Table 3-7.

Existing Conditions and Proposed Project

As described in Appendix C, *Methylmercury and Dissolved Oxygen Technical Memorandum*, of this document, the project site has documented levels of mercury (total Hg) and methylmercury (MeHg) that are generally consistent with, or slightly higher than, other areas of the marsh, managed wetlands in general, and Grizzly Bay ambient concentrations of total Hg and MeHg. The levels for total Hg are documented at 5.8 nanograms per liter (ng/L), and average MeHg is documented at 1.07 ng/L. Managed wetlands are typically considered sources of total Hg and MeHg because of the minimal mixing and the alternating wetting and drying cycles needed for management. Specifically, the prolonged drying associated with managed wetlands, along with other potential factors (e.g., the amount of available organic matter, organic carbon, DO and pH levels, sulfate, iron, Hg availability, temperature, salinity), provides conditions for producing MeHg. Typically, because of wetting and drying, MeHg in the marsh is highest during the fall flood-up and stays high until it tapers off after several months of continuous inundation through the winter. Studies on MeHg accumulation in fish tissues in Suisun Bay and Suisun Marsh have shown high levels of MeHg in fish (Appendix C). A regional study of mercury in small forage fish (silversides and topsmelt), from south San Francisco Bay to Suisun Marsh, documented average total Hg in silversides of less than 0.060 micrograms per gram; mercury concentrations were much lower for fish from Suisun Bay than for fish in San Pablo or San Francisco bays (Greenfield et al. 2013).

Tidal wetlands are considered both sources and sinks of total Hg and MeHg. Conversion of the project site from managed wetlands to tidal wetland is expected to reduce the episodic discharges of MeHg because they experience a much greater flow and are not periodically dried, which would reduce constituent concentration and MeHg formation in sediments, in the long term. The creation of more open-water areas, with longer inundation of restored tidal marshes, is also expected to reduce methylation of Hg in the long term. As evidenced by MeHg concentrations from the Blacklock restoration project in Suisun Marsh, long-term MeHg concentrations declined following conversion from managed wetlands to tidal after an initial period of increase in the MeHg load (Appendix C).

The Suisun Marsh Total Maximum Daily Load (TMDL) applicable to MeHg is still in development by the Regional Water Quality Control Board (Appendix C). The San Francisco Bay TMDL was approved in 2008 by the U.S. Environmental Protection Agency, which has a goal for total Hg in suspended sediment of 0.2 milligram per kilogram (mg/kg) (parts per million [ppm]). It is anticipated that, as part of establishing the Suisun Marsh TMDL or another effort (as documented in the SMP EIS/EIR), MeHg monitoring will occur within Suisun Marsh. As appropriate, monitoring may occur on the Tule Red restoration site as part of permitting and/or coordination with the Regional Water Quality Control Board to adaptively manage the site over time and monitor total Hg and MeHg (Appendix C). Because there is no evidence for concluding that tidal restoration would lead to increased problems with respect to MeHg for fish, wildlife, or consumers above baseline conditions and that tidal restoration would be expected to increase tidal prism and flushing and reduce residence time, a decrease in MeHg concentrations may occur; impacts would be less than significant. In addition, the proposed project may participate in a regional monitoring program to document and provide evidence for MeHg fate and transport as a result of tidal restoration.

Similar to levels of Hg and MeHg, the documented low levels of DO at the project site are generally consistent with, or slightly lower than, levels in other areas of the marsh and managed wetlands. The DO levels on the project site are documented to be low in October and March, April, and May. The DO levels on the project site are also influenced by the discharge from the California Department of Fish and Wildlife (CDFW) drain. Seasonal DO variations in the marsh occur, with most DO depressions occurring in early summer and fall in certain locations (e.g., northwestern Suisun Marsh). Preliminary load estimates suggest the most significant drivers of low DO levels in the marsh. Although there are areas of the marsh where it is known that DO is poor, DO patterns are not well understood in marsh sloughs. The effect of managed wetlands on DO is generally episodic (e.g., after discharge events) and associated with discharge events under certain tidal conditions (Appendix C).

The Tule Red project is not expected to reduce DO levels from their current low levels because managed wetland activities would cease once the project site is restored. An increase in tidal prism and flushing as well as reduced residence time are expected to result in increased in DO concentrations. The CDFW drain would continue to discharge onto the project site; this discharge is expected to contain low levels of DO. However, natural tidal flushing would occur under restoration, reducing residence time of the water on-site and increasing mixing and dilution. The proposed project would also install a spray aeration structure on the existing CDFW drain and construct a pooling area to improve DO levels (as described in Chapter 2 of this document). Monitoring of the discharge onto the project site would occur after installation of the spray aeration structure.

Impacts on water quality as a result of methylmercury and DO levels are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.1.2 Salinity

SMP EIS/EIR

Hydraulic modeling was performed using RMAs hydrodynamic model to identify and evaluate potential tidal hydraulic changes and salinity changes from the SMP alternatives under different restoration scenarios. Changes in tidal elevations and tidal flows, both upstream and downstream of connections with new tidal wetlands, are somewhat difficult to anticipate; mathematical modeling is the most accurate method for simulating these effects. Specific restoration areas were not identified at the time of the analysis because they were not known. However, two possible distributions of new tidal wetlands within the marsh were simulated to estimate the likely general effects from substantial new tidal wetlands (about 7,500 acres in each representative simulation). These simulations assumed all the tidal wetland restoration occurred at one time and looked at the immediate effect on tidal elevations of the total restoration.

The SMP EIS/EIR determined that restoration activities would have less-than-significant impacts on salinity because modeled results did not indicate substantial changes in salinity that would affect the water quality of designated beneficial uses (e.g., drinking water supplies). The SMP EIS/EIR documented different yearly seasonal salinity regimes, which are controlled by the seasonal pattern of effective outflow. The SMP EIS/EIR modeling predicted that salinity changes at Suisun Marsh monitoring locations, including the eastern channels, would be much less than the maximum allowed by monthly objectives (monthly objectives defined in 1995 Bay-Delta Water Quality Control Plan).[1] In addition, the largest increase in upstream salinity would be much less than 10% of the average baseline salinity, with no month increasing by more than 10% of the salinity objective; therefore, no expected significant changes to exports or Sacramento–San Joaquin Delta (Delta) diversions were identified. The seasonal salinity pattern (determined primarily by Delta outflow) would remain similar, and any potential change to salinity should not reduce the value of marsh channel water for managed wetlands flood and drain operations.

Existing Conditions and Proposed Project

The magnitude of the salinity effects associated with restoration activities depends primarily on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands. The proposed project is located in the central and southern portion of Suisun Marsh (Region 4), immediately adjacent to Grizzly Bay; this is the downstream terminus of managed wetland activities in the immediate area. The breach location would be in the northern portion of the project site, away from Roaring River.

The project site is approximately 420 acres. Modeling of salt transport, using electrical conductivity as a surrogate, was performed under baseline and proposed project conditions for the 2002 to 2003 period (the same years evaluated in the SMP EIS/EIR). This modeling determines potential salinity effects in the marsh and upstream of the marsh as a result of the Tule Red project (Appendix D.1, *Salinity Modeling Analysis of the Proposed Tule Red Tidal Marsh Restoration*). Overall the model predicted very small increases in salinity during the time period at the locations that were evaluated. These results are detailed in Appendix D.1 of this document and summarized below.

[1] The 1995 Bay-Delta Water Quality Control Plan was updated in 2006; however, no substantive changes were made to the water quality objectives for protecting beneficial uses related to salinity.

- Very small maximum changes in salinity at Jersey Point and Emmaton (western Delta), +0.4% and +0.3% for 2002 (2003 changes were even less).
- Very small maximum changes in salinity for the Mallard Island west Delta location, +0.7% for 2002 (2003 changes were even less).
- Very small maximum changes at upstream southern Delta export locations, +0.2% and +0.3% in 2002.
- Very small changes in salinity for Beldon's Landing in the eastern marsh, between +0.5% and -0.5% for 2002 and 2003.
- Very small changes in salinity at Montezuma slough above the salinity control gates, between +0.7 and -1.0% for 2002 and 2003.

These changes for the western Delta and export locations are consistent with the water quality objectives stated in the SMP EIS/EIR.

Electrical conductivity at the Contra Costa Water District (CCWD) Rock Slough location was processed to evaluate potential changes in chloride compliance (i.e., an overall maximum mean daily chloride limit of 250 milligrams per liter (mg/L) and a level less than or equal to 150 mg/L at least 165 days for 2002 [dry water year] and 190 days for 2003 [above-normal water year]) at the Rock Slough intake location. The peak values for both the baseline and the proposed project were 203 mg/L and meet the 165- and 190-day requirements (Appendix D.1, Table 4). Electrical conductivity at CCWD Old River, at State Route 4, and CCWD Victoria Canal showed almost no changes between baseline and project conditions (Appendix D.1, Tables 9 and 10). Therefore, impacts on water quality as a result of salinity levels are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.1.3 Hydrology and Water Supply

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would significantly alter tidal elevations or velocities. Alteration could affect the timing of available water related to the riparian water supply of managed wetlands, mobilize sediment, and cause erosion because of changes in hydrology. The RMA model was used to understand changes in velocity and how sediment may be mobilized and transported under restoration conditions in the SMP EIS/EIR. The SMP EIS/EIR determined that restoration breaches could be designed to ensure that tidal flows would remain below about 2 feet per second (fps) to prevent tidal muting (i.e., reduced tidal range) caused by the increased water surface gradient during peak tidal flows in channels with relatively high velocities and thus not affect the managed wetland water supply. It was also determined that breaches could be designed to ensure that tidal flows would remain below 3 fps to prevent tidal muting or scouring caused by the increased water surface gradient during peak tidal flows in channels with relatively high velocities. As such, impacts on hydrology and water supply were determined to be less than significant (Bureau of Reclamation [Reclamation] 2011, Chapter 5).

Existing Conditions and Proposed Project

The hydrodynamics of Suisun Marsh are influenced by numerous factors, including daily tides from San Francisco Bay, input from the Sacramento–San Joaquin Rivers and Delta, and diversions for managed wetland activities and water supply. Tidal hydraulics, in turn, influence the availability and the timing of water supply for the managed wetlands and sediment transport (e.g., scour and deposition) in the marsh (Reclamation 2011, Section 5.1). Most water is diverted by gravity to the managed wetlands, and these flooding operations rely on adequate tidal water elevations to divert water from the channels (Reclamation 2011, Section 5.1). Tidal velocities in the marsh are controlled by the tidal flows and the cross sections in the marsh channels and sloughs. The peak velocities are generally less than 2 to 3 fps (Reclamation 2011, Section 5.1). The natural processes of scouring and deposition produce channel sections in the marsh that are in equilibrium with these processes and the upstream tidal area (volume) (Reclamation 2011, Section 5.1). Velocities of more than 3 fps are likely to scour mud and sand bottoms (Reclamation 2011, Section 5.1). Channels are accumulating sediment where channel velocities are low enough for sediment to settle out of the water column (Reclamation 2011, Section 5.5). Where channel velocities are higher, sediments are suspended and carried in the direction of flow until they settle out again. If the tidal prism (i.e., upstream tidal volume) changes through restoration, scour zones and depositional zones could also change (Reclamation 2011, Section 5.5).

The project site is located in Region 4 of Suisun Marsh. This region includes Grizzly, Van Sickle, Hammond, Simmons, Chipps, and Wheeler Islands. Montezuma Slough, the Sacramento and San Joaquin Rivers, and Grizzly, Suisun, and Honker Bays hydrologically dominate this area (Reclamation 2011, Section 6.2). All of these channel and bays are highly energetic, with enormous daily movements of water driven by tides, Delta outflow, wind, and the Suisun Marsh Salinity Control Gates (SMSCG) (Reclamation 2011, Section 6.2).

The hydrodynamics expected under the proposed project were evaluated using a two-dimensional depth-averaged hydrodynamic model, as described in Appendix D.2, *Hydraulic and Geomorphic Basis of Design Report*, of this document. This model was run multiple times to refine different restoration concepts and breach locations. The final run was completed in the fall of 2015 using the conceptual plan described in Chapter 2, *Project Description*, of this document. The modeling helps determine potential impacts associated with the proposed project as well as the hydraulic and geomorphic design needed to meet the ecological goals of the proposed project. The model allowed evaluation of the ability of the tidal channels to provide full tidal exchange throughout the project site, given local tidal characteristics, as adapted from Port Chicago tide records; vegetation roughness on the marsh plain; and the proposed channel layout. Hydraulic sheer stresses from the model were compared to sediment properties that were estimated to be characteristic for the project site to ensure that excavated channels were not depositional and determine rates of erosion if channels were not fully excavated at the time of the breach.

The proposed project’s internal tidal channels (i.e., not connected to other sloughs or waterways) would have velocities of 2 to 3 fps. In Grizzly Bay (modeled at approximately 1,500 feet out into the bay from the site), velocities are only 0.2 fps. The 0.2 fps velocity is consistent with existing-condition velocities, indicating that local impacts on velocity do not extend out that far. The results of the numerical modeling and observations of other tidal marsh sites around Suisun and San Pablo Bay do not indicate that a scour hole is likely to form at the entrance to project site (NHC pers. comm.).

As described in Appendix D.2, the proposed project is being constructed on a lower marsh plain, lower than the mean high water, with an excavated tidal network, providing significant tidal prism volume and associated tidal flux for flushing flows throughout the constructed tidal channel network. Erosion can occur when shear stress exerted by a fluid over a channel surface exceeds the critical shear stress of the channel bed material. Tidal fluctuations, flooding, and draining of the marsh are the driving forces of shear stress in a tidal marsh channels. As a response to this shear stress, bed material erodes from the channel bed and becomes entrained in the current. Thus, the channel becomes deeper, with steeper side slopes that can erode. Results of the hydrodynamic model show that shear stresses in the channels are great enough to provide erosion, where needed, and establish equilibrium on the project site; they are also high enough to inhibit deposition of fine suspended sediments on the margins of the constructed tidal channels. It is expected, and the modeling predicts, that purposeful erosion will occur at the breach and in portions of the larger fourth-order channel along the habitat berm under project conditions; the project site can develop its final channel width and depth naturally and reach equilibrium over time (estimated to be between 0.2 year and 1.8 years after breach) (Appendix D.2). Therefore, impacts on surface hydrology, sediment, and water supply are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.2 Biological Resources

3.3.2.1 Fisheries

The SMP EIS/EIR evaluated the potential impacts of restoration activities on the various life stages of sensitive, special-status, and other fish species, as described in Table 3-7 of this document. This section provides a summary of sensitive, special-status, and other fish species, as evaluated in the SMP EIS/EIR, under the proposed project.

The SMP EIS/EIR evaluated the potential impact of restoration activities on passage and holding or rearing habitat as well as salinity-related impacts on the various life stages of sensitive and special-status fish species, as described in Table 3-7 of this document. The sensitive and special-status fish species evaluated were delta smelt, Chinook salmon (four races or runs), steelhead, green sturgeon, splittail, and longfin smelt. The SMP EIS/EIR also included a broad analysis of the composition of general species of different fish and the potential to affect benthic invertebrate communities. The primary restoration activity evaluated in the SMP EIS/EIR that could affect sensitive, special-status, and other fish species was the breaching of external levees to allow for tidal exchange. The SMP EIS/EIR used RMA modeling to determine which velocities would allow for fish passage and meet the habitat needs of sensitive and special-status fish species during site restoration. Based on the environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document) and the characteristics and conditions related to breaching the levees, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on sensitive and special-status fish species, fish species in general, and benthic communities.

Existing Conditions and Proposed Project

California Central Valley steelhead, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley fall-/late fall–run Chinook salmon, delta smelt, longfin smelt, Sacramento splittail, and green sturgeon are listed special-status native species that occur in Suisun Marsh. The SMP EIS/EIR (Table 6.1-3) describes the status, distribution, and likelihood of occurrence for these species in Suisun Marsh as well as designated critical habitat. This information is current, with the exception of the federal listing for longfin smelt, which is now considered a candidate for listing. Adult and juvenile Chinook salmon, steelhead, and green sturgeon are known to migrate through Suisun Bay and major sloughs of Suisun Marsh; juveniles are known to occur or potentially occur in these waters and smaller sloughs of the marsh. Delta smelt, longfin smelt, and

Sacramento splittail are found throughout the marsh. Subtidal, low-intertidal, low-marsh, mid-marsh, and high-marsh areas all provide habitat for special-status fish species (Reclamation 2011, Section 6.1). The SMP EIS/EIR (Tables 6.1-4 and 6.1-5) describes life-stage timing for these species in Suisun Marsh and their salinity and velocity tolerances. This information is current; however, longfin smelt (adults and juveniles) and delta smelt (estuarine-rearing adults and juveniles) may be found year-round, including the summer months. Studies in the marsh have found that most species are found in smaller sloughs. In general, juvenile native species use the marsh as a rearing area in the winter and spring months, while nonnative species use the marsh in the summer and early fall months when the water is warmer. The number of native fish species has declined over the years (Reclamation 2011, Section 6.1).

The project site is located in Region 4 of the marsh. This region has seen a significant investment in fish-screened facilities over the last 15 years, with diversions to about 20,000 acres of managed wetlands. The presence of numerous fish-screened facilities, including the Roaring River Distribution System, has changed management strategies for these wetlands. Many of the managed wetland areas in this region obtain their water from Montezuma Slough and drain to the bays if physically possible. If not, the wetland areas drain directly into the large tidal sloughs (Reclamation 2011, Section 6.1).

As described in Chapter 2, *Project Description*, of this document, the proposed project would be implemented in two phases. Phase 2 would consist of breaching the natural berm to restore tidal action to the site; this would occur in 2017 or 2018. As described in the SMP EIS/EIR, Phase 2 activities have the potential to affect fish species because a connection between Grizzly Bay, where fish species may be present, and the project site would be established. All in-water activities associated with Phase 2, which would be permitted by various regulating agencies (e.g., U.S. Army Corps of Engineers [Corps], Regional Water Quality Control Board), would occur only during the period of September 1 through November 30. This is the appropriate time for performing in-water work because it avoids periods when special-status species are likely to be present. All environmental commitments, as described in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, of the proposed project would be applied to protect fish species. Specifically, this appendix describes all programmatic conservation measures identified in the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Programmatic Biological Opinion for the SMP EIS/EIR that are applicable to special-status fish species and the proposed project would implement.

The SMP EIS/EIR included an adaptive management and monitoring plan to outline the need for, and the intent of monitoring and adaptive management, as well as general considerations for project proponents. As described in Appendix E, *Adaptive Management and Monitoring Plan*, of the SMP EIS/EIR, project proponents will be responsible for implementing monitoring as incorporated into project planning documents. The approach for each restoration action is to be determined by the specific lead agencies and will be based on the SMP EIS/EIR, project-specific design components, consideration of any new information (including that obtained through the implementation of the AMP), or other factors. Each project will create a monitoring plan that clearly identifies each monitoring activity, expected results, and responsible party for each monitoring activity. To make monitoring useful, choices of ecological attributes to monitor and how to monitor them (frequency, extent, intensity, etc.), must be linked closely to the management situation that motivates the monitoring.

Consistent with the intent and information contained in Appendix E of the SMP EIS/EIR, monitoring would occur as part of the proposed project to inform adaptive management. Monitoring would occur for a number of species, but specifically, fish monitoring would occur to inform the project objectives as outlined in the Biological Assessment (ESA 2016). These objectives are related to enhancing regional foodweb productivity, providing rearing habitat for out-migrating juvenile salmon, providing habitats for aquatic and wetland dependent species, and providing topographic variability for resilience against climate change and sea level rise. The monitoring would measure the expected outcomes related to those objectives, the metrics by which progress towards meeting the objectives, as well as triggers for undertaking a management response if goals are not being met or problems occur which require intervention.

Fish Passage

The timing of the breach (September 1 through November 30) would minimize the potential for entrainment by avoiding the winter and spring months when the most sensitive life stages (larvae and early juveniles) of special-status species are likely to be present in Grizzly Bay. Entrainment of salmonids into the site is not expected because of the velocities expected on- and off-site (Appendix D.2 and NHC pers. comm.). In addition, the velocity accelerations expected in the pelagic zone, an area that delta smelt and other fish inhabit, are predicted to be less than the 1 fps design guidance of the SMP EIS/EIR (Appendix D.2 and NHC pers. comm.). If fish do enter the project site, the vegetated channel margins would be roughened, providing respite for fish from higher velocities (i.e., 2 to 3 fps) and allowing them to move out on the ebb tide and return to relatively calm Grizzly Bay. Therefore, impacts on fish passage, as described in Table 3-7, are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Habitat

Restoration activities under the proposed project would be outside of the riparian vegetation zone and in brackish water areas of an existing managed wetland; therefore, such activities are not anticipated to reduce cover or habitat for salmonids. Levee breaching for the proposed project would affect only small areas, and scouring impacts on aquatic vegetation would be minimal compared to existing and created habitat. Furthermore, the restoration design includes intertidal habitat that would provide vegetative cover after breaching. Therefore, impacts on habitat, as described in Table 3-7, are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Salinity

The breach location at the northern end of the project site and the tidal exchange between the project site and Grizzly Bay can result in a change in salinity within the marsh and in upstream areas. This change could affect fish survival, growth, and movement. As described in the SMP EIS/EIR, Table 6.1-5, sensitive fish species have a wide range of salinity tolerances; large changes in salinity would need to be experienced to have significant effects on survival, growth, and movement. As described above in Section 3.3.1.2, *Salinity*, the proposed project was modeled using the RMA Bay-Delta Model (the same model used in the SMP EIS/EIR). The difference between baseline and the simulated project condition results in the 2002–2003 period is very small for all locations that were simulated. Maximum differences depend on the location simulated but range between -1.0%

and +0.7% (Appendix D.1.). Table 3-3, below, provides a summary of the results. Detailed results can be found in Appendix D.1, Tables 2, 3, and 6 through 10.

Table 3-3. Range of Salinity Changes at Certain Locations

Location	Month	Base EC (uS/cm)	EC Change (uS/cm)	EC Change (%)
Beldon's Landing	June 2002	5,336	24.5	0.5
	April 2003	1,957	-9.1	-0.5
Montezuma Slough	April 2002	1,427	10.6	0.7
	April 2003	878	-8.6	-1.0
Mallard Island (Western Delta)	April 2002	1,472	10.6	+0.7
	April 2003	878	-8.6	-1.0

EC = electrical conductivity; uS/cm = microSiemens per centimeter

Given the very small maximum differences between the simulated baseline and project conditions at the different modeled locations and the wide tolerance of salinity in the sensitive fish species that are typically present in Suisun Marsh, salinity-related effects on fish survival, growth, movement, or reproduction attributable to restoration activities are not expected. Therefore, impacts on salinity, as described in Table 3-7, are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Monitoring

The fish monitoring would be coordinated with regional monitoring by IEP and UC Davis Suisun Marsh Fish Study, and other agency programs. Both NMFS and USFWS have been consulted regarding the monitoring for the proposed project and potential take of special-status fish species during monitoring (ESA 2016). The incidental take of salmonids and sturgeon associated with monitoring is permitted under the NMFS 2009 Biological Opinion on the Long term Operations of the Central Valley Project and State Water Project (OCAP BO) (NMFS 2009). As recommended by USFWS, the proposed project is using similar monitoring methods as the IEP Fish Restoration Program and the take estimates associated with those IEP monitoring methods (ESA 2016). Post-breach monitoring would occur during the first five years after breaching (Interim Management Period) for at least three of the five years (e.g., Year 1, 3, and 5). A likely schedule would be fish and pelagic foodweb sampling 3 times a year (spring, summer and fall), and benthic invertebrate sampling twice a year (spring and fall). The aquatic sampling would be designed to meet the requirements for FAST crediting approval monitoring, while minimizing the amount of take to the extent feasible. Fish sampling would be scaled to the population index of the previous year. Prior to defining the upcoming year's sampling program, recent trends in population indices for delta smelt, longfin smelt, and listed salmonids would be reviewed. Sampling intensity and methods would be adjusted to reduce potential for take in years when population indices are deemed at critical levels. Monitoring would be done consistent with conditions of the NMFS 2009 Biological Opinion on the Long term Operations of the Central Valley Project and State Water Project and the Biological Opinion for the proposed project, which will include the following conditions:

- To avoid harming delta smelt (and other fish) during sampling, fish would be carefully removed from nets, processed quickly, held in suitable containers with aeration, and returned to suitable habitat as soon as possible. Any incidentally caught adult delta smelt fish will be released alive immediately.

- If any method captures 25% or more of the total listed fish take in one tow, it will be discontinued.
- Take of delta smelt will be linked and scaled to the population index in coordination and consultation with IEP and USFWS. Each year prior to any sampling occurring, a maximum amount of take based on current population metrics would be developed and adhered to during the monitoring program.
- The sampling program will be adjusted as new technologies with lower risk of take become available, such as “smelt cam” and environmental DNA.
- To avoid harming listed salmonids and green sturgeon (and other fish) during sampling, fish would be carefully removed from nets, processed quickly, held in suitable containers with aeration, and returned to appropriate habitat as soon as possible.
- The sampling program will be adjusted as new technologies with lower risk of take become available, such as environmental DNA

Given that monitoring would be done in accordance with the existing Long-Term Operations Biological Opinion (NMFS 2009) and the proposed project Biological Opinion, would incorporate measures similar to those of other programs (IEP), and that monitoring would occur over different temporal and geographic scales, impacts would be less than significant. No mitigation is required.

3.3.2.2 Vegetation and Wetlands

The SMP EIS/EIR evaluated the potential direct and indirect impacts of restoration activities on the various special-status plant species and land cover types, as described in Table 3-7 of this document. The SMP EIS/EIR defined special-status plant species as species that are legally protected under the California Endangered Species Act (CESA), the federal Endangered Species Act (ESA), or other regulations as well as species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants were included in the SMP EIS/EIR evaluation based on their potential to occur in the study area; species that are not found in land cover types present in the study area were eliminated from further consideration (see Table 6.2-3 of the SMP EIS/EIR[2]). The special-status plant species evaluated were soft bird’s-beak (*Cordylanthus mollis* var. *mollis*), Suisun thistle (*Cirsium hydrophilium* var. *hydrophilium*), Suisun Marsh aster (*Symphyotrichum lentum*), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), Mason’s lilaeopsis (*Lilaeopsis masonii*) and Delta mudwort (*Limosella subulata*). The SMP EIS/EIR also included a broad analysis of land cover types and the effects of restoration on these land cover types. Land cover types in the marsh have been mapped and defined for numerous studies and documents. As a result, the definitions of the various land cover types vary slightly. For the purpose of the SMP EIS/EIR, the land cover types were identified by CDFW. These land cover types include bays and sloughs, tidal wetlands, managed wetlands, riparian, uplands, seasonal wetlands, vernal pools, and developed areas (Section 6.2 Reclamation 2011, Section 6.2).

The primary restoration activities evaluated in the SMP EIS/EIR that could affect special-status species and land cover types were grading and excavating, breaching of external levees to allow for

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[2] A California Natural Diversity Database (CNDDB) search was performed in December of 2015 to update and confirm the documentation of special-status plant species in the marsh. One other special-status plant species was identified within a 5-mile radius of the project site that was not identified in Table 6.3-2 of the SMP EIS/EIR, Bolander's water-hemlock (*Cicuta maculata* var. *bolanderi*). The special-status plant surveys of the project site (Appendix E, *Special-Status Plant Surveys*) did not identify this species on the project site.

tidal exchange, and construction of habitat berms. In addition, the potential for tidal muting or scour under restored conditions could also result in impacts on special-status plant species or vegetation types (Reclamation 2011, Section 6.2). The SMP EIS/EIR qualitatively analyzed the presence of special-plant and land cover types within the marsh as well as the types and locations of different habitats in the marsh to determine potential indirect and direct effects of restoration. The analysis assumed temporary and permanent impacts on vegetation and wetland resources in the marsh. Temporary impacts would be those that occur only during the construction period (i.e., associated with restoration and enhancement of wetlands). Permanent impacts would occur as a result of irreversible changes in land cover types. The analysis was based on the most current proposed implementation of the SMP, as described in the EIS/EIR and existing biological resource information. Based on the environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document) and the characteristics and conditions of restoration, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on special-status plant and land cover types.

The section below provides a summary of special-status and land cover types, as evaluated in the SMP EIS/EIR and under the proposed project (Reclamation 2011, Section 6.2).

Tidal Wetlands

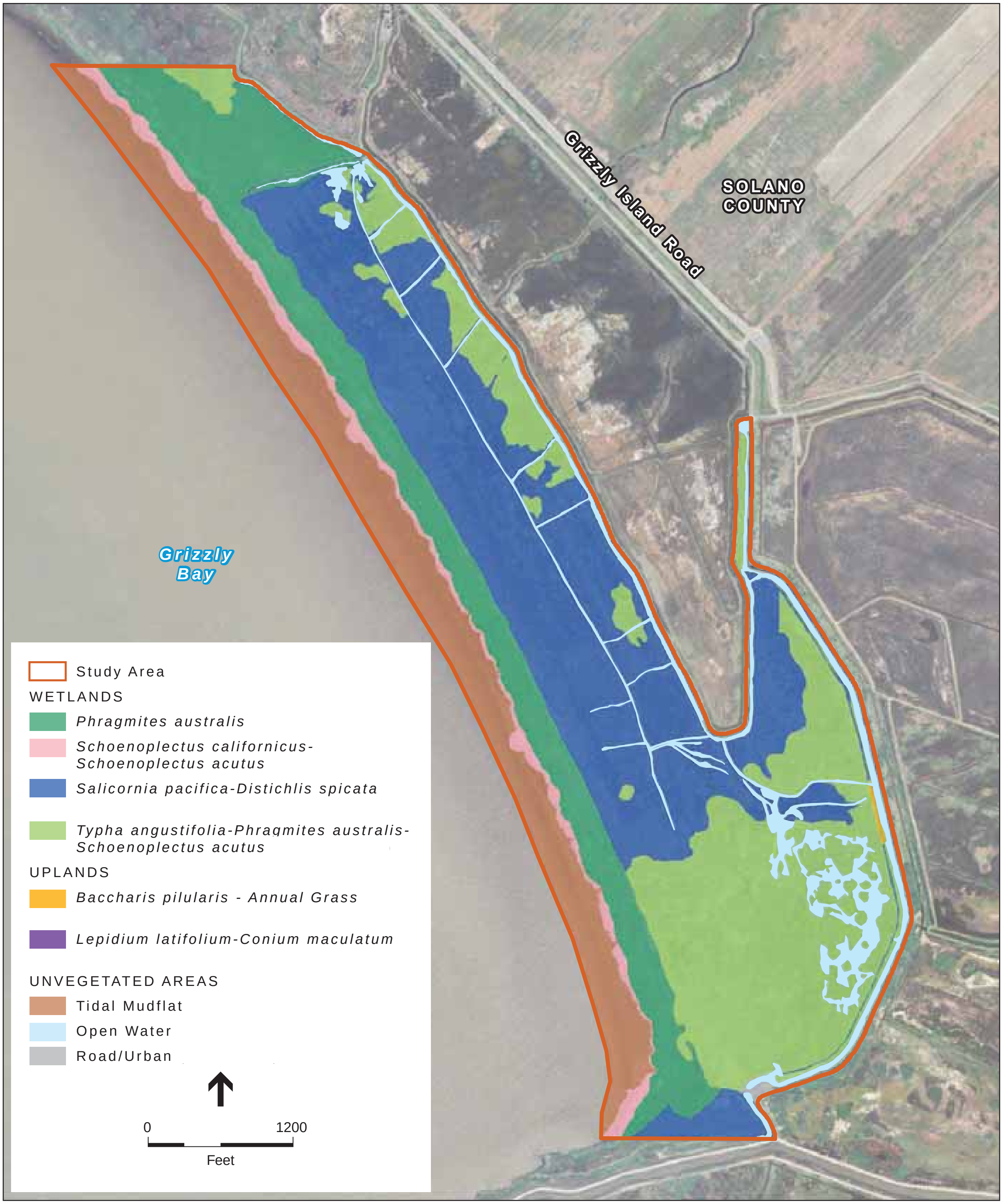
SMP EIS/EIR

The restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if it would significantly affect tidal wetlands, an important land cover type in Suisun Marsh. The evaluation documented that construction activities related to converting habitat in managed wetlands to tidal wetlands would result in a temporary reduction in tidal wetland acreage; however, the purpose of restoration is to create many more acres of this land cover type within the marsh. During construction, exterior levee breaching is expected to convert a small amount of tidal wetland acreage to aquatic perennial habitat. This is because the area of the levee that may have had tidal wetlands/emergent vegetation would be removed to allow for tidal exchange and restoration of the managed wetlands to tidal wetlands. However, the amount of affected acreage would be relatively small compared to the amount anticipated to be restored to tidal habitat (i.e., 1%).

Under restored conditions, increased scour could occur temporarily as a result of greater flows near breach sites. Although existing tidal wetlands in the vicinity of the levee sections may be affected (e.g., through temporary conversion of a small amount of tidal wetlands to tidal perennial aquatic habitat), breach locations would be chosen that would minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes. Therefore, the SMP EIS/EIR determined that restoration activities would have a less-than-significant impact on tidal wetlands, as described in Table 3-7 of this document.

Existing Conditions and Proposed Project

The project site is located in Region 4 of Suisun Marsh, the largest geographic region in the marsh. The 36,094 acres in this region make up approximately 47% of the terrestrial and aquatic habitat in the marsh. Tidal wetlands account for 8% (2,940 acres) of the land cover in this region. The project site supports approximately 50 acres of tidal emergent wetland. Most of this area is located along the natural berm adjacent to Grizzly Bay (Figure 3-1). The vegetation in this area consists primarily of tules (*Schoenoplectus californicus* and *S. acutus*) (ESA 2015).



Source: Westervelt Ecological Services , 2015.

Graphics ... 347.15 (1/13/16) AB

Figure 1
Vegetation

The proposed project went through several rounds of project design, during which time different breach locations were evaluated to determine their potential efficacy for restoration success and their impacts on areas outside of the project site, per the SMP EIS/EIR assumption that breach locations would be chosen to minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes (ESA 2015). A breach location on the northern end of the project site would ensure adequate tidal inflow and meet the biological goals and objectives of the site. It would also allow appropriate velocities so that scour and erosion would not occur off-site. During construction activities, as part of Phase 2 of the proposed project, the natural berm would be breached in the northern section of the project site to allow for tidal exchange. This would require removing a 50-foot section of the natural berm. Ultimately, the breach would widen and reach equilibrium at approximately 120 feet. As such, this area (less than1 acre) of existing tidal wetlands on the natural berm in the area of the breach would be converted to tidal perennial aquatic habitat to allow for tidal exchange. Under restored conditions, tidal exchange would occur between Grizzly Bay and the project site on a daily basis. As such, the project site would gain approximately 334 acres of tidal wetlands, for a total of 454 acres of tidal wetlands. This gain is consistent with the expectation of the SMP EIS/EIR (i.e., that a relatively small loss of tidal wetland would occur), but the restoration of tidal action would restore more tidal wetland habitat than would be affected.

This tidal exchange is expected to perform some erosion within the project site to establish equilibrium conditions; however, it is not expected to erode or scour the existing natural berm or areas within Grizzly Bay. As discussed in Section 3.1.1, *Water Quality*, *Surface Hydrology*, *and Water Supply*, of this document, tidal velocities would be at or below 3 fps within the interior of the project site and only 0.2 fps approximately 1,500 feet out into Grizzly Bay. These velocities are similar to existing conditions or locations in other parts of Suisun and San Pablo Bay and do not indicate that erosion or scour would occur. As such, it is anticipated that existing tidal wetlands would not be affected through scour. Therefore, impacts on tidal wetlands are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Managed Wetlands

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would significantly affect managed wetlands, an important land cover type in the Suisun Marsh. The evaluation concluded that converting the habitat in managed wetlands to tidal wetlands would result in a permanent decrease in the managed wetland acreages in the marsh (5,000–7,000 acres); however, an increase the amount of tidal wetlands within the marsh would provide some of the functions and values as the managed wetlands. In addition, the tidal wetlands would provide habitat and food sources that benefit tidal wetland-dependent species and many, but not all, managed-wetland dependent species. Therefore, the SMP EIS/EIR determined that restoration activities would have a less-than-significant impact on tidal wetlands, as described in Table 3-7 of this document.

Existing Conditions and Proposed Project

The project site is located in Region 4 of the Suisun Marsh. Managed wetlands and tidal wetlands account for 80% (28,628) of the land cover in this region. The project site consists of approximately 320 acres of managed marsh (non-tidal) that supports phragmites (*Phragmites australis*), pickleweed (*Saliconia pacifica*)-saltgrass (*Distichlis spicata*), cattails (*Typha angustifolia*), and tules (*Schenoplectus acutus*). The road margins support ruderal vegetation comprising mainly perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*), with occasional mature coyote brush shrubs (*Baccharis pilularis*), wild radish (*Raphanus sativus*), and annual grasses (*Bromus diandrus*, *B. hordeaceus*, and *Hordeum murinum*). Most of this vegetation is located in the interior of the project site or on the easterly side of the natural berm or on the roads (Figure 3-1). The project site would result in a conversion of the managed wetlands to tidal wetlands. Overall, construction activities as part of Phases 1 and 2 of the proposed project would temporarily disturb approximately 150 acres of managed wetlands (i.e., jurisdictional waters of the United States), and the conversion of managed wetlands to tidal wetlands would result in a permanent net loss of up to 10 acres of managed wetlands (i.e., jurisdictional waters of the United States) as a result of the habitat berm incorporated into the proposed project.

The Draft (USFWS 2009) and Final Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (USFWS 21013a) provides a clear scientific basis for tidal restoration in Suisun Marsh. The goal of the Recovery Plan is the comprehensive restoration and management of tidal marsh ecosystems in five recovery units—Suisun Bay being one of them. The Suisun Bay Recovery Unit is divided into the Western Suisun/Hill Slough Marshes, Suisun Slough/Cutoff Slough Marshes, Nurse Slough/Denverton Slough Marshes, and Grizzly Island Marshes. These areas correspond with Regions 1, 2, 3, and 4 of the SMP. Depending on the location within Suisun Marsh, different species would benefit from tidal restoration or improved management of diked managed wetlands. The four endangered species that would benefit from implementation of the SMP are the California clapper rail (*Rallus longirostris obsoletus*), salt marsh harvest mouse (SMHM) (*Reithrodontomys raviventris*), Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), and soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*). Tidal restoration in Region 4 would aid in the recovery of soft bird's beak and SMHM, as described in Sections 6.2 and 6.3 of the SMP EIS/EIR, respectively. Additionally, restoration is expected to benefit delta smelt by providing increased food productivity inside and exported from the marsh as well as additional rearing habitat for longfin smelt, salmonids, and other fish species (Reclamation 2011, Chapter 14).

A qualitative comparison of the ecosystem functions and services offered under the existing pre-project (managed marsh complex) condition versus the proposed project (tidal wetland complex) was prepared for the Corps in the Supplemental Information Documentation to the 404 Permit Application for the proposed project (ESA 2015). The qualitative comparison included elements of both the California Rapid Assessment Method (CRAM) and the Hydrogeomorphic Approach and adapts them for a qualitative assessment, comparing functions before and after restoration of the project site (ESA 2015).[3] Based on the comparison, the level and suite of functions and services that are offered by the proposed tidal wetland complex are superior to those associated with managed marsh complex, such as that currently existing at the Tule Red site (ESA 2015). In particular, the following are anticipated to be enhanced by the proposed project: hydrogeomorphic processes, tidal marsh, marsh-upland transition habitat, fish habitat, and foodweb support for the aquatic ecosystem (ESA 2015). These functions are expected to be enhanced in part because of the habitat berm, which was deemed by the project proponents and state and federal agencies as a necessary component that provides the

[3] CRAM assesses wetland condition by using attributes of landscape context, hydrology, physical structure, and biotic structure (vegetation) and identifying key stressors. The Hydrogeomorphic Approach is a wetland assessment procedure based on three fundamental factors that influence how wetlands function: position in the landscape (geomorphic setting), water source (hydrology), and the flow and fluctuation of the water once in the wetland (hydrodynamics).

following: upland refugia for wildlife species, a mosaic of different habitats within the restored area, and a means to protect sensitive species (i.e., SMHM) that rely on tidal habitat. In addition, managed wetlands are hydrologically disconnected approximately half of the year because they are purposefully drained and dried. Therefore, they physically cannot provide the full value of wetlands throughout the year. As such, the restoration design of the proposed project meets the SMP EIS/EIR intent of including habitat levees, benches, and other features that would provide some of the functions and values as the managed wetlands. As the tidal wetlands become established, they will increase the variety of wetland functions and values. Although project implementation would result in temporary disturbance of wetlands due to construction and a net loss of up to 10 acres of waters of the United States, the overall structure and function of the tidal wetland ecosystem, including tidal exchange and foodweb production, would increase substantially in both quantity and quality (ESA 2015).

Overall, there would continue to be approximately 52,000 acres of managed wetlands in Suisun Marsh and approximately 28,294 acres in Region 4 that would provide the type of function and value associated with managed wetlands. Therefore, considering the function and value the tidal wetlands would provide and the number of acres converted in Region 4 (approximately 1%), impacts on managed wetlands would be within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Upland Plant Communities

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would significantly affect upland plant communities, an important land cover in the Suisun Marsh. The evaluation concluded that levee breaching could disturb upland plant communities; however, upland areas would be protected through the selection of breach sizes and locations in consideration of the habitat that would be affected. Therefore, the SMP EIS/EIR determined that restoration activities would have a less-than-significant impact on upland plant communities, as described in Table 3-7 of this document.

Existing Conditions and Proposed Project

The breach to occur in Phase 2 would be located in the northern portion of the project site and be approximately 50 feet wide. The breach would reach equilibrium at approximately 120 feet wide. As documented in Appendix E, *Special-Status Plant Species Surveys*, of this document and Figure 3-1, the current site of the breach comprises primarily non-upland plant communities (i.e., tule). Therefore, breaching of the existing natural berm would not disturb upland plant communities. Impacts are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Noxious Weeds/Invasive Plants

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would result in the significant spread of noxious weeds or invasive plant species. The evaluation concluded that soil-disturbing activities associated with grading and construction could promote the introduction of noxious weeds. In addition, invasive plant species could spread as a result of either public access after restoration occurred on a site or through possible tidal muting. However, invasive species would be controlled through various environmental commitments and through restoration project design measures (i.e., breach location evaluation and selection). Based on this and the environmental commitments described in Table 3-7 of this document, the SMP EIS/EIR determined that restoration activities would have a less-than-significant impact on invasive plant species and noxious weeds.

Existing Conditions and Proposed Project

Currently, there are known invasive species at the project site, including common reed or phragmites (*Phragmites australis)*, which is controlled on the project site in the summer management period by herbicide application during the flowering period. Much of the phragmites occurs on the natural berm adjacent to Grizzly Bay, and it cannot be removed without undermining the structural integrity of the berm, which would compromise the design and objectives of the proposed project. Although phragmites is an invasive species that is known for capitalizing on disturbance, and the proposed project does include grading and disturbing approximately 150 acres, the proposed project would include multiple environmental commitments, as described under Nonnative Plant Control in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, of this document, to avoid introducing invasive nonnative species and substantially improving conditions for invasive species. These environmental commitments are the same as those found in Appendix F, *Mitigation Monitoring and Reporting Program*, of the SMP EIS/EIR, with the one exception of including the option of using a naturalized seed mix instead of certified weed-free native mixes for any restoration planting, as provided in the revegetation plan developed in cooperation with CDFW. Furthermore, as described in Sections 5.3.2.1, *Fisheries*, and 5.3.1.3, *Hydrology and Water Supply*, the velocities expected during the initial breach and as the project site reaches equilibrium are not velocities that would lead to tidal muting. Therefore, the breach is not expected to increase the spread of invasive plant species. As such, impacts are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Special-Status Plants

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would significantly affect special-status plant species documented in the Suisun Marsh. The evaluation concluded that restoration could result in temporary construction impacts; however, these would be reduced through the appropriate selection of breach size and location to minimize scour effects, and environmental commitments would be implemented to determine if special-status plant species were present and then to buffer them. Furthermore, the range of marsh elevations expected under restoration would create new habitat for special-status plant species. Based on this and the environmental commitments described in Table 3-7 of this document, the SMP EIS/EIR determined that restoration activities would have a less-than-significant impact on special-status plant species.

Existing Conditions and Proposed Project

Appendix E, *Special-Status Plant Species Surveys*, of this document describes the two special-status plant surveys done on the project site (an early-season and late-season survey). These surveys document no known special-status plant species within the project site. In addition, the project site would be managed as a managed wetland prior to grading for restoration purposes. Managed wetland activities include disking and other vegetation control measures that greatly reduce the likelihood of special-status plant species inhabiting the project site. Furthermore, the project site would be flooded prior to breaching (Phase 2) the existing natural berm, which would discourage special-status species from colonizing the project site.

The SMP EIS/EIR allows for ECs and BMPs to be implemented for each specific project, depending on the project location, the potential to adversely affect biological resources, and the guidance and requirements set forth by resource agencies through informal and formal consultations. Any adverse effects on special-status plant species attributable to construction activities may require implementation of additional avoidance or mitigation measures. USFWS and CDFW will be consulted, and additional avoidance and mitigation measures may be implemented on a site-specific basis (Reclamation 2011). The proposed project would incorporate select ECs from the SMP EIS/EIR that are relevant to the project as described in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, of this document, including:

- Biological Resources Best Management Practices – General Best Management Practices
- Biological Resources Best Management Practices – Worker Training
- Biological Resources Best Management Practices – Special-Status Plant Species Protection
- Biological Monitoring

These ECs and BMPs would verify the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. The extent of mitigation of direct loss of or indirect impacts on special-status plants would be based on these survey results. If found, the locations of special-status plants in proposed construction areas will be recorded using a global positioning system (GPS) unit and flagged. Any special-status plant species observed during surveys will be reported to USFWS and CDFW so the observations can be added to the California Natural Diversity Database (CNDDB).

Plants would be identified and protected by flagging and the presence of a biological monitor during construction activities. In addition, all construction personnel would receive worker awareness training which would include the description and location of any special-status in the project area and the penalties of impacting those individual plants. With the implementation of the environmental commitments identified in Appendix B of this document, the proposed project would result in less-than-significant impacts on special-status plants. Therefore, impacts on special-status plants are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.2.3 Wildlife

The SMP EIS/EIR evaluated the potential direct and indirect impacts of restoration activities to the various special-status and other wildlife species, as described in Table 3-7 of this document. The SMP EIS/EIR defined special-status wildlife species as species that are legally protected under the ESA, CESA, or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. The special-status wildlife species evaluated were Suisun SMHM (*Reithrodontomys raviventris*), California clapper rail (*Rallus longirostris obsoletus)*, California black rail (*Laterallus jamaicensis coturniculus)*, California least tern *(Sterna antillarum browni)*, northern harrier *(Circus cyaneus)*, saltmarsh common yellowthroat *(Geothlypis trichas sinuosa)*, short-eared owl (*Asio flammeus)*, Suisun song sparrow (*Melospiza melodia maxillaris)*, Swainson's hawk *(Buteo swainsoni*), tricolored blackbird (*Agelaius tricolor)*, western burrowing owl (*Athene cunicularia hypogea*), white-tailed kite (*Elanus leucurus*), Suisun shrew (*Sorex ornatus sinuosus*), and western pond turtle (*Clemmys marmorata)*. These special-status wildlife were included in the SMP EIS/EIR evaluation based on the presence of available habitat in the Suisun Marsh to support them and the known and confirmed presence in the marsh or the high likelihood of presence in the marsh (Table 6.3-2 of the SMP EIS/EIR).[4] The SMP EIS/EIR also included a broad analysis of general waterfowl and shorebird species. The primary restoration activities evaluated in the SMP EIS/EIR that could affect sensitive, special-status, and other wildlife species were grading and excavating activities, breaching of external levees to allow for tidal exchange, and construction of habitat berms. The SMP EIS/EIR qualitatively analyzed the presence of special-status wildlife species within the marsh as well as the types and locations of different habitats in the marsh to determine potential indirect and direct effects of restoration (Reclamation 2011, Section 6.3, *Wildlife*). The analysis assumed that tidal wetland restoration actions, specifically levee breaching, initially would result in the establishment of primarily open-water habitat and also intertidal areas for vegetation and special-status wildlife species (Reclamation 2011, Section 6.3, *Wildlife*). Tidal wetland vegetation would establish as sediment accrues over time, reducing the amount of open water habitat and increasing tidal habitat (Reclamation 2011, Section 6.3, *Wildlife*). Based on the environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document) and the characteristics and conditions of restoration, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on special-status and other wildlife species (Reclamation 2011, Section 6.3, *Wildlife*). This section provides a summary of special-status and other wildlife species as evaluated in the SMP EIS/EIR and under the proposed project.

Salt Marsh Harvest Mouse

SMP EIS/EIR

Restoration of tidal wetlands was evaluated in the SMP EIS/EIR to determine if restoration would significantly affect SMHM, identified as endangered under the CESA and the federal ESA. The evaluation documented that construction activities related to converting the habitat in managed wetlands to tidal wetlands would result in a temporary reduction in SMHM habitat. The evaluation included several environmental commitments related to SMHM during construction, such as having a biologist look for SMHM before and during restoration activities. If found, construction activities would stop, then continue once the individual moves from the area. The evaluation included the possibility of removing pickleweed habitat during construction but acknowledged that the restored areas would be expected to provide permanent suitable and sustainable habitat. Furthermore, the timing and scale of construction activities (implemented over the 30-year plan period and not concentrated in a small geographic area or time frame) would constrain impacts on SMHM. In addition, the SMP EIS/EIR allows for project proponents of restoration to propose alternative measures for protecting sensitive species through project-level formal or informal consultations. Based on this and the other environmental commitments in the SMP EIS/EIR (summarized in Table 3-

[4] A California Natural Diversity Database (CNDDB) was performed in December of 2015 to update and confirm the documentation of special-species in the marsh. Only one other special-status species was identified within a 5-mile radius of the project site that is not identified in Table 6.3-2 of the SMP EIS/EIR: San Joaquin Pocket Mouse (*Perognathus inornatus*). The one occurrence of this species was documented between railroad tracks and Port Chicago Highway in a mixture of grassland and scrub. This species is discussed in this section.

7 of this document), as well as the characteristics and conditions of foraging and breeding habitat, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on SMHM.

Existing Conditions and Proposed Project

The SMHM is found in numerous locations within the marsh, indcluding tidal wetlands and managed wetlands. Specifically, 13 areas on state lands have been set aside in the marsh, totaling more than 2,500 acres, to conserve habitat for SMHM and other wetland-dependent species (Reclamation 2011, Section 6.3, *Wildlife*). The SMHM preserves are Peytonia Slough; Hill Slough West Ponds 1, 2, 4, and 4A; Hill Slough East, Areas 8 and 9; a portion of Joice Island, the Crescent Unit, a portion of Lower Joice Island; Blacklock; and Grizzly Island Ponds 1 and 15. Mitigation areas are Island Slough Ponds 4 and 7 (Reclamation 2011, Section 6.3, *Wildlife*). Regular trapping of mice occurs in these areas by CDFW and the Department of Water Resources (DWR) to document the presence and number of mice observed and track the sustainability of the popultaion of mice in the marsh. The preserves closest to the project site are Cresent Unit 1 and Pond 15, located in the Grizzly Island Wildlife Area northeast of the project site. In Cresent Unit 1, between 2004 and 2015, CDFW/DWR had a capture efficiency[5] for mice between 6.5% and 18.25%. In Pond 15, between 2004 and 2015, the capture efficiency for mice was between 4.5% and 13.75%. The USFWS Recovery Plan for Tidal Marsh Ecosystems considers a capture efficiency level of 5% or better in some, and 3% or better in most, viable habitat areas to be a primary indicator of a sustainable population.

SMHM are dependent on dense cover, including that provided by pickleweed- or non-pickleweed-dominated mixed wetlands. Mixed stands of native salt marsh vegetation dominated by pickleweed have higher habitat value than pure stands (Conceptual Model 2010). This species has been observed in tidal wetlands and along sloughs as well as within managed wetlands. Suitable habitat for harvest mice in the managed wetlands, in terms of halophytic species, typically occurs at the higher elevations in the wetlands or in wetlands with higher soil salinity. Studies suggest SMHM use a mix of vegetation types and pickleweed, including emergent vegetation, to escape rising water in both tidal wetlands and managed wetlands (Sustaita et al. 2011; Smith 2012). There are approximately 50 acres of tidal emergent wetland located on the project site that support tules (*Schoenoplectus californicus* and *S. acutus*). Most of this is located along the natural berm adjacent to Grizzly Bay (Figure 3-1). There are also approximately 320 acres of managed marsh (non-tidal) that support phragmites (*Phragmites australis*), pickleweed (*Salicornia pacifica*), saltgrass (*Distichlis spicata*), cattails (*Typha angustifolia*), and tules (*Schoenoplectus acutus*). Most of this vegetation is located in the interior of the project site or the easterly side of the natural berm (Figure 3-1). Based on the studies conducted in Suisun Marsh, the presence of mice in nearby areas (Crescent Unit and Pond 15), and the presence of suitable habitat for the SMHM, there is a relatively high likelihood of SMHM to be present on the project site.

The project site is currently a managed wetland. As such, it is flooded until February and drawn down between March and June, per standard management wetland activities authorized by the existing Regional General Permit 3 (Permit #2012-00258N) from the Corps and the associated Biological Opinion from USFWS for SMHM and other listed fish and wildlife species for managed wetland activities. During this time, the mice move to the outer edges of the project site or use tall emergent vegetation within the managed wetland areas to escape the high water levels. During the summer months (June to September/October), approximately 175 acres of the project site is

[5] Capture efficiency is the number of individual SMHM divided by the total number of trap nights. A trap night is one trap set for one night. During a survey, CDFW usually sets 100 traps for 4 nights, or 400 trap nights.

disturbed with heavy equipment (mowers, dozers, backhoes, discs, excavators) to perform annual maintenance activities and vegetation manipulations. Mowing and discing is used to set back successional stages of desirable vegetation and control invasive species. Discing is limited to 80 acres (20%) of the project site per year. Mowing is used to prepare the pond to provide adequate open-water and foraging opportunities for wintering waterfowl and control invasive phragmites. The high water table and periodic discharges from the CDFW drain sometimes require areas that are repeatedly disced or mowed until the beginning of fall flood-up in mid-October. During the summer management period, SMHM most likely find refuge in the remaining undisturbed and vegetated areas on the site.

The SMP EIS/EIR and the USFWS Programmatic Biological Opinion (USFWS 2013b) allows for ECs and BMPs implemented for each specific project depending on the project location, potential to adversely affect biological resources, and guidance and requirements set forth by resource agencies through informal and formal consultations. Any adverse effects on SMHM attributable to construction activities may require implementation of avoidance or mitigation measures. USFWS and CDFW will be consulted, and avoidance and mitigation measures may be implemented on a site-specific basis (Reclamation 2011). The proposed project would incorporate select ECs from the SMP EIS/EIR that are relevant to the project as described in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, of this document including:

- Biological Resources Best Management Practices – General Best Management Practices
- Biological Resources Best Management Practices – Worker Training
- Biological Resources Best Management Practices – Special-Status Wildlife Protection: Mammals
- Biological Monitoring

The following project-specific measures would be implemented to minimize potential effects on SMHM:

- A USFWS-approved biologist, with previous salt marsh harvest mouse monitoring and surveying experience, will identify suitable salt marsh habitat for the mouse and conduct preconstruction surveys for the mouse prior to project initiation.
- Vegetation will be removed from all areas (driving roads, action areas, or anywhere else that vegetation can be stepped on).
- A USFWS-approved biologist with previous salt marsh harvest mouse experience will be on site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The USFWS-approved biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the USFWS-approved biologist has requested work stoppage because of take of any of the listed species, USFWS and CDFW will be notified within 1 day by email or telephone.
- If a salt marsh harvest mouse is discovered, construction activities will cease in the immediate vicinity of the individual until USFWS is contacted and the individual has been allowed to leave the construction area.
- Disturbance to wetland vegetation (i.e., pickleweed [*Salicornia spp.*]) will be avoided to the extent feasible in order to reduce potential impacts on SMHM habitat. If wetland vegetation (i.e., pickleweed [Salicornia spp.]) cannot be avoided, it will be removed by a method approved by

the USFWS and CDFW. The USFWS-approved biologist will be on site to monitor all wetland vegetation removal activities.

The proposed project would minimize SMHM habitat within the footprint of construction while preserving large undisturbed areas of vegetation for SMHM refuge during construction of Phase 1 and Phase 2. The proposed project would disturb only 150 acres within the project site, compared with typical disturbance of 175 acres under managed wetland conditions. During construction by heavy equipment, a qualified biologist with SMHM experience will be on-site and identify SMHM if they are present in or adjacent to work areas and stop construction or remove the species to prevent potential injury or mortality. After construction by heavy equipment and prior to Phase 2, the project site would be pre-flooded and managed to avoid SMHM return to the site and to allow any SMHM present to migrate to higher elevations and tall vegetation within the site. Under operating conditions (i.e., post-breach), there would be no annual disturbance to the marsh plain vegetation that, because of its elevation, is expected to develop into marsh habitats favored by SMHM. In addition, the gradual slope of the habitat levee would provide refuge to SMHM during extreme high tides. The reduction in overall disturbed acres compared to baseline, combined with the environmental commitments identified in Appendix B of this document, would result in less-than-significant impacts on the SMHM. Therefore, impacts on SMHM are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Suisun Shrew

SMP EIS/EIR

The SMP EIS/EIR evaluated the potential impacts of restoration activities on the Suisun shrew, as described in Table 3-7 of this document. Similar to the potential impacts described above for SMHM, suitable habitat for the Suisun shrew would be temporarily disturbed during the restoration activities. The evaluation included the possibility of removing habitat during construction but acknowledged the restored areas would be expected to provide permanent suitable and sustainable habitat through the use of habitat berms. Furthermore, the timing and scale of construction activities (implemented over the 30-year plan period and not concentrated in a small geographic area or time frame) would constrain impacts on the Suisun shrew. Based on this and the other environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document), as well as the characteristics and conditions of foraging and breeding habitat, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on the Suisun Shrew.

Existing Conditions and Proposed Project

Suisun shrews occur in tidal wetlands and managed wetlands. This species occupies the same middle and high marsh zone habitat as the SMHM (Williams 1986). Driftwood and organic litter above the high-tide inundation zone may be used for nesting and foraging. Suisun shrews use the higher tidal wetland zones and upland transition zones as escape cover from high tides. This species has been observed in tidal wetlands and in managed wetlands. Occurrences were documented in Grizzly Island, Cordelia Salt Marsh, Cutoff Slough, Hill Slough, and Suisun Slough (Reclamation 2011, Section 6.3). Given the proximity of the project site to Grizzly Island and the fact that Suisun shrews occur in managed wetlands, it is likely that Suisun Shrews may occupy the project site. Suisun shrews use habitat similar to SMHM, so the analysis and environmental commitments discussed above for SMHM would apply to shrews. As such, similar to the evaluation of the proposed project on SMHM, the proposed project would minimize the Suisun shrew habitat within the footprint of construction while preserving large undisturbed areas of vegetation for Suisun shrew. The proposed project would disturb only 150 acres within the project site, compared with typical disturbance of 175 acres under managed wetland conditions. Under operating conditions (i.e., post-breach), there would be no annual disturbance to the marsh plain vegetation that, because of its elevation, is expected to develop into marsh habitats favored by Suisun shrew. The reduction in overall disturbed acres compared to baseline, combined with the other environmental commitments identified in Table 3-7 of this document, would result in less-than-significant impacts on the Suisun shrew. Therefore, impacts on Suisun shrew are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Bats

SMP EIS/EIR

The SMP EIS/EIR did not evaluate the potential effects of restoration on various bat species. The SMP EIS/EIR included a short description of various bats that could inhabit Suisun Marsh, including the following:

- Western red bat (*Lasiurus blossevillii*) – State Species of Concern
- Townsend's big-eared bat (*Corynorhinus townsendii*) – CESA Candidate[6]
- Hoary bat (*Lasiurus cinereus*) – no listed status

Western red bat and hoary bat are known to inhabit primarily trees. The species have had limited observances in the Suisun Marsh. They were dismissed from further evaluation in the SMP EIS/EIR. Townsend's big-eared bat is known to inhabit structures, as well as other types of habitats, and has one record in Suisun Marsh. Those species that are likely to occur in the study area and be affected by SMP actions were further evaluated in the SMP EIS/EIR. Those species that occur in habitats in the study area but deemed not to be affected by SMP restoration or managed wetland activities were not further evaluated. As such, the bat species known to occur in Suisun Marsh were not evaluated because habitat for these species was presumed not to be affected by typical restoration activities or managed wetland activities.

Existing Conditions and Proposed Project

As documented in the SMP EIS/EIR, several bat species are known to exist within Suisun Marsh. The project site, including existing structures and the habitat surrounding the project site, is predominantly wetland and, as such, could provide suitable foraging habitat for a range of bat species. The presence of scattered trees and structures on Grizzly Island could provide day and night roost habitat for all species known to occur in the region. As documented in Appendix G, *Bat Habitat Assessment Technical Memorandum*, of this document, species confirmed to occur on Grizzly Island include the foliage-roosting western red bat (*Lasiurus blossevillii)*, for which there are both breeding and acoustic records (Pierson et al. 2006; CDFW 2015), and the crevice-roosting Mexican free-tailed bat (*Tadarida brasiliensis)*, for which there are acoustic records (Pierson et al. 2006). Both species were documented during the summer. Western red bat roosts in trees and would not be expected to day roost in or on the buildings. Mexican free-tailed bat is often found in human structures. However, given habitat suitability and the project site's location within the range of many of

[6] Townsend's big-eared bat was identified as a California species of special concern in the SMP EIS/EIR and is now a candidate to be listed under the California Endangered Species Act.

Northern California's bat species, a wider variety of species than the two confirmed in Pierson et al. could be expected within the vicinity of the project site, as described in Table 1 of Appendix G. However, as described below, different bat species have different habitat and roosting requirements; thus, it expected that of the species listed in Table 1 of Appendix G the following could potentially use the structures: pallid bat (*Antrozous pallidus*), big brown bat (*Eptesicus fuscus*), California myotis (*Myotis californicus*), little brown myotis (*Myotis lucifugus*), Yuma myotis (*Myotis yumanensis*), Mexican free-tailed bat (*Tadarida brasiliensis*), and Townsend's big-eared bat (*Corynorhinus townsendii*). Of these species, the pallid bat is a Species of Special Concern (CDFW status) and the Townsend's big-eared bat is a CESA candidate species (CDFW status) (Table 1 of Appendix G).

Different species of bats tend to be associated with different physical roost characteristics, with some species associated almost solely with cracks and crevices, others with cavern-like spaces, and still others with tree foliage (as described in Table 1 of Appendix G). Some species are flexible in their roost structure choices than others and have been found roosting both in crevices and in open cavern-like spaces. During seasonal movements, such as fall migration, bats may be found in atypical roost locations or habitats. Structural characteristics provide one aspect of bat roost habitat; however, temperature is another key element. It may be that temperatures in potential available roost spaces are not conducive to colonial activity in the active season (spring, summer or fall depending on the bat). Finally, level of disturbance may also effect whether bats take up residence and, if so, which species (Appendix G).

The project site includes five existing wooden structures of differing sizes and ages. As such, these structures were evaluated for potential bat habitat in January of 2016 by an ICF biologist. Neither bat sign nor bats were observed in or on any of the existing structures during the assessment. The existing structures create plentiful moderate-quality crevice and cavity habitat. However, where visual examination was possible in and under the potential habitat, there were no signs of colonial bat activity. If there were significant long-term colonial bat activity associated with the buildings during the active season, it would be reasonable to expect some sign of bat activity remaining in undisturbed areas. The caretaker who resides on-site informed the ICF biologist that he had seen only one bat in 20 years. This observation was of a dead bat of unknown species. The caretaker did not remember the time of year at which he found the bat. The potential for colonial maternity roosting cannot be ruled out, but if a maternity roost had been present, no evidence remained at the time of the January habitat assessment. Based on the habitat assessment, and the bats known to exist within the vicinity of Suisun Marsh, the most likely use, if bats are present, would be occasional use by scattered or isolated non-reproductive individuals. Large colonies are generally easier to detect than scattered individuals, and active bats leave more sign and tend to be easier to detect than torpid or hibernating bats. Individual bats roosting in or behind debris or stored items could easily remain undetected given the significant quantity of this type of material limiting full visual access to the existing structures.

While there is no known history of bat use, in or on the existing structures, there is a history of birds nesting on the structures. As such, pre-demolition surveys would be required prior to the demolition to ensure no bat or migratory bird presence. These pre-demolition surveys would be conducted by a qualified biologist, and would occur up to 3 days prior to demolition. This type of survey is similar to those pre-construction surveys required for various species in the SMP EIS/EIR and as described in Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures.* The pre-demolition survey for bats would occur in conjunction with nesting bird surveys. Windows and doors of the structures would be kept closed and sealed prior to demolition through the summer to prevent bats, migratory birds, or other species from inhabiting or roosting in the interior of the structures. Debris piles, material stored in and around the buildings, decorative panels and building furnishings would be removed prior to the preconstruction survey to ensure full survey access. If no live bats or sign (e.g., guano, staining, prey remains, bat carcasses) are found, and if no nests of protected bird species are active on or within the existing structures the structures may be demolished at any time. If live bats or indications of bat use are found, or if active protected bird nests are found, the demolition of the structures would be limited to the beginning of September to the middle of October. This time period avoids the risk to young that would occur if a maternity roost were demolished and avoids disturbing torpid bats during winter when resources are scarce. Thus, this time period is the least sensitive time in the lifecycle of bats. The pre-demolition survey procedure described above would be repeated between the beginning of September and middle of October, and demolition would be postponed until colonial bats or special status bats could be evicted according to appropriate protocols or leave of their own volition.

Although the potential presence of suitable bat habitat on the project site and the planned demolition of the existing structures as part of the proposed project does change what was previously disclosed in the SMP EIS/EIR with respect to bats, it does not create a substantially more severe impact on biological resources, and it does not require substantially different or new mitigation measures. Since bats and indicators of bats were not found in or on any of the existing structures during the habitat assessment and the proposed project incorporates pre-demolition surveys and seasonal restrictions, impacts on bat species would be less than significant. No mitigation is required.

Raptors

SMP EIS/EIR

The SMP EIS/EIR evaluated the potential impacts of restoration activities on foraging and breeding habitat used by special-status raptor species, as described in Table 3-7 of this document. Raptors were identified in the SMP EIS/EIR as special-status species and listed as threatened, endangered, or special-status under the federal ESA or the CESA. The document noted that a temporary reduction in foraging habitat could occur for those species that forage in managed wetlands; however, restoration activities would most likely be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame. Further, it is expected that suitable adjacent areas would continue to provide habitat for raptors between breaching the levee and the establishment of a fully functioning tidal wetland. Breeding season impacts would be avoided. Based on the environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document) and the characteristics and conditions of foraging and breeding habitat, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on special-status raptor species.

Existing Conditions and Proposed Project

The special-status raptors in the marsh (e.g., western burrowing owl, Swainson's hawk, white-tailed kites) use primarily upland areas and non-managed wetland areas for both foraging and nesting. Most need mature trees or shrubs for nesting and upland habitat for foraging. Therefore, for most special-status raptors, there is a low likelihood that restoration would affect them. However, northern harrier and short-eared owl are ground nesters and could nest in managed wetlands, such as the project site. The environmental commitments identified in the SMP EIS/EIR for the protection of special-status species including birds and raptors, and in Appendix B of this document, are incorporated into the proposed project. Therefore, impacts on raptors are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Other Special-Status Birds

SMP EIS/EIR

The SMP EIS/EIR evaluated the potential impacts of restoration activities on various other special-status (non-raptor) bird species, as described in Table 3-7 of this document. The evaluation determined that restoration activities associated with site preparation, grading, and breaching exterior levees could result in impacts on foraging and breeding habitat, depending on the type of bird species evaluated and the location of the activities with Suisun Marsh. However, the SMP EIS/EIR incorporated species-specific restrictions on these types of restoration activities during nesting and breeding season in the marsh, in addition to project design features that would reduce the potential for tidal muting and scour under restored conditions. Based on the environmental commitments in the SMP EIS/EIR for the protection of special-status species including birds, California clapper rail and California black rails, and California least tern(summarized in Table 3-7 of this document) and the characteristics and conditions restoration, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on special-status bird species.

Existing Conditions and Proposed Project

The Suisun Marsh provides habitat for numerous other special-status (non-raptor) bird species, as summarized by Table 6.3-3 in the SMP EIS/EIR. Tidal habitat within the marsh affords primarily the California clapper rail, California black rail, California least tern, Suisun song sparrow, salt marsh common yellowthroat, and tricolored blackbird locations for resting, foraging, or breeding. Managed wetlands were designed primarily to preserve and enhance habitat for migratory waterfowl; however, they also provide ancillary benefits for other wildlife and wetland-dependent species. Much of the public land within the marsh, including the Grizzly Island Wildlife Area, is managed to conserve and enhance diversity among all wildlife, fish, and special-status species (Reclamation 2011, Section 6.3, *Wildlife*).

The California clapper rail and black rail are permanent residents of Suisun Marsh. The California least tern is a migrating resident of the marsh. Appendix F, *Memorandum Regarding California Clapper Rail*, *California Black Rail*, *and California Least Tern*, of this document summarizes known information regarding the presence of the California clapper rail, California black rail, and California least tern on the project site. In general, there is a low probability for these species to exist on the project site because conditions of the site are not preferred habitat for these species and because the project site is outside of the primary known locations of California clapper rails in the marsh (in the western marsh identified by Figure 15 in the SMP EIS/EIR). Specifically, the project site does not support or provide:

- Established vegetative cover, direct tidal circulation, abundant high marsh cover, and an intricate network of tidal sloughs that provide abundant invertebrate populations for clapper rail and black rail habitat
- Sand or fine substrate gravel with sparse vegetation near open water for least turn habitat

In addition, the project site has been managed for more than 5 years as a managed wetland, and during this time there have been no observations of California clapper rail, black rail, or least tern (Appendix F of this document). However, the proposed project incorporates environmental commitments, as referenced in the SMP EIS/EIR and as identified by Appendix B of this document, that if construction activities are necessary during the breeding season, preconstruction surveys for California clapper rail or black rail will be conducted by a USFWS-approved biologist at and adjacent to areas of potential tidal and managed wetlands habitat for California clapper rail and black rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. In addition, no activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys). The environmental commitments identified in the SMP EIS/EIR, and in Appendix B of this document, are incorporated into the proposed project. Therefore, impacts on the California clapper rail, black rail, and least tern are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Salt marsh common yellowthroat, Suisun song sparrow, and tricolored blackbird are permanent residents of the marsh and the greater Sacramento-San Joaquin Valley (Reclamation 2011, Section 6.3). The common yellowthroat and song sparrow typically occur in tidal and brackish marshes and managed wetlands in the marsh and favor habitat characterized by bulrush, cattail, and other emergent marsh vegetation (Reclamation 2011, Section 6.3). The tricolored blackbird is typically found in dense stands of tule, cattail, Himalayan blackberry thickets, and fallow fields. Suitable nesting habitat in extensive stands of emergent wetland vegetation is associated with tidal and brackish wetlands and managed wetlands. The project site does have some tidal emergent vegetation, located primarily on the natural berm adjacent to Grizzly Bay, which includes tule and bulrush. As such, the environmental commitments identified in the SMP EIS/EIR EIR for the protection of special-status wildlife species including birds, and in Appendix B of this document, are incorporated into the proposed project. The following project-specific measures would be implemented to minimize potential impacts:

- All woody and herbaceous vegetation will be removed from construction areas (earthwork areas), during the nonbreeding season (September 1–February 1) to the extent feasible, to minimize effects on nesting birds. If woody and herbaceous vegetation removal occurs during the breeding season, a qualified biologist will survey the construction area for active nests and young migratory birds immediately before removal activities

Therefore, impacts on salt marsh common yellowthroat, Suisun song sparrow, and tricolored blackbird are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Waterfowl and Shorebirds

SMP EIS/EIR

The SMP EIS/EIR evaluated the potential impacts of restoration activities on various waterfowl and shorebirds, as described in Table 3-7 of this document. The evaluation determined that restoration activities associated with site preparation, grading, and breaching exterior levees could result in impacts on foraging and breeding habitat, depending on the type of bird species evaluated and the location of the activities with Suisun Marsh. In addition, the conversion of managed wetlands to tidal wetlands would result in a reduction of managed wetland habitat for waterfowl use. However, the

SMP EIS/EIR incorporated species-specific restrictions on these types of restoration activities during nesting and breeding season in the marsh. Based on the environmental commitments in the SMP EIS/EIR (summarized in Table 3-7 of this document) and the characteristics and conditions for restoration, the SMP EIS/EIR determined that restoration would have a less-than-significant impact on waterfowl and shorebird species.

Existing Conditions and Proposed Project

The Suisun Marsh provides nesting, foraging, and wintering habitat for waterfowl, and the marsh is a key waterfowl wintering area in the Pacific Flyway. The large expanses of managed wetlands provide nesting and foraging habitat for resident and migratory species. Table 6.3-5 in the Suisun EIS/EIR describes the types of waterfowl that use the managed wetlands for foraging, resting, and breeding. These include dabbling ducks, diving ducks, geese, and swans.[7] The value of individual managed wetlands to waterfowl production and overwintering habitat varies, depending on water management practices, soil salinity, and the associated plant communities. The goal of most managed wetlands in Suisun Marsh is to provide wintering habitat for waterfowl. These waterfowl also use tidal wetlands and bays and sloughs in the marsh for foraging and loafing (Reclamation 2011, Section 6.3, *Wildlife*).

The tidal wetlands and managed wetlands provide habitat for several species of shorebirds, particularly migrating and overwintering birds. The value of the managed wetlands to shorebirds varies, depending on water level, salinity, and the vegetation communities present. The common shorebird species that occur in the marsh and the habitats in which they occur are identified in Table 6.3-6 of the SMP EIS/EIR and include probers (i.e., birds that probe wet soil with their beaks for food) and sweepers (i.e., birds that sweep through standing or running water with their beaks for food). Managed wetlands provide primarily foraging and loafing habitat for shorebirds, with the exception of killdeer, American avocet, and black-necked stilt, which are also known to use managed wetlands for breeding. Shorebirds typically prefer tidal flats for foraging, and the presence of vegetative cover (as in managed wetlands during certain times of the year) reduces the amount of suitable habitat for both probers and sweepers (Reclamation 2011, Section 6.3, *Wildlife*).

Restoration of the proposed project site would convert approximately 150 acres of managed wetlands to tidal wetlands on the entire 420-acre project site. The Grizzly King property and the Grizzly Island Wildlife Unit comprise approximately 9,200 acres of managed wetlands immediately adjacent to the project site and provide the same habitat benefits to waterfowl and shorebird species as the project site. In addition, there would be approximately 52,000 acres of managed wetlands in the entire marsh that shorebirds and waterfowl would continue to use. As a result of the proposed project, less than 1% (approximately 0.8%) of the total managed wetland habitat in Suisun Marsh would be converted to tidal habitat. Further, tidal habitat provides both foraging and loafing value to both waterfowl and shorebirds, as described in Tables 6.3-5 and 6.3-6 in the SMP EIS/EIR. The environmental commitments identified in the SMP EIS/EIR, and in Appendix B of this document, are incorporated into the proposed project. Therefore, impacts on waterfowl and shorebirds are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

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[7] Taxonomically, migratory waterfowl that use Suisun managed wetlands for wintering habitat are dabbling ducks, diving ducks (or bay ducks), sea ducks, stiff-tailed ducks, geese, and swans (Conceptual Model 2010). For the purpose of this document, diving ducks will include those species that are taxonomically considered diving ducks as well as sea ducks and stiff-tailed ducks.

Other Wildlife

SMP EIS/EIR

The SMP EIS/EIR did not evaluate the potential effects of restoration on the San Joaquin pocket mouse. However, given the criteria used in the analysis to evaluate species based on the presence of available habitat in the Suisun Marsh to support them, as well as the known and confirmed presence in the marsh or the high likelihood of presence in the marsh, the mouse would most likely not have been incorporated in the evaluation because it typically occurs in upland areas characterized by grasses, and it has been documented only once in the Suisun Marsh area. Its documentation was in an upland area, and it is not a federally or state-listed species.

Existing Conditions and Proposed Project

San Joaquin pocket mouse is typically found in upland/grassland habitat with sandy areas in which to dig burrows (CDFW 2016). The species favors dry, open, grassy or weedy ground and arid annual grasslands, savanna, and desert-shrub associations with sandy washes or finely textured soil (IUCN 2016). This information is consistent with the CNDDB-documented location (i.e., upland by railroad tracks). The project site is a managed wetland with primarily damp and wet clay and silty soils, with limited upland habitat and sandy, dry soils. Therefore, it is expected that the San Joaquin pocket mouse would have a low probability of existing on the project site. However, as described above, the project site would have a footprint of disturbance less than that of the baseline. It also includes a habitat berm that could provide upland habitat that would be more favorable for the pocket mouse when compared to baseline conditions. Therefore, impacts on San Joaquin pocket mouse are within the scope of the impacts that were identified in the SMP EIS/EIR and are less than significant. No mitigation is required.

3.3.3 Air Quality, Greenhouse Gases, and Climate

The previously certified SMP EIS/EIR evaluated restoration construction (short-term) and operational (long-term) emissions by using a specific equipment list for restoration activities, the approved model for evaluating impacts at that time (URBEMIS), and the draft Bay Area Air Quality Management District (BAAQMD) California Environmental Quality Act (CEQA) thresholds for air quality pollutants. The SMP EIS/EIR also evaluated air quality showing combined restoration activities and managed wetland activities to identify a potential worst-case scenario for air quality. Generally, the restoration activities analyzed in the SMP, described in Table 3-7 of this document, assumed the following: grading, improving levees, building channels and islands, and levee breaching. The assumed equipment, as listed in Table 5.7-8 of the SMP EIS/EIR and described in Table 3-7 of this document, is as follows: tractors/loaders/backhoes, rubber-tired dozers, excavators, graders, and box scrapers. The impact analysis determined that less-than-significant impacts (without mitigation) would occur with respect to the following criteria pollutant emissions: reactive organic gas (ROG), carbon monoxide (CO), particulate matter 10 microns in diameter or less (PM10), particulate matter 2.5 microns in diameter or less (PM2.5), and carbon dioxide (CO_2). The impact analysis determined that less-than- significant impacts with mitigation incorporated would occur with respect to the following criteria pollutant emissions: oxides of nitrogen (NO_X). The SMP EIS/EIR identified no significant and unavoidable air quality impacts with respect to restoration activities.

Since certification of the SMP EIS/EIR, the BAAQMD finalized the CEQA thresholds for air quality, which are the same as those used and compared in the SMP EIS/EIR, except the sulfur dioxide CEQA threshold, which BAAQMD did not include in its final CEQA Guidelines (2011). Also, since certification of the SMP EIS/EIR, the model used to evaluate air quality impacts, URBEMIS, has been replaced; URBEMIS is no longer used. Currently, CalEEMod is used to evaluate impacts in place of the older URBEMIS model that was used in the SMP EIS/EIR analysis. CalEEMod differs from URBEMIS in that CalEEMod uses updated emission factors, land use data, and possible mitigation measures. Because CalEEMod is the standard now with which to evaluate air quality emissions, it was used to generate estimates of emissions for the Tule Red restoration project. The BAAQMD still designates Solano County as a nonattainment area for the following pollutants under state air quality standards, as identified in the SMP EIS/EIR: ozone, PM2.5, and PM10. Solano County is also in nonattainment for the following pollutants under national air quality standards, as identified in the SMP EIS/EIR: ozone and PM2.5.

3.3.3.1 Restoration Construction

As a worst-case scenario, the SMP EIS/EIR combined site preparation (SMP Restoration Phase I) and levee breaching (SMP Restoration Phase II) emissions into a total daily emissions value, because it is possible that the two separate construction phases could occur at the same time. All construction equipment was assumed to operate for 8 hours per day of construction activities. The evaluation of combined SMP Restoration Phase I and Phase II construction activities resulted in less-than-significant temporary increases in unmitigated emissions of ROG, CO, PM10, PM2.5, and CO_2. However, unmitigated emissions from the combined SMP Restoration Phase I and Phase II construction activities exceeded the BAAQMD construction threshold for NO_X. Mitigation measures AQ-MM-1 through AQ-MM-3 were incorporated in the SMP EIS/EIR to reduce the total restoration construction NO_X emissions to less than significant.

Implementation of the proposed project would require more total construction equipment than is assumed in the SMP EIS/EIR analysis, as described in Chapter 2, *Project Description*, of this addendum; however, the site preparation phase of the proposed project (Phase 1) and the breaching of the natural exterior berm (Phase 2) would not take place simultaneously, as described in the SMP EIS/EIR. The SMP EIS/EIR estimated construction equipment for the SMP Restoration Phase I construction activities is as follows: one tractor/loader/backhoe, one rubber-tired dozer, one excavator, one grader, and one box scraper. For the proposed project Phase I, three construction equipment scenarios were evaluated, each with a different mix of scrapers, dozers, excavators, graders, backhoes, front-end loaders, and water trucks. The mix of equipment that would actually be used would depend on the activities that would occur within the phase and the conditions of the project site. As such, these three scenarios are evaluated to disclose the potential air quality emissions that could be generated and to ensure that construction emissions would be below the emissions threshold. The different equipment scenarios are presented in Tables 3-4a through 3-4c, including equipment horsepower, engine tier level, hours per day of use, number of days of use, and number of pieces of equipment for each type of equipment. These scenarios include the equipment that would be needed to construct the pooling area around the CDFW drain. All proposed construction equipment for Phase 1 are assumed to incorporate Level 1 diesel particulate filters and 40% oxidative catalyst reductions, consistent with mitigation required in the SMP EIS/EIR analysis. All scrapers, dozers, and excavators would have a Tier 3 or better engine.

Table 3-4a. Proposed Project, Phase 1 Construction Scenario A

Equipment Type (horsepower [hp]): Tier Level	Use (hours/day)	Duration (working days)	Pieces of Equipment
Scraper (500 hp): Tier 3	10	60	4
Dozer (150 hp):Tier 3	10	60	2
Excavator (328 hp): Tier 3	10	60	2
Grader (174 hp): Tier 2	4	80	1
Backhoe (93 hp): Tier 2	2	80	1
Front-End Loader (88 hp): Tier 2	2	80	1
Water Truck	NA	60	1

Table 3-4b. Proposed Project, Phase 1 Construction Scenario B

Equipment Type (hp): Tier Level	Use (hours/day)	Duration (working days)	Pieces of Equipment
Scraper (500 hp)			
Tier 3	8	50	4
Tier 4 Interim	8	50	4
Dozer (150 hp): Tier 3	8	50	2
Excavator (328 hp): Tier 3	8	50	3
Grader (174 hp): Tier 2	4	50	1
Backhoe (93 hp): Tier 2	2	50	1
Front-End Loader (88 hp): Tier 2	2	50	1
Water Truck	NA	50	1

Table 3-4c. Proposed Project, Phase 1 Construction Scenario C

Equipment Type (hp): Tier Level	Use (hours/day)	Duration (working days)	Pieces of Equipment
Scraper (500 hp)			
Tier 3	10	40	1
Tier 4 Interim	10	40	7
Dozer (150 hp)			
Tier 3	10	40	2
Tier 4 Interim	10	40	1
Excavator (328 hp)			
Tier 3	10	40	1
Tier 4 Interim	10	40	2
Grader (174 hp): Tier 2	4	40	1
Backhoe (93 hp): Tier 2	2	40	1
Front-End Loader (88 hp): Tier 2	2	40	1
Water Truck	NA	50	1

The SMP EIS/EIR estimated construction equipment for SMP Restoration Phase II construction activities as follows: one excavator. For the proposed project Phase 2 analysis, one construction equipment scenario is evaluated and shown in Table 3-4d. This construction equipment scenario includes the equipment needed for the demolition of the existing on-site structures (total square footage is approximately 3,600) and the breach of the existing natural berm. This analysis incorporates all BAAQMD best management practices (BMPs) and AQ-MM-2 and AQ-MM-3, as identified in the SMP EIS/EIR and listed in Table 3-7 of this document.

Table 3-4d. Proposed Project, Phase 2 Construction Equipment

Equipment Type (hp): Tier Level	Use (hours/day)	Duration (working days)	Pieces of Equipment
Dozer (150 hp): Tier 3	8	30	2
Excavator (328 hp): Tier 4 Interim	8	30	2
Backhoe (93 hp): Tier 3	8	30	2
Front-End Loader (88 hp): Tier 3	8	30	2
Water Truck	NA	30	2
Dump Trucks	NA	15	> 20 tucks (40 trips)

Phase 1

The SMP EIS/EIR estimated mitigated restoration activities (SMP Restoration Phase I and Phase II) construction emissions to be below BAAQMD thresholds for all criteria pollutants. After implementation of mitigation measures AQ-MM-1 through AQ-MM-3, the impact from construction-related emissions was determined to be less than significant in the SMP EIS/EIR.

As shown below in Tables 3-5a through 3-5c, construction-related criteria pollutant emissions for Phase I construction Scenarios A through C are all below BAAQMD thresholds for all criteria pollutants under all three Phase 1 scenarios. Installation of a spray aeration structure on the existing CDFW drain would use the existing pipe outfall and basin and would require no additional earthwork or construction equipment. Because no additional construction equipment would be required, this would not add construction-related emissions to Phase 1 total emissions. The equipment associated with constructing a pooling area to control the discharge of the CDFW drain water into the restoration area is incorporated into the construction equipment lists in Tables 3-4a through 3-4c. Because the construction activities for constructing the pooling area are included with restoration activities, emissions are thus included in emissions results, as shown above in Tables 3-5a through 3-5c. Impacts related to air quality and greenhouse gases (GHGs) are within the scope of the impacts that were identified in the SMP EIS/EIR, below existing BAQMD thresholds, and remain less than significant. As discussed above, mitigation measures AQ-MM-2 and AQ-MM-3, as described in the SMP EIS/EIR, were incorporated in this analysis and would be implemented for the proposed project.

Table 3-5a. Proposed Project, Phase 1 Scenario A Emissions (pounds/day)

	ROG	NO_X	CO	SO_2	Exhaust PM10	Exhaust PM2.5	CO_2e (MT/yr)
Emissions	3.8	43.9	83.1	0.1	2.1	2.1	429.0
BAAQMD Thresholds	54	54	NA	NA	82	54	NA
Exceed BAAQMD Thresholds?	No	No	NA	NA	No	No	NA

CO_2e (MT/yr) = metric tons of carbon dioxide equivalent per year.

Table 3-5b. Proposed Project, Phase 1 Scenario B Emissions (pounds/day)

	ROG	NO_X	CO	SO_2	Exhaust PM10	Exhaust PM2.5	CO_2e (MT/yr)
Emissions	4.7	52.0	117.2	0.2	2.0	1.9	508.1
BAAQMD Thresholds	54	54	NA	NA	82	54	NA
Exceed BAAQMD Thresholds?	No	No	NA	NA	No	No	NA

Table 3-5c. Proposed Project, Phase 1 Scenario C Emissions (pounds/day)

	ROG	NO_X	CO	SO_2	Exhaust PM10	Exhaust PM2.5	CO_2e (MT/yr)
Emissions	5.0	52.6	150.4	0.3	1.1	1.1	517.3
BAAQMD Thresholds	54	54	NA	NA	82	54	NA
Exceed BAAQMD Thresholds?	No	No	NA	NA	No	No	NA

AQ-MM-1, which would limit construction activity during restoration to a single parcel to reduce NO_X emissions, is not needed for the Tule Red project because all three Phase 1 construction equipment scenarios would result in NO_X emissions that would be below the BAAQMD NO_X threshold. Therefore, impacts related to air quality are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Phase 2

The SMP EIS/EIR estimated mitigated combined restoration activities (SMP Restoration Phase I and Phase II) construction emissions to be below BAAQMD thresholds for all criteria pollutants. Thus, after implementation of mitigation measures AQ-MM-1 through AQ-MM-3, the impact from construction-related emissions was determined to be less than significant in the SMP EIS/EIR.

As shown below in Table 3-5d, construction-related criteria pollutant emissions for the proposed project Phase 2 activities are below BAAQMD thresholds for all criteria pollutants for the equipment summarized in Table 3-4d, including approximately 20 dump trucks. Given the relatively small square footage (approximately 3,600 square feet) expected to be demolished, fewer than 20 dump trucks (approximately 40 truck trips) would be needed to haul the material away. In addition, mitigation measures AQ-MM-2 and AQ-MM-3, as described in the SMP EIS/EIR, are incorporated into this analysis. Therefore, impacts related to air quality are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

Table 3-5d. Proposed Project, Phase 2 Construction Emissions (pounds/day)

	ROG	NO_X	CO	SO_2	Exhaust PM10	Exhaust PM2.5	CO_2e (MT/yr)
Emissions	1.1	12.1	28.5	< 0.1	0.6	0.6	66
BAAQMD Thresholds	54	54	NA	NA	82	54	NA
Exceed BAAQMD Thresholds?	No	No	NA	NA	No	No	NA

3.3.3.2 Combined Restoration and Management Activities

The SMP EIS/EIR estimated mitigated restoration and management activities are combined because it is possible that the construction activity associated with restoration and management activities could occur at the same time. Emissions associated with restoration, management activities that would increase in frequency, and new management activities were summed together to reflect the potential worst-case construction activity overlap. Mitigated construction emissions for the combined restoration and management activities were shown to exceed BAAQMD thresholds for NO if all the restoration and management activities were to happen concurrently. Therefore, in addition to mitigation measures AQ-MM-1 through AQ-MM-3, AQ-MM-4 was required to reduce this impact to less than significant in the SMP EIS/EIR.

As discussed above, AQ-MM-2 and AQ-MM-3, as described in the SMP EIS/EIR, were incorporated into this analysis and would be implemented during the proposed project. As a result of adherence to AQ-MM-4, the project proponent would limit restoration and management activity so that the equipment used for Tule Red would include the equipment described in Tables 3-4a through 3-4d to ensure NO_X emissions remain below the BAAQMD threshold during restoration. Although this is a change to AQ-MM-4 as it is written in the SMP EIS/EIR, the intent of the mitigation measure is to ensure NO_X remains below the BAAQMD threshold while considering the construction equipment type, mix, and numbers used during restoration. The construction equipment type, mix, and numbers identified in Tables 3-4a through 3-4d quantitatively show that NO_X emissions would not exceed the BAAQMD threshold; therefore, the change in mitigation measure is appropriate for the proposed project and would not result in a substantive change or a change in the severity of the impact or determination previously made in the SMP EIS/EIR. Furthermore, the project site acreage that would be disturbed when compared to baseline conditions would be reduced. Typically, 175 acres of the project site is managed as managed wetlands, requiring construction equipment throughout the year and especially during the summer. However, under the proposed project, only 150 acres would be disturbed during Phase 1, thus resulting in an overall reduction in the area of disturbance. In addition, between proposed project Phases 1 and 2, there would be reduced construction equipment activity when compared to baseline conditions because the site would be managed to promote vegetation growth or would be pre-flooded prior to the breach. Finally, management activities for the project site would be reduced because the project site would cease to be a managed wetland once Phase 2 was complete; heavy construction equipment would no longer be used during the summer. Therefore, impacts related to air quality are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.3.3 Restoration Operation

Operational emissions for the SMP were not evaluated because the activities associated with restoration and management were considered construction activities.

Once the project site is restored, habitat establishment would occur on the site starting in approximately 2018. Limited maintenance, monitoring, and management tasks would occur during this time, including development of tules and other native marsh vegetation, weed control within the habitat berm, inspections for erosion or settling of habitat level, and patrolling for trash and trespass. Long-term management would include all habitat establishment activities, periodic biological monitoring of the project area, and periodic mapping of the marsh and channel.

Emissions related to restoration operation should be minimal given the lack of heavy equipment activity and minimal number of worker vehicle trips. In addition, management activities on the project site would cease; thus, emissions would be reduced when compared to baseline because heavy equipment, which is currently used to manage the wetland, would no longer be used during the summer. Impacts related to air quality and GHGs would be less than significant. No mitigation is required.

3.3.3.4 Greenhouse Gases and Climate Change

The SMP EIS/EIR estimated that approximately 276.3 tons of CO_2 per year would be generated from restoration activities alone; however, this estimation was generated using the outdated URBEMIS emissions model. Based on emissions modeling using the current CalEEMod emissions model, which generally has higher GHG emission factors than the URBEMIS emissions model, carbon dioxide equivalent (CO_2e) emissions generated by the proposed project are expected to range from 429 metric tons per year (MT/yr) to 517 MT/yr for Phase 1 Scenarios A through C and approximately 66 MT/yr for Phase 2. As identified in the SMP EIS/EIR, construction emissions would be offset though changes in net GHG sources and sinks, because the Tule Red project site is a tidal restoration habitat project and would become a sink for CO_2. In addition, the CO_2 emissions currently generated every year under the managed wetland activities would no longer occur (estimated with URBEMIS at 322 MT/yr), further reducing CO_2e emissions associated with the proposed project.

The proposed project is expected to regularly accrete sediment on the existing natural exterior berm (as it has been doing for several decades), which would reduce the likelihood of continual inundation associated with sea level rise (Appendix D.2, Table 5.1). Grizzly Bay has a high suspended sediment load; the adjacency of the project site and direct connection to the bay is ideal for accommodating sea level rise. The existing elevations of the managed marsh (between 3 and 5.5 feet NAVD88) would be ideal for capturing sediment deposited from the adjacent Grizzly Bay once the channels and breach to the bay open the site up to tidal influence. Sediment deposition at the edge of the bay has led to advancement of the shoreline at a current rate of 6 to 10 feet per year; modeling by NHC indicates sediment will deposit on the marsh plain at rates that exceed sea level rise (Appendix D.2). In addition, the gradually sloping wetland upland transition zone along the habitat berm would provide an elevation gradient over which tidal wetlands could shift upslope when floodwaters rise. The stability of the habitat levee should minimize future management requirements, even with elevated sea levels.

Emissions and impacts associated with GHGs and climate change under the proposed project are within the scope of the emissions impacts that were identified in the SMP EIS/EIR and less than significant. No mitigation is required.

3.3.4 Cultural Resources

SMP EIS/EIR

The SMP EIS/EIR determined that there would be significant and unavoidable impacts on cultural resources due to inundation of certain lowland and marsh areas, construction in unsurveyed areas, and potential damage to character-defining features of the Montezuma Slough Rural Historic Landscape.

Existing Conditions and Proposed Project

The proposed project would not result in significant and unavoidable impacts on cultural resources located in the Montezuma Slough Rural Historic Landscape or near Mein's Landing because the project site is not located near these areas. Therefore, the mitigation measures in the SMP EIS/EIR with respect to these resources are not applicable to the proposed project, and impacts would be less than significant.

Of the 24 previously recorded cultural resources identified in the SMP EIS/EIR, 13 are in Region 4 of the marsh, the location of the project site (Reclamation 2011, Table 7.7-10). All but two are recommended as National Register of Historic Places/California Register of Historic Resources (NRHP/CRHR) ineligible for not meeting state and federal cultural significance criteria. The remaining two resources are identified as undetermined but are not near the project site; these are a lowland grassland area and the Montezuma wetlands flume structure (Reclamation 2011, Table 7.7-10).

A cultural resources evaluation of the project area was conducted in June 2015 according to the standards and criteria identified in the National Register of Historic Places (36 CFR 60.4), National Historic Preservation Act (36 CFR 800.4), State CEQA Guidelines (14 CCR 15064.5[a]) and National Register Bulletin 15 prepared by Andrus and Shrimpton (1997 revised 2002) (Appendix H, *Cultural*

Resources Report). As part of this evaluation, a literature review and archeologist-led field reconnaissance of the project site was performed. The literature review was conducted by the Northwest Information Center of the California Historical Resources Information System at Sonoma State University, and the results of this review indicated that the project area has no known cultural resources. The archeologist-led field reconnaissance indicated no evidence of prehistoric occupation or use of the project site. The cultural resources study concluded, based on the literature review and the field reconnaissance, that the potential for buried archaeological sites in the project area is low because of heavy sedimentation that has buried older surfaces to a considerable depth. The only area of the project site where deep excavation (up to 15 feet) could occur is in the northwest where a channel would be cut to breach the existing natural berm and restore tidal action. This is an area that was part of Grizzly Bay before the 1850s gold rush, and it is unlikely that prehistoric resources would be present (Appendix H, *Cultural Resources Report*). Although there is a low potential for unknown significant cultural resources to existing on the project site because of the unique characteristics of sediment accretion on the site and the fact that the site was part of Grizzly Bay until the mid-1950s, the proposed project would incorporate the following, similar to the conditions found in CUL-MM-1 and CUL-MM-5 of the SMP EIS/EIR, tailored to the project specific conditions and the results of the cultural resources evaluation:

- Prior to ground-disturbing activities in restoration areas, the State and Federal Contractors Water Agency (SFCWA) will conduct a cultural resources inventory of the restoration area according to the standards cited in:
    a. The implementing regulations for Section 106 of the NHPA (36 CFR 800.4).
    b. The State CEQA Guidelines (14 CCR 15064.5[a]).
    c. Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines (48 Federal Register [FR] 44716–44742).
    d. The Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation Programs Pursuant to the National Historic Preservation Act (including the Guidelines for the Treatment of Cultural Landscapes).
    e. Applicable NRHP bulletins and National Park Service technical briefs (Andrus and Shrimpton 1997; Birnbaum 1994; McClellan et al. 1995).
- If any cultural resources are determined to be historic properties and ground-disturbing activities are found to result in adverse effects, the Corps or SFCWA will resolve the effects in accordance with Section 106 of the National Historic Preservation Act (NHPA) or CEQA, as applicable.

In addition, the proposed project would incorporate the following environmental commitment for the Inadvertent Discovery of Unknown Cultural Resources. This is identified by the SMP EIS/EIR, with the inclusion of the bolded text for the proposed project.

- If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work within 100 feet of the find immediately and notify the SFCWA and the Corps. All construction personnel will leave the area. Vehicles and equipment will be left in place until a qualified archaeologist identifies a safe path out of the area. The on-site supervisor will flag or otherwise mark the location of the find and keep all traffic away from the resource. The on-site supervisor immediately will notify the lead state or federal agency of the find. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.

The cultural resources study described the existing structures on the site. It concluded that, because of the age, condition, characteristics, location, and use, they do not meet any of the criteria of a significant historic cultural resource (Appendix H, *Cultural Resources Report*). Therefore, the existing on-site structures are not considered significant historic cultural resources.

The Native American Heritage Commission (NAHC) was contacted for a sacred lands review, which indicated that no properties in the vicinity of the project are listed on the sacred lands file. The Cortina Band of Indians and the Yocha Dehe Wintun Nation were contacted to request information and/or comment. The Yocha Dehe replied that the project is within their aboriginal territory and claim authority over the Native American resources of the area. They also requested additional information regarding the project (Appendix H). Although there is a low potential for human remains to exist on the project site because of the unique characteristics of sediment accretion on the site and the fact that the site was part of Grizzly Bay until the mid-1950s, the proposed project would incorporate the following environmental commitment, as described in the SMP EIS/EIR for the Inadvertent Discovery of Unknown Cultural Resources:

- If human remains of Native American origin are discovered during ground-disturbing activities on non-federal land, SFCWA or the Corps must comply with state laws related to the disposition of Native American burials, which fall within the jurisdiction of the NAHC (Public Resources Code [PRC] 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, SFCWA or the Corps will not allow further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:

    f. The Solano County Coroner has been informed and has determined that no investigation of the cause of death is required, and

    g. If the remains are of Native American origin, the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work regarding the means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods, as provided in PRC 5097.98; or

    h. The NAHC is unable to identify a descendant or the descendant failed to make a recommendation within 48 hours after being notified by the NAHC.

    i. If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.

As determined by the cultural resources evaluation, there are no significant cultural resources in the project area. Impacts on cultural resources under the proposed project are within the scope of the impacts that were identified in the SMP EIS/EIR and less than significant. No mitigation is required.

3.3.5 Land Use

SMP EIS/EIR

The SMP EIS/EIR determined there would be less-than-significant impacts on land uses because implementation of the plan, including restoration projects, would not alter existing land use patterns; conflict with existing land use plans, policies, and regulations; or conflict with any applicable habitat conservation plan or natural community conservation plan, as described in Table 3-2. Therefore, no mitigation was required.

Existing Conditions and Proposed Project

Implementing the proposed project also would not alter the existing land use patterns; conflict with existing land use plans, policies, and regulations; or conflict with the existing SMP, as described in Table 3-7. The project area land use designation is "marsh" and "resource conservation overlay" (Solano County 2008). The construction and restoration activities associated with the proposed project would be consistent with these land use designations. The propose project is a restoration project that is allowed for under the SMP, and its purpose and objectives, design, location, and implementation are consistent with the SMP, as described in Chapter 2, Section 2.3 *Proposed Project*. Therefore, impacts on land use due to implementation of the proposed project would remain less than significant, and no mitigation is required.

The Delta Plan became effective with legally enforceable regulations on September 1, 2013 (Delta Stewardship Council 2013). The proposed project meets the criteria of a "covered action," as defined by the Delta Plan (described in Table 3-7) and PRC 21056, and therefore is subject to the policies of the Delta Plan. Compliance with Delta Plan policies is required for proposed covered actions. All Delta Plan policies were reviewed, and those specific to restoration projects were deemed applicable to the proposed project and selected to be included in this analysis. In addition, those policies and recommendations identified by the Delta Stewardship Council letter to the project proponent are included in this analysis. Recommendations are not regulatory in nature and are provided by the Delta Stewardship Council to work toward coequal goals for the delta, as identified in the Delta Plan. Given that the proposed project would not conflict with applicable Delta Plan policies, conclusions regarding land use impacts have not changed relative to those disclosed in the SMP EIS/EIR impact analysis. Therefore, impacts would remain less than significant, and no mitigation is required. The applicable Delta Plan policies and recommendations and consistency between those policies and recommendations and the proposed project are discussed below.

Policies

DP GP 1: Detailed Findings to Establish Consistency with Delta Plan—Covered Actions Must Use Best Available Science

The proposed project would be consistent with Delta Plan policy GP 1. The project site was selected for its location adjacent to a tidal marsh habitat to the north; it is a naturally accreting site and has not been previously diked or managed. It was also selected because of its proximity and connection to Grizzly Bay, a documented location of delta smelt. The project design has used best available science to refine the conceptual plan and determine the appropriate design to support protected and native fish species (e.g., delta smelt). The project design supports the following conceptual models prepared for the SMP:

- Tidal Marsh Conceptual Model – Connected to sub-tidal and other tidal marsh habitats, providing export of vegetation, invertebrates, algae, phytoplankton, and zooplankton to support the foodweb.
- Levee Conceptual Model – Supports levee stability and protects adjacent managed wetlands from uncontrolled inundation.
- Mercury Water Quality Conceptual Model – Conversation from managed marsh decreases annual methylmercury "flush" from fall flood-up.
- Organic Matter Conceptual Model – Provides an additional source of organic material processes and export.

In addition, the selection of the project location and design features incorporates the most recent species data available, accurate elevation data taken from the site, and information from relevant studies of foodweb productivity and tidal marsh occupation by native species (UC Davis 2015). The proposed project design has been refined through repeated collaboration with multiple agencies, entities, and scientists. Specifically, the following have been consulted:

- **Suisun Marsh Adaptive Management Advisory Team** (AMAT) is an advisory team composed of technical staff personnel from CDFW, DWR, Suisun Resource Conservation District (SRCD), Reclamation, USFWS, and the Delta Stewardship Council, with invitations to other entities to participate as appropriate. Project proponents can use the AMAT and their knowledge of the marsh for project development, design, and support and as a forum to coordinate and cooperate for the benefit of the overall restoration goals. AMAT was consulted on June 3, 2015. Attendees and contributors included:
    - Cody Aichele, BCDC
    - Darcy Austin, DSC
    - Bob Batha, BCDC
    - Steve Chappell, SRCD
    - Maggie Christman, DSC
    - Jessica Davenport, DSC
    - Sarah Estrella, CDFW
    - Cliff Feldheim, DWR
    - Kristin Garrison, DWR
    - Lauren Hastings, DSP
    - Tiffany Heitz, USFWS
    - XDaniel Huang, DSC
    - Karen Kayfetz, DSP
    - Gregory Krzys, USBR
    - Joe Laclair, BCDC
    - Erik Loboschefsky, DWR
- **Fishery Agency Strategy Team** (FAST) is a review team composed of technical-level representatives from each fishery agency and Reclamation; the team will work with proponent water agency(ies) to review and assist in planning habitat projects and provide guidance to water agency(ies) on expected benefits of proposed habitat projects in meeting restoration objectives. FAST was consulted on the following dates:
    - February 6, 2013
    - March 27, 2013
    - May 21, 2013
    - September 23, 2013
    - November 21, 2014

    - April 1, 2015
    - June 23, 2015
    - October 28, 2015

- **Expert Panel** is a panel that was convened specifically to analyze the proposed project. It comprised representatives of both the scientific community (i.e., those specifically involved in research and studies related to the Delta ecosystem) as well as those experienced in tidal wetland design and implementation. Professional expertise was represented at the February 18, 2015, meeting in the following disciplines:
    - Suisun Marsh Plan Consistency: Steve Chappell, SRCD
    - Fisheries: Teejay Orear
    - Tidal Marsh Restoration Ecology: Peter Baye
    - Marsh Construction Engineering: Steve Carroll, Ducks Unlimited
    - Foodweb Production: Anke Mueller-Solger
    - Sediment Transport: Brad Hall, Northwest Hydraulics Consultants
    - Long-Term Marsh Sustainability; Larry Wyckoff, CDFW
    - Tidal Marsh Hydrology: Eric Loboschefsky, DWR
    - Terrestrial Marsh Species (SMHM): Lorraine Thompson, Katie Smith, CDFW
    - Suisun Marsh Historic Ecology/Processes: Amber Mardry
    - Monitoring: Romana Swenson, ESA
- **UC Davis Center for Watershed Sciences** is a center that conducts ongoing scientific research and provides extensive scientific knowledge and study of issues facing the bay and delta. Drs. Jim Durand and Peter Moyle of this center were consulted on the design of the proposed project on February 13, 2015. Their recent studies on Luca Pond regarding the effect of residence times in brackish marshes and native fish populations significantly influenced the final breach location and addition of marsh ponds and tidal pannes to the project.
- **Adaptive Management and Monitoring Plan** is the project guiding document that utilizes best available science. This plan is under development by WES, SFCWA, and the cooperating resource agencies and incorporates the best available science and information on land management and monitoring methods. Regular coordination with leadership of the Interagency Ecological Program Tidal Wetlands Monitoring Group is ensuring that the monitoring framework is applicable to the larger studies occurring within the estuary. The plan calls for submittal of annual reports, which will include descriptions and photographs of management and monitoring activities conducted as well as identification of significant ecological and physical process changes that may have occurred. Annual reports will also include summaries and citations regarding recent scientific studies that may inform ongoing management and monitoring of the site. Annual reports will be distributed to FAST and other wildlife and regulatory agencies. Regular site visits with the regulatory and scientific community to view and address habitat and structural issues will occur.

DP GP1: Detailed Findings to Establish Consistency with the Delta Plan—Covered Actions Include Applicable Feasible Mitigation Measures Identified in Delta Plan's Program EIR

Delta Plan policy GP1 requires that covered actions that are not exempt from CEQA include "applicable feasible mitigation measures identified in the Delta Plan's Program EIR (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective" (Delta Stewardship Council 2013). Therefore, a review was done of mitigation measures identified in the Delta Plan's Program EIR to determine if they are applicable to the proposed project. The review determined that the mitigation measures provided in the Delta Plan are already incorporated into the proposed project (either as environmental commitments or mitigation measures and described under relevant Delta Plan policies below, where applicable) or are not applicable to the proposed project because of the following:

1. They are not specific to the geography of Suisun Marsh. For example, the proposed project is not within a designated mineral resource extraction area; therefore, mitigation measure 13-1, which, in part, calls for future land use changes within designated mineral resource extraction areas to recognize mineral resource extraction as a compatible use, and mitigation measure 13-2, which is related to maintaining access to active mineral resource extraction sites, would not apply (Delta Stewardship Council 2013).
2. They are not specific to restoration projects. For example, Delta Plan mitigation measure 11-7 applies to levee construction projects and projects entailing surface impoundments and fill embankments; Delta Plan mitigation measure 11-8 applies specifically to the construction of on-site wastewater treatment systems (Delta Stewardship Council 2013).
3. Many of the impacts on resources as a result of the proposed project and the SMP EIS/EIR are deemed to be less than significant and thus do not require mitigation (e.g., aesthetics and geology).
4. Site specific SMP environmental commitments and/or mitigation measures are already incorporated into the proposed project for various resources, as applicable (Section 2.6, *Environmental Commitments and Mitigation Measures*, and Appendix B). These measures would be equally effective at avoiding and/or reducing impacts on the resources identified here in Sections 3.3.1–3.3.5 as similar measures identified in the Delta Plan Program EIR.

DP P2: Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitat

The proposed project would be consistent with Delta Plan policy DP P2. The proposed project does not include the siting of water or flood facilities. The conversion of managed wetlands to tidal wetlands would not be considered an incompatible use with the existing land use designations of the proposed project area or of the adjacent areas in the vicinity (primarily designated by Solano County as "marsh" and "agriculture" [Solano County 2008]). The overall current use of the Suisun Marsh, in general, and of the project area specifically, for recreational activities (hunting, fishing, wildlife viewing, walking, etc.) would not change. In addition, restoration of the proposed project site would not affect water management on the adjacent Grizzly King property because the proposed habitat berm would protect this adjacent property from the expected tidal exchange once the existing natural berm is breached and the project site it is fully restored. Finally, the CDFW Grizzly Island Wildlife Area would continue to be managed by CDFW under its current management plan and the proposed project would not affect that management. Under the proposed project the existing drain that allows CDFW to pump discharges drain water from the managed wetlands of the Grizzly Island Wildlife Area onto the project site would be modified by installation of a spray aeration structure and constructing a pooling area, as described in Chapter 2 of this document. This modification would not impact the Grizzly Island Wildlife area because it would not change the hydrodynamics of the drain (i.e., the drain would continue to drain from the CDFD property onto the project site) and because it would result in higher water quality (lower dissolved oxygen) from the CDFW area onto the project site.

ER P2: Restore Habitats at Appropriate Elevations

The proposed project would be consistent with Delta Plan policy ER P2. The Suisun Marsh is one of six priority habitat restoration areas designated by the Delta Plan (Delta Stewardship Council 2013). The proposed project would not conflict with land elevations identified for "intertidal" in the elevation map of Appendix 4 of the *Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions* (Delta Stewardship Council 2013) because the elevation of the proposed project is considered intertidal.

ER P3: Protect Opportunities to Restore Habitat

The proposed project would be consistent with Delta Plan policy ER P3. As discussed under ER P2, The Suisun Marsh is one of six priority habitat restoration areas designated by the Delta Plan (Delta Stewardship Council 2013). The conversion of managed wetlands to tidal wetlands under the proposed project would be consistent with restoring habitat and would support ER P3 in protecting opportunities to restore habitat.

ER P5: Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species

The proposed project would be consistent with ER P5. Currently, there are known invasive species at the project site, including phragmites (*Phragmites australis)*, which is controlled on the project site during the summer management period by herbicide application during the flowering period. Much of the phragmites occurs on the natural berm adjacent to Grizzly Bay, and it cannot be removed without undermining the structural integrity of the berm, which would compromise the design and objectives of the proposed project. Although phragmites is an invasive species that is known for capitalizing on disturbance, and the proposed project does include grading and disturbing approximately 150 acres, the proposed project would include multiple environmental commitments as described under Nonnative Plant Control in Appendix B of this document to avoid introducing invasive nonnative species and substantially improving conditions for invasive species, as listed below.

- Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.
- Use certified, weed-free, imported erosion control materials (or rice straw in upland areas). Coordinate with the county agricultural commissioner and land management agencies to ensure that the appropriate BMPs are implemented.
- Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds.
- Clean equipment at designated wash stations after leaving noxious weed infestation areas
- As feasible, treat isolated infestations of noxious weeds identified in the project area with approved eradication methods at an appropriate time to prevent further formation of seed, and destroy viable plant parts and seed

- Minimize surface disturbance to the greatest extent possible.
- Seed all disturbed areas with native and naturalized seed mixes, as provided in the revegetation plan developed in cooperation with CDFW. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.
- Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing
- Restore or enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.

In addition, the proposed project includes an Adaptive Management and Monitoring Plan that incorporates practicable and feasible monitoring and approaches to control non-native invasive species. Finally, the proposed project would restore tidal action to the interior of the project site, which would potentially reduce the ability of invasive species to continue to exist. Furthermore, the restoration would help promote native species suited to a tidal wetland habitat.

Recommendations

ER R2: Prioritize and Implement Projects that Restore Delta Habitat

The proposed project would be consistent with Delta Plan recommendation ER R2. The proposed project occurs within the Suisun Marsh, which is one of the six areas designated by the Delta Plan as priority habitat restoration areas. The proposed project would restore managed wetlands to tidal habitat to support native species, consistent with ER R2.

DP R11: Provide New and Protect Existing Recreation Opportunities

The proposed project is consistent with Delta Plan recommendation R11. The proposed project area currently provides private duck hunting opportunities to duck club members. Under the proposed project, all duck blinds and no longer provide a location within Suisun Marsh for private duck hunting after it is restored. However, over 50,000 acres of managed wetlands would remain within Suisun Marsh available to duck hunting opportunities. During the interim management period (time of breach to approximately five years after breach) the site will be accessible from the bay by boat and could result in passive boating opportunities if boaters so decided. The proposed project site would eventually be turned over to CDFW and it would be managed under this public agencies stewardship. As such, it would be managed by CDFW policies and plans regarding public recreation. Public opportunity for passive recreation (e.g., wildlife viewing) or public duck hunting access may increase on the proposed project site as a result. It is expected that recreation opportunities would be encouraged through those plans and policies as they are consistent with CDFW management of the proposed property.

DP R16: Encourage Recreation on Public Lands

The proposed project is consistent with Delta Plan recommendation R16. As described, in DP R11, once the proposed project is complete it would be managed by CDFW policies and plans regarding public recreation. Public opportunity for passive recreation (e.g., wildlife viewing) or public duck hunting access may increase on the proposed project site as a result. It is expected that recreation opportunities would be encouraged through those plans and policies, as they are consistent with CDFW management of the proposed property.

3.3.6 Other Resources

Construction and project site management of the proposed project would either have no impact or a less-than-significant impact on the following resources, as described below (see Table3-7 for additional details for each resource):

- Aesthetics
- Agricultural resources
- Geology, soils, and mineral resources
- Hazards and hazardous materials
- Noise
- Recreation
- Transportation and navigation
- Utilities and public services
- Population and housing

3.3.6.1 Aesthetics

There are no sensitive view receptors within close proximity of the project area that would be affected by any changes in view during or following construction activities, and no buildings would be built under the proposed project. The demolition of the structures would remove five existing structures that would represent a change to the current visual landscape, but would not affect sensitive viewers as none currently exist on the site. Furthermore, the buildings do not add visual quality to the existing landscape and interrupt views of Grizzly Bay and the surrounding low lying marsh land area. Finally, over time the visual character of the area would be consistent with the surrounding landscape because all disturbed areas would be revegetated, as part of the proposed project's restoration component and environmental commitments (see Table 3-7 and Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*). Therefore, impacts on visual resources are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.2 Agricultural Resources

There are no agricultural lands within the project area and the project area has never been used for agriculture. As such, there would be no impact on agricultural resources due to implementation of the proposed project. No mitigation is required.

3.3.6.3 Geology, Soils, and Mineral Resources

During construction of the habitat berm, the area may be subject to ground shaking and increased ground pressures from heavy equipment or placement of fill. This additional loading may exceed the potential for the existing levee material or levee foundation material to support the levee section (i.e., shear strength) and may cause rapid settling or fracture of the levee section. However, construction equipment access and placement of fill would be controlled to maintain acceptable loading based on the shear strength of the foundation material, as part the proposed project's environmental commitments.

The proposed project would not involve the construction or operation of buildings and would not bring substantial amounts of people to Suisun Marsh; therefore, neither people nor structures would be exposed to potential substantial adverse effects, including the risk of loss, injury, or death associated with geologic activities.

Project activities are not expected to create unstable cut or fill slopes, and would likely benefit slopes in the newly created tidal wetlands (Hultgren-Tillis Engineers 2015). Ground-disturbing activities, such as earthwork during Phase 1 and the demolition of the existing structures in Phase 2, could result in the loss of topsoil and erosion. Breaching of the levee would result in scour and localized sediment deposition but would reflect the restoration of natural tidal processes interrupted by the existing natural berm. As such, the proposed project implements of a Stormwater Pollution Prevention Plan (SWPPP) and an Erosion and Sediment Control Plan (see Table 3-7 and Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*).

There are no underground or aboveground natural gas lines, petroleum lines or known mineral resources within the project area.

Given that the proposed project would not substantially affect geologic or mineral resources, or soils and that project design and environmental commitments would be implemented to ensure this, impacts are within the scope of the impacts identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.4 Hazards and Hazardous Materials

Proposed project activities would not create significant hazards to the public or environment through exposure to hazardous materials because the proposed project does not involve the handling, transportation, or distribution of large quantities of hazardous materials. The project area has never been used for agriculture and has only experienced periodic spraying of phragmites in discrete areas of the project area, as approved by existing permits. Furthermore, a site reconnaissance and records review did not identify physical evidence of soil or groundwater impairments and no known documentation of potential impairments (Erikson pers. comm.). Given the site characteristics and the results of the records review and site reconnaissance, there is a low probability of soil and groundwater contamination. Environmental commitments would be implemented to reduce hazards to the public or environment during construction Phases 1 and 2, including the demolition of the existing structures, including a Hazardous Materials Management Plan and standard design features and construction practices (see Table 3-7 and Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*). Further, because restoration of the project area would not significantly change wildlife or bird usage of the area, and because the project area is over five miles from the nearest airport that bird activity would not affect air traffic, there would be no effect on air traffic safety. Also, given the location of the proposed project area, there would be no potential to expose people or structures to wildland fires, or to impede emergency access. Therefore, impacts related to hazards and hazardous materials are within the scope of the impacts identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.5 Noise

Although there would be increased noise in the proposed project area and immediately adjacent areas due to construction activities associated with restoration of the site, because there are no residences or sensitive receptors nearby, people would not be exposed to excessive noise or groundborne vibrations. Accordingly, potential noise impacts are within the scope of the impacts that were identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.6 Recreation

There are no recreational activities or recreational facilities associated with the proposed project; therefore, there would be no adverse physical effect on the environment associated with increased recreation because of project implementation. Although private duck hunting opportunities would no longer exist in the project area following project implementation, ample hunting opportunities exist within the greater Suisun Marsh area. Public opportunity for passive recreation (e.g., wildlife viewing) may increase as a result of the tidal restoration. Therefore, potential impacts on recreation are within the scope of the impacts identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.7 Transportation and Navigation

Given the nature of the proposed project (limited truck trips and a limited duration of less than 80 days), it would not conflict with any applicable plan, ordinance or policy related to the performance effectiveness or level of service of land transportation. The proposed project would not increase road hazards because activities would occur away from existing major road networks, and would not interfere with air traffic. Additionally, although the proposed project would require the transport of construction equipment, it would not require the import or export of fill materials and therefore damage to roadway surfaces is expected to be limited. Although there would be limited work on the exterior natural berm adjacent to Grizzly Bay, the work would be limited in magnitude and duration such that it would not be a navigation hazard (e.g., less than one month). Therefore, potential impacts on transportation and navigation are within the scope of the impacts identified in the SMP EIS/EIR and remain less than significant. No mitigation is required.

3.3.6.8 Utilities and Public Services

There are no underground or aboveground natural gas lines, petroleum lines, or overhead power lines on the project site, and therefore, implementation of the proposed project would not damage or disrupt these utilities (First American Title Insurance Company [unknown date]). As such, the mitigation measures identified in the SMP EIS/EIR are not applicable to the proposed project (Table 3-7). Similarly, the proposed project would not require the construction of new water, wastewater, or stormwater drainage facilities; the use of wastewater facilities; a water supply; or landfills and, therefore, would not affect these public services. In addition, although project-associated construction vehicles would be traveling on local roadways, they would be limited in number, for a limited duration (less than 80 days), and thus would not be expected to affect emergency services. Lastly, the proposed project does not involve or require construction or expansion of government facilities and would not affect schools, parks, or other community services. Therefore, potential impacts on utilities and public services are within the scope of the impacts identified in the SMP EIS/EIR and would either have no impact or remain less than significant. No mitigation is required.

3.3.6.9 Population and Housing

Because it is a tidal wetlands restoration project, the proposed project would not result in direct or indirect population growth, displacement of existing housing, construction of new housing, or the displacement of people such that construction of replacement housing would be necessary. Therefore, there would be no impact on population and housing. No mitigation is required.

3.3.7 Cumulative Impacts

The State CEQA Guidelines require the cumulative impacts of a proposed project to be addressed when the cumulative impacts are expected to be significant and, under CEQA, when the project's incremental effect is cumulatively considerable (State CEQA Guidelines Section 15130[a], 40 Code of Federal Regulations [CFR] Section 1508.25[a][2]). Cumulative impacts are impacts on the environment that result from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions (State CEQA Guidelines Section 15355[b], 40 CFR Section 1508.7). Section 15130 of the State CEQA Guidelines states that the discussion of cumulative impacts need not provide as much detail as the discussion of effects attributable to the project alone. The level of detail should be guided by what is practical and reasonable.

3.3.7.1 SMP EIS/EIR

The SMP EIS/EIR generated a project list to evaluate cumulative impacts. That list included:

- Other tidal restoration projects in the San Francisco Bay Area that could result in impacts and benefits similar to those of the SMP.
- Related projects, including CALFED, BDCP/California Water Fix, Delta Vision, DRERIP, SF Bay LTMS, DRMS, SF Bay Ecosystems Goals, the Delta Plan, and the various USFWS Recovery Plans for species that use Suisun Marsh;
- City and county development projects (e.g., new or expanded residential, commercial, or industrial development projects); and
- Regional and local agency infrastructure projects (e.g., water and wastewater facility construction and/or improvements and flood protection projects).

In addition, regional plans were reviewed to characterize development trends and growth projections in Solano County over the 30-year implementation period. These projects are considered with the SMP to determine whether the combined effects of all of the projects would be cumulatively considerable and, therefore, result in significant cumulative impacts.

The SMP EIS/EIR determined that, for all resources, except cultural resources, cumulative impacts would either not occur or the SMP incremental contribution to the cumulative impact would not be cumulatively considerable and significant. This is generally because:

- SMP restoration activities would be restricted to areas within the marsh; many of the other projects that could result in a cumulatively considerable impacts to resources such as air quality, biological resources, cultural, noise, traffic, water quality, and utilities would occur well outside the marsh
- SMP restoration activities would occur at on a different temporal and geographic scale than some of the restoration and development/infrastructure projects

- SMP restoration modeled scenarios contribution to changes in water quality (i.e., salinity) were not considerable and restoration would be subject to the various regulations in place to control salinity in the marsh and throughout the Delta
- SMP restoration activities would include design criteria and environmental commitments to reduce substantial changes related to water supply, water quality, terrestrial and aquatic biological resources, sediment and geology, and transportation and navigation
- SMP restoration activities would be small, sporadic, and short term in nature and magnitude over the entire marsh and through plan implementation
- SMP restoration activities would result in an increase in quality and quantity for sensitive terrestrial and aquatic biological resources
- SMP restoration activities would implement, as appropriate, mitigation measures related to air quality, cultural resources, and utilities and public services as described in the SMP EIS/EIR
- SMP restoration activities would not result in impacts on some resource, such as aesthetics, recreation, flood control and levee stability, noise, and land use

The SMP EIS/EIR determined that, for cultural resources, restoration activities would be cumulatively considerable and significant because significant impacts on numerous cultural resources, including the Montezuma Hills Rural Historic Landscape, would occur. Impacts on the Montezuma Hills Rural Historic Landscape resource are especially consequential, as several constituent features—some of which are likely to have individual significance—would be affected by restoration activities described in the SMP.

3.3.7.2 Proposed Project

Table 3-6a provides a list of wetland restoration and enhancement projects (status and projects updated since the time of certification of the SMP EIS/EIR). Several tidal restoration projects have been completed, are under way, or are proposed throughout the San Francisco Bay Area. Each of these restoration projects is expected to increase natural habitats for species that historically have occupied these areas. Because they all require a shift in habitat types, these projects all have some level of habitat loss associated with conversion. Additionally, managed wetland activities have been proposed through the North American Waterfowl Conservation Act and the San Francisco Bay Joint Venture. Associated activities are expected to improve management capabilities and habitat functions and values. Other major projects that could have a restoration component to them are also included in this table, such as the BDCP/California WaterFix or the Delta Plan. Table 3-6b provides a list of other projects identified in the SMP EIS/EIR that could result in cumulative impacts.

As disclosed in the SMP EIS/EIR, the projects identified in Tables 3-6a and 3-6b have the potential to result in cumulatively considerable impacts on the following resources, depending on project specific considerations, project design, and geographic conditions:

- Biological Resources – Fish
- Biological Resources – Vegetation and Wetlands
- Biological Resources – Wildlife
- Water quality
- Geology and groundwater
- Sediment transport

- Transportation and navigation
- Air Quality
- Noise
- Utilities and Public Services
- Cultural Resources

Table 3-6a. Updated Wetland Restoration and Enhancement Cumulative Project List

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
12th Street Reconstruction Project	Planned	Alameda	0.7	Completed, 2013
Adobe Creek Upper Reach 5 Restoration Project	Planned	Santa Clara	0.8	Completed, 2009
Albany Bulb Lagoon	Planned	Alameda	6.7	Planned*
Albany Salt Marsh Expansion	Planned	Alameda	3.6	In progress**
American Canyon Creek Restoration	Planned	Napa	1.1	Planned*
American Canyon Ecosystem Enhancement Project	Completed	Napa	610.0	N/A
Bahia Lagoon	Completed	Marin	30.1	N/A
Bailey Estates	Planned	Contra Costa	5.7	Planned*
Bair Island Restoration Project	In progress	San Mateo	1,385.5	In progress (as of December 2015)
Bair Island SFO Mitigation	Completed	San Mateo	220.2	N/A
Barron Creek at 1018 Los Robles Avenue	Planned	Santa Clara	< 0.1	Planned*
Bayside Business Park—December 2002	In progress	Alameda	17.0	Completed
Bayside Business Park—Phase I	Completed	Alameda	271.0	N/A
Bayside Business Park—Phase II	Completed	Alameda	88.0	N/A
BDCP/California WaterFix	Planned	Primarily Alameda, Contra Costa, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties	Depends on the alternative selected but could include at least 15,000 acres of restored habitat, some of which would be tidal habitat	Planned
Bel Marin Keys Unit V	In progress	Marin	1,564.4	Estimated completion, 2015
Belden's Landing	Completed	Solano	15.2	N/A
Blacklock Tidal Marsh Restoration	Completed	Solano	70.0	N/A
Bothin Marsh	Completed	Marin	0.5	N/A

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Breuners Mitigation Bank	Planned	Contra Costa	109.1	Completed, 2014
Brisbane Baylands	In progress	San Mateo, San Francisco	32.0	In progress
Burlingame Lagoon	Completed	San Mateo	0.3	N/A
Caltrans Mitigation Site	Completed	Solano	21.6	N/A
Camp 2 Wingo Unit Marsh Restoration	In progress	Napa, Sonoma	608.0	In progress*
Can Duck Club	Planned	Napa	Unknown	Planned*
Canalways	Planned	Marin	85	Planned**
Cargill Mitigation Marsh	Completed	Alameda, San Mateo	49.2	Planned *
Carquinez Bridge Seismic Retrofit Project	In progress	Solano	0.7	Completed, 2003
Carriger Creek Enhancement	Planned	Sonoma	1.0	Planned**
Castro Cove	In progress	Contra Costa	20.0	In progress
Castro Valley Creek Daylighting Project	Planned	Alameda	0.8	Completed, 2010
Central Avenue Marsh	Completed	Contra Costa	2.9	N/A
Central Avenue Marsh—Albany Sequel	Completed	Contra Costa, Alameda	Unknown	N/A
Cerrito Creek at Albany Hills	Completed	Alameda	1.1	N/A
Charleston Slough Tidal Marsh Restoration Project	Completed	Santa Clara	101.3	N/A
Chipps Island East***	Completed	Solano	270.0	N/A
Chipps Island West***	Completed	Solano	148.0	N/A
Citation Marsh	Completed	Alameda	95.4	N/A
City of Calistoga Bank Stabilization	Planned	Napa	0.1	Planned**
Codornices Creek Restoration—Nagai Property	Planned	Alameda	< 0.1	Estimated completion, 2007
Cogswell Marsh	Completed	Alameda	229.1	N/A
Colma Creek Mitigation	Completed	San Francisco, San Mateo	1.6	N/A
Color Spot	Completed	Contra Costa	1.5	N/A
Cooley Landing	Completed	San Mateo	118.4	N/A
Corte Madera Ecological Reserve Expansion	Completed	Marin	8.3	N/A
Coyote Creek Flood Control Project	Completed	Santa Clara	66.6	N/A

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Coyote Creek Lagoon	Completed	Alameda	8.0	N/A
Crissy Field	Completed	San Francisco	13.5	N/A
Cullinan Ranch	Planned	Solano, Napa	1,564.1	In progress
Damon Slough Seasonal Wetland Mitigation	Completed	Alameda	9.8	N/A
Dan Wilson Creek Bridge Project	Planned	Solano	1.1	Completed, 2010
Deak Marsh	Completed	Marin	0.6	N/A
Deer Valley Wetland Restoration	Planned	Santa Clara	2.2	Planned*
Delta Plan	In progress	Primarily Alameda, Contra Costa, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties	U/K	Completed
Downtown Sewer, Water, and Storm Drain Improvements	Planned	Contra Costa	Unknown	Planned*
Dutch Slough Tidal Marsh Restoration Project	Not Included	Contra Costa	1,200	Planned
Dunphy Park	Completed	Marin	0.8	N/A
DUST Marsh	Completed	Alameda	15.0	N/A
East San Rafael Wetlands	Completed	Marin	13.0	N/A
East Shore Park—Berkeley Meadows	Planned	Alameda	55.2	Completed, 2005
East Shore Park—Schoolhouse Creek	Planned	Alameda	2.3	Planned*
East Shore Park—Strawberry Creek	Planned	Alameda	1.7	In progress
Eden Ecological Preserve Restoration Project	Planned	Alameda	767.6	Completed, 2015
Eden Ecological Preserve Restoration Project—Dixon Landing Road Project	In progress	Alameda, Santa Clara	17.5	Completed, 2015
Edgerley Island Marina	Completed	Napa	9.4	N/A
Elsie Gridley Mitigation Bank—North Suisun Mitigation Bank	Planned	Solano	1.4	Completed, 2007
Elsie Roemer Enhancement Project	Planned	Alameda	0.6	Estimated completion, 2007
Emeryville Crescent	Completed	Alameda	50.3	N/A
Emily Renzel Marsh	Completed	Santa Clara	36.0	N/A

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Faber Tract Marsh	Completed	San Mateo	87.3	N/A
Fairfield Corporate Commons Project	Planned	Solano	2.3	Planned*
Figueras Tract	Planned	Solano	72.7	Planned*
Foster City Mitigation Sites	In progress	San Mateo	29.2	In progress*
Galbraith Golf Course Wetland Mitigation Project	Completed	Alameda	8.0	N/A
Gallinas Creek Restoration Project (Phases 1, 2, and 3)	Completed	Marin	19.5	N/A
Gasser, Vernice/FHK Investment—Gasser Estate Wetland Mitigation	Planned	Napa	1.0	Planned*
Ghisletta Project Site	Planned	Napa	1.6	Estimated completion, 2009
Gianulius Property	Completed	Solano	2.1	N/A
Green Point/Toy Marsh	Completed	Marin	57.4	N/A
Guadalcanal Village Restoration Project	Completed	Solano	55.5	N/A
Hamilton Wetlands Restoration Project	In progress	Marin	1,451.2	Estimated completion, 2015
Harvey Marsh	Completed	Santa Clara	52.0	N/A
Hayward Marsh Brackish	Completed	Alameda	60.0	N/A
Hayward Marsh Fresh	Completed	Alameda	85.9	N/A
Hayward Shoreline Enhancement Project	Completed	Alameda	80.3	N/A
Hayward Shoreline Enhancement Project-Oliver Salt Ponds	Planned	Alameda	134.0	Planned*
Hill Slough West Restoration Project	Planned	Solano	223.0	In progress
Hoffman Marsh Wetland Mitigation Project	Completed	Contra Costa	6.0	N/A
Honker Bay Conservation Bank	Not Included	Solano	125	Planned
Huichica Creek Enhancement	Completed	Napa, Sonoma	105.5	N/A
Huichica Creek Unit	In progress	Sonoma	51.0	Completed
I-80 Improvements/HOV Land Project	Completed	Alameda	2.8	N/A
Ideal Marsh	Completed	Alameda	129.4	N/A
Inverness Ridge	Planned	Alameda	0.7	Planned*
Island Slough Unit	Completed	Solano	354.0	N/A
John F. Kennedy Park Wetland Enhancement Project	Planned	Napa	17.0	Planned*

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Kennedy Park Master Plan	Planned	Napa	0.1	In progress
KGO Towers	Completed	Alameda	1.3	N/A
Kingdom Hall of Jehovah's Witnesses	Planned	Napa	0.2	Planned*
Knapp Tract	Planned	Santa Clara	381.8	In progress
La Riviere Marsh	Completed	Alameda	117.6	N/A
Lake Merritt Restoration	Planned	Alameda	153.3	In progress
Lakeside Drive and Mariner's Island Extension Mitigation	Completed	San Mateo	1.9	N/A
Las Gallinas Ponds	Planned	Marin	68.4	Completed
Leonard Ranch Wetlands Restoration Project	Completed	Sonoma	334.8	N/A
Lower Walnut Creek Emergency Interim Protection	Planned	Contra Costa	8.2	Completed, 2007 and 2012
Lower Yolo Ranch Tidal Restoration Project	Not Included	Yolo	1,100	Planned
Madera Bay Park	Completed	Marin	4.9	N/A
Madera del Presidio Project (Phases I and II)	Completed	Marin	100.0	N/A
Mallard Farms Conservation Bank	Not Included	Contra Costa/Solano?	700	In Progress
Mare Island Navy Conservation Areas	Planned	Solano	106.3	Planned*
Mare Island Navy Mitigation Marsh	Planned	Solano	62.7	Planned*
Mare Island Refuge	Planned	Solano	169.9	Planned*
Marin Flood Control—Seasonal	Completed	Marin	343.4	N/A
Marin Flood Control/CDFW—Perennial	Completed	Marin	309.2	N/A
Marta's Marsh	Completed	Marin	20.7	N/A
Martinez Regional Shoreline Salt Marsh Enhancement Project	Completed	Contra Costa	11.0	N/A
Mayhew's Landing	Planned	Alameda	110.4	Completed, 2013
McGarvey Gulch Salmonid Barrier Improvements Project	Planned	San Mateo	0.6	Planned*
Mill Valley Marsh	Completed	Marin	6.5	N/A
Miller Creek	Completed	Marin	12.0	N/A
MLK Jr. Regional Shoreline Wetlands Project	Completed	Alameda	70.6	N/A
Montezuma Wetlands Project	In progress	Solano	2,229.0	Completed

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Moseley Tract	Planned	San Mateo	61.0	Planned*
Mountain View Tidal Marsh	Completed	Santa Clara	28.9	N/A
Muzzi Marsh	Completed	Marin	147.9	N/A
Napa Air Center Wetland Preserve	Planned	Napa	0.6	Planned*
Napa Meadows Development	Planned	Napa	9.9	Planned*
Napa River Bank Stabilization—Carpy-Connolly Ranch	Planned	Napa	0.7	Planned*
Napa River Flood Control	Planned	Napa	940.1	In progress
Napa River Oxbow Preserve	Planned	Napa	37.3	Completed, 2009
Napa River, Gasser Wetland Relocation	Planned	Napa	9.5	Planned*
Napa Sonoma Marsh Restoration Project	In progress	Napa, Sonoma	7,322.4	Completed
Napa Urban Waterfront Restoration	Planned	Napa	Unknown	Planned*
Napa Valley Gateway Business Park and Sheehy Creek Realignment and Enhancement Project	Planned	Napa	5.4	Planned*
Napa Valley Unified School District Site	Planned	Napa	314.1	Planned*
Nevada Parcel	Completed	Contra Costa	109.0	N/A
New Chicago Marsh	Completed	Santa Clara	387.0	N/A
Nordstrom/Shorebird Marsh	Completed	Marin	48.2	N/A
North Basin Wetlands	Completed	Alameda	5.0	N/A
North Bothin Marsh Enhancement Project	Completed	Marin	0.4	N/A
Northern Outer Bair Island	Completed	San Mateo	551.7	N/A
Novato Creek Antenna Field	Planned	Marin	134.2	Planned*
Novato Flood Control Project Mitigation	Completed	Marin	8.0	N/A
Novato Sanitary District Reclamation Project	Completed	Marin	65.0	N/A
Oakland Middle Harbor Enhancement Project	In progress	Alameda	4.9	In progress
Oro Loma Marsh Enhancement Project	In progress	Alameda	315.3	In progress*
Oro Loma Marsh Mitigation Project	Completed	Alameda	21.0	N/A
Pacheco Pond	Completed	Marin	110.9	N/A
Pacific Commons Development	Completed	Alameda	492.0	N/A
Pacific Shores Center	Completed	San Mateo	146.2	N/A
Palmaz Vineyards Creek Restoration	Planned	Napa	Unknown	Complete, 2010

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Palo Alto Harbor Improvements	Completed	Santa Clara	14.3	N/A
Perry Gun Club Mitigation Project	In progress	Alameda	16.8	In progress*
Petaluma Marsh Expansion Project	In progress	Marin	108.3	Completed, 2005/2006
Petaluma River Marsh	Completed	Sonoma	45.8	N/A
Pier 94	In progress	San Francisco	7.7	Completed, 2006
Pier 98	Completed	San Francisco	8.8	N/A
Pioneer Bank Stabilization Project	Planned	Napa	0.1	Completed, 2013/2014
Plummer Creek Wetlands Restoration Mitigation Project	Completed	Alameda	26.0	N/A
Point Buckler***	Completed	Solano	49.5	N/A
Polhemus Creek Restoration Project	Planned	San Mateo	0.2	Planned*
Pond 3	Completed	Alameda	110.2	N/A
Pond A18	Planned	Santa Clara	855.6	Complete, 2005/2008
Pond A4	Planned	Santa Clara	306.4	Planned*
Port Sonoma Marina Perimeter	Completed	Sonoma	8.9	N/A
Prospect Island Tidal Restoration Project	Not Included	Solano	1,600	Planned
Ravenswood Triangle	Completed	San Mateo	3.0	N/A
Reconstruction of Bollinger Road Bridge over Calabazas Creek	Planned	Santa Clara	0.2	Complete, 2009
Redwood-San Andreas High School Marsh	Completed	Marin	15.0	N/A
Refugio Creek Bridge Project	Planned	Contra Costa	0.2	Planned*
Richardson Bay Bridge Marshes	Completed	Marin	6.6	N/A
Richmond Parkway	Completed	Contra Costa	3.3	N/A
Ringstorm Bay Unit Marsh Restoration	In progress	Napa	50.0	Completed, 2004
River Park	Planned	Solano	38.8	Planned*
Route 101/Ralston Ave. Interchange	In progress	San Mateo	1.9	Completed
Rush Creek/Cemetery Marsh Enhancement Project	Completed	Marin	272.1	N/A
Ryer Island***	Completed	Solano	929.2	N/A

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
San Carlos Airport North Clear Zone	Completed	San Mateo	0.6	N/A
San Leandro Shoreline Marshlands Enhancement Project	Completed	Alameda	171.9	N/A
San Mateo's Master Shoreline Parks Master Plan	In progress	San Mateo	13.1	Completed
Sanchez Creek Marsh	Completed	San Mateo	3.1	N/A
Schellville	Planned	Sonoma	386.7	Planned*
Scottsdale Marsh Enhancement Project	Completed	Marin	46.4	N/A
Seabreeze Marina	In progress	Alameda	0.3	In progress*
Seal Slough	Completed	San Mateo	47.2	N/A
Shell Marsh Restoration Project at Peyton Slough	In progress	Contra Costa	200.0	In progress*
Simmons Slough Wildlife Corridor	Planned	Marin	186.2	Completed
Skaggs Island	Planned	Sonoma	4,166.8	Planned
Sky Ranch Stock Pond Rehabilitation	Planned	Contra Costa	0.2	Completed, 2006
Slaughterhouse Point	Completed	Solano	275.5	N/A
Sonoma Baylands Salt Marsh Restoration	Completed	Sonoma	350.0	N/A
South Basin Wetlands	Completed	Alameda	3.7	N/A
South Bay Salt Pond Restoration Project	In progress	Alameda, San Mateo, Santa Clara	13,681.9	In progress
St. Helena Comprehensive Flood Protection Project	Planned	Napa	7.8	Completed, 2011
Stevens Creek Tidal Marsh	Completed	Santa Clara	30.6	N/A
Sulphur Creek Restoration Project	Planned	Napa	0.8	In progress
Sunnyvale Baylands Park	Completed	Santa Clara	12.4	N/A
Tasman Corridor Light Rail Transit Mitigation Project	In progress	Santa Clara	3.6	Completed, 2009
Tolay Creek	Completed	Sonoma	305.5	N/A
Trancas Road—State 29 Interchange	Planned	Napa	0.2	Estimated Completion, 2004
Treasure Island	Planned	San Francisco	16.7	In progress
Triangle Marsh at Hayward Shoreline	Completed	Alameda	8.7	N/A
Triangle Marsh at Larkspur	In progress	Marin	1.0	In progress*
Triangle Marsh Restoration Project	Completed	Marin	15.9	N/A

Project	SMP EIS/EIR Status	County	Total Acres	Current Status
Triangle Marsh, Refuge Entry	In progress	Alameda	9.4	In progress*
Tubbs Island Marsh Restoration Project	Completed	Sonoma	68.4	N/A
U.S. Maritime Administration Marsh	Completed	Solano	69.6	N/A
Upper York Creek Dam Sediment Removal Project	Planned	Napa	2.0	In progress
Vallejo Mitigation Sites	Completed	Solano	137.4	N/A
Viansa Winery	Completed	Sonoma	94.3	N/A
Warm Springs Pasture	Planned	Alameda	276.0	Planned*
Webb Ranch Mitigation Site	Planned	San Mateo	1.8	Estimated completion, 2007
West End Duck Club	Completed	Napa, Solano	355.2	N/A
West Navy Marsh	Completed	Contra Costa	64.4	N/A
Western Stege Marsh Restoration	In progress	Contra Costa	9.4	Completed, 2004
Whales Tail	Completed	Alameda	254.0	N/A
Wheeler Island	Completed	Solano	98.0	N/A
Whipple Ave Mitigation	Completed	San Mateo	7.7	N/A
White Slough	Completed	Solano	94.1	N/A
Wildcat Creek Marsh Restoration Project	Completed	Contra Costa	279.7	N/A
Zanker Road Landfill Mitigation Site	Completed	Santa Clara	25.0	N/A
Zone 12 Lines H, J, and K Sediment Removal Project	Planned	Alameda	3.2	In progress

* Status from SMP EIS/EIR was used.
** Projects identified on the San Francisco Bay Joint Venture Active Project List.
*** These properties were restored as a result of unrepaired levee failures, not as restoration projects.

Table 3-6b. Updated Other Projects Cumulative Project List

Project	SMP EIS/EIR Status	Location	Total Acres	Current Status
CVP/SWP Coordinated Operations Biological Opinions	In progress	Primarily Solano and Sacramento	8,000 acres in Suisun Marsh and the north Delta	In progress
Sacramento Deep Water Ship Channel Dredging	Planned	Sacramento	—	In progress
Potrero Hills Landfill Expansion Project	Planned	Solano	250	In progress
Industrial Development (south of SR 12 and north of Cordelia Road)	Planned	Solano	—	In progress
Collinsville-Montezuma Wind Resource Area	Planned	Solano	—	In progress
Montezuma Wind Project and PG&E Reconductoring Project	Planned	Solano	—	Completed
Kirby Hills Natural Gas Storage Facility	Planned	Solano	—	Completed, 2009
Bay Area Regional Rail Plan	In progress	Multiple	—	Completed, 2007

As demonstrated in the analysis in Sections 3.3.1 through Section 3.3.6 and contained in Table 3-7, the proposed project would not result in impacts not previously disclosed in the SMP EIS/EIR. In addition, the proposed project would not result in any significant and unavoidable impacts on resources not previously disclosed in the SMP EIS/EIR and would not result in new significant and unavoidable impacts on resources. Furthermore, impacts on cultural resources and utilities and public services would be less than significant under the proposed project because of the baseline conditions and the location of the proposed project and, thus, would be reduced when compared to the impact determination disclosed for those resource in the SMP EIS/EIR (i.e., significant and unavoidable or less than significant with mitigation incorporated).

In November 2015, CCWD requested a quantitative cumulative salinity analysis by expanding the model analysis of the proposed project (Appendix D.1) to one that contained several foreseeable habitat restoration projects. RMA modified the model to include the following projects, which are in concept and planning phases: Dutch Slough (1,178 acres modeled), Prospect Island (1,600 acres modeled), Lower Yolo Restoration Project (1,787 acres modeled), Mallard Farms Conservation Bank (650 acres modeled), Honker Bay Conservation Bank (112 acres modeled), and McCormack-Williamson Tract (1,600 acres modeled). None of these projects are as close to implementation as the proposed project. The addition of several thousand acres of tidal prism to the model geometry, especially the addition of McCormack-Williamson Tract located in the eastern Delta, resulted in increases in salinity at the Delta pumps well beyond what was modeled for the proposed project alone[8]. Several proposed tidal restoration projects within the Suisun Marsh, which may dampen the modeled salinity increases in the Delta, were not included in the model run. Furthermore, there is uncertainty regarding which Delta tidal restoration projects would be fully implemented. As such, the salinity effects of the proposed project do not exceed those described in the SMP EIS/EIR, and the incremental contribution of the proposed project is not cumulatively considerable or significant.

The proposed project does not include activities that would contradict the cumulative impact analysis and conclusions in the SMP EIS/EIR. Thus, the proposed project:

- Would be restricted to areas within the marsh; many of the other projects that could result in potentially cumulatively considerable impacts related to resources such as noise, traffic, utilities and public services, and cultural resources would occur outside the marsh
- Would occur at on a different temporal and geographic scale than some of the restoration and development/infrastructure projects listed in Tables 3-6a and 3-6b
- Includes design criteria and environmental commitments to reduce substantial changes related to water supply, water quality, fish and wildlife species, vegetation and wetlands, and sediment and geology
- Would be relatively small, sporadic, and short term in nature and magnitude during construction over the entire marsh and, thus, have very limited, localized, or temporary effects related to water quality, fish and wildlife species, vegetation and wetlands, sediment and geology, and hazards and hazardous materials during construction
- Would result in an increase in quality and quantity related to sensitive fish and wildlife species and vegetation

[8] The RMA report is available at SFCWA website: http://www.sfcwa.org/2013/03/27/tule-red-restoration-project/

- Would not need to implement mitigation measures related cultural resources or utilities and public services
- Would not need to implement new mitigation measures related to air quality
- Would not result in impacts on aesthetics, recreation, flood control and levee stability, noise, or land use

Although past, present, and reasonably foreseeable future projects may result in cumulatively considerable impacts on certain resources, it is anticipated that the proposed project would not result in a cumulatively considerable contribution, and impacts would be less than significant.

3.4 Impact Checklist

Table 3-7 provides an impact-by-impact discussion of each resource. It includes a discussion of the Appendix G thresholds of the State CEQA Guidelines, the SMP EIS/EIR thresholds and impact determinations, and the Tule Red impact determinations.

The following are important to note with respect to this table:

- The table notes where environmental commitments, BMPs, or mitigation measures differ between the Tule Red project and the information described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management*, *Preservation*, *and Restoration Plan*, of the SMP EIS/EIR. In other words, the Tule Red project incorporates all environmental commitments, BMPs, and mitigation measures described in Appendix F and Chapter 2 of the SMP EIS/EIR unless otherwise described.
- The first resources identified in the table are those resources identified in the initial study checklist of Appendix G of the State CEQA Guidelines. Resources in parenthesis indicate resources evaluated in the SMP EIS/EIR.
- Environmental commitments identified in the SMP EIS/EIR (2011) impact analysis are bolded.
- "No Information Incorporated": This means the SMP EIS/EIR impact analysis did not refer to specific environmental commitments or specific assumptions related to restoration.
- If specific SMP restoration activities in the impact analysis are not noted, assume the following (from SMP EIS/EIR Chapter 2):
  - Site preparation
    - Grade and prepare to re-create flows and hydraulic conditions
    - Fill ditches in with dirt, brush boxes, or other material
    - May include digging starter channels
    - Establish vegetation communities prior to inundation
    - Moist soil management
    - Maintenance of levees and water control structures
  - Upgrading or constructing new exterior levees

- Existing interior levees may be upgraded with brush boxes or other biotech wave dissipaters, or new exterior levees may be constructed
- Construct habitat levees, depending on cost and availability of fill, by widening existing interior levees or constructing new interior levees or islands
- Habitat levees would be constructed from available resources and may include channel dredged material as well as excavated material

  - Breaching levees
    - Breach edges may require scour protection with rock, geotextiles, or piles, or long reaches of levee may be graded down to lower elevations
    - Breach location, number, and size chosen to maximize ecological benefits and minimize upstream tidal muting, tidal elevation changes, slough channel scour, and hydraulic changes

- Mitigation measures identified in the SMP EIS/EIR (2011) impact analysis are underlined

Table 3-7. Impact Checklist

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
AESTHETICS (VISUAL / AESTHETIC RESOURCES)[2]								
a.) Have a substantial adverse effect on a scenic vista. c.) Substantially degrade the existing visual character or quality of the site and its surroundings.	VIS-1: Temporary Changes in Views Caused by Construction Activities	LS	None required	—	• Breaching and lowering exterior levees • Upgrading or creating new interior levees • Creating habitat levees • Increasing connectivity between marsh plain and waters • Redirecting intakes, discharges, and outfalls	Construction activities would introduce heavy equipment and associated vehicles into the viewshed; evening and nighttime construction activities would require the use of bright lights, which would affect nighttime views.	**Environmental Commitment: Visual / Aesthetic Best Management practices, specifically: Identify sensitive view receptors for site-specific analysis and ensure that contractors minimize fugitive light from portable sources used for nighttime operations. Also, a visual barrier will be installed to prevent light spill from truck headlights in areas with sensitive view receptors**.[3]	There are no sensitive view receptors in proximity to the Tule Red project site that would experience a substantial change in view caused by construction activities or would be affected by fugitive light from potable light sources. Furthermore, it is not expected that construction would require significant sources of portable light given it will primarily be performed during daylight hours (e.g., sunup to sundown). Construction activities would occur over a short duration (90 days). The demolition of the structures would remove five existing structures that would represent a change to the current visual landscape, but would not affect sensitive viewers as none currently exist on the site. Furthermore, the buildings do not add visual quality to the existing landscape and interrupt views of Grizzly Bay and the surrounding low lying marsh land area. Therefore, the EC identified in the SMP EIS/EIR is not applicable to the proposed project. Impacts would be less than significant.
	VIS-2: Temporary Changes in Views Caused by Habitat Reestablishment Period	LS	None required	—	Habitat reestablishment during transitional state and over a period of a couple of years prior to maturation of vegetation and recolonization.	The restored tidal areas may be temporarily denuded of vegetation, or appear so from a distance because of immature planted vegetation, and look more like a mud flat or open water where mature vegetative communities once existed. Because the sites would be scattered in different locations, a visual imposition on the landscape would not be created or perceived as a large-scale visual change. Because restored sites attract wildlife, the visual quality of the areas would be improved.	No information incorporated.[4]	There are no sensitive view receptors in proximity to the Tule Red project site that would experience a substantial change in view caused by construction activities. Furthermore, construction activities would occur over a short duration (90 days) and would not occur at night. No ECs or MMs were identified in the SMP EIS/EIR impact analysis. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Impacts would be less than significant.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
	VIS-3: Changes in Views to and from Suisun Marsh	LS	None required	—	• Breaching and lowering exterior levees • Upgrading or creating new interior levees • Creating habitat levees • Increasing connectivity between marsh plain and waters • Redirecting intakes, discharges, and outfalls • Installing fencing, brush boxes, and planted upland, riparian, and tidal vegetation	Views to and from the marsh would not be greatly affected because restoration-associated landscape changes would quickly appear to be part of the existing visual landscape and would not alter the visual character of the marsh. Restored lands with increased public access would improve the aesthetic quality of the marsh and increase the availability of those aesthetic resources.	No information incorporated	Same as Impact VIS-2. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Impacts would be less than significant.
b.) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.	VIS-4: Damage to Scenic Resources along Scenic Highway	NI	—	—	No description of specific restoration activities.[5]	There is no roadway in or near the plan area that is designated in California plans as a Scenic Highway or route worthy of protection for maintaining and enhancing scenic viewsheds. Although State Route 12 is a county-designated scenic route, views along the roadway could improve with marsh restoration.	No information incorporated	Similar to the SMP EIS/EIR impact analysis, no roadway in or near the project site is designated in California plans as a Scenic Highway or route worthy of protection for maintaining and enhancing scenic viewsheds. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Impacts would be less than significant.
d.) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.	VIS-5: Create a New Source of Light and Glare That Affects Views in the Area	LS	None required	—	No description of specific restoration activities other than a general reference to the installation of permanent lighting features and the use of portable lighting and maintenance vehicles at night.	There would be a small increase in glare due to increased water surface area, but this would be negligible relative to the whole of the marsh. Actions that require the installation of permanent lighting and restoration activities at night that require the use of lighting would be a source of light, and new buildings could create glare and introduce inappropriate building materials, finishes, or colors.	**Same as Impact VIS-1; Environmental Commitment: Visual / Aesthetic Best Management Practices**	Same as Impact VIS-1. Impacts would be less than significant.
a.) Have a substantial adverse effect on a scenic vista.	VIS-6: Conflict with Policies or Goals Related to Visual Resources	NI	—	—	No description of specific restoration activities.	The SMP is consistent with the intent and purpose behind the establishment of the policies and goals created to help protect and enhance the aesthetic value of the marsh. Furthermore, the actions would aid in the facilitation of goals to preserve and enhance the aesthetic resources of the marsh and, therefore, improve views of, from, and within the marsh.	No information incorporated	Same as Impact VIS-2 and Impact VIS-4. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Impacts would not occur.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
AGRICULTURAL RESOURCES (NONE)[1]								
a.) Convert prime farmland, unique farmland, or farmland of statewide importance, as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency to non-agricultural use. b.) Conflict with existing zoning for agricultural uses or a Williamson Act contract. c.) Conflict with existing zoning for, or cause rezoning of, forestland. d.) Result in the loss of forestland or conversation of forestland to non-forestland. e.) Involve other changes in the existing environment that, because of their location or nature, could result in the conversation of farmland to non-agricultural use or the conversation of forestland to non-forestland.	None.	None.	—	—	None.	None. The SMP EIS/EIR did not analyze this specific Appendix G impact as activities under the SMP would not affect agriculture because there is no agriculture within the managed wetland areas or potential tidal restoration areas.	None.	The Tule Red project site has no agricultural lands and has never been used for agricultural purposes. Therefore, the Tule Red project has no ability to affect agricultural lands. Impacts would not occur.

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AIR QUALITY (AIR QUALITY)[1]								
a.) Conflict or obstruct implementation of the applicable air quality plan. b.) Violate any air quality standards or contribute substantially to an existing or projected air quality violation. c.) Result in a cumulatively considerable net increase in any criteria pollutants for which the project region is designated a nonattainment area under an applicable federal or state ambient air quality standard.	AQ-1: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration	S	<u>AQ-MM-1: Limit Construction Activity during Restoration</u>[6] <u>AQ-MM-2: Reduce Construction NO_X Emissions</u> <u>AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures</u>[6]	LS	As a worst-case scenario, site preparation and levee breaching emissions were combined into a total daily emissions value because it is possible that two different projects could occur at the same time. The site preparation phase entails grading, improving levees, and building channels and islands. The water management phase does not include the use of heavy equipment. Levee breaching includes only one excavator.	Construction activities would result in a temporary increase in emissions of ROG, NO_X, CO, PM10, PM2.5, and CO_2. Unmitigated emissions from the site preparation phase and levee breaching phase (assumed simultaneous) exceed the BAAQMD draft construction thresholds for NO_X but mitigated emissions do not.	Assumptions made: • Assumed operation of equipment for 8 hours per day. • Anticipated construction equipment (and number) for restoration: Site Preparation o Tractor/loader/backhoe (1) o Rubber-tired dozer (1) o Excavator (1) o Grader (1) o Box scraper (1) Levee Breaching o Excavator (1) • SMP assumes site preparation phase and levee breaching occur simultaneously for worst-case scenario.	Implementation of Tule Red restoration would require more construction equipment than accounted for in the SMP EIS/EIR analysis, as described in Chapter 2, *Project Description*, of this addendum; however, the site preparation phase (Phase I) and the breaching of the natural exterior berm (Phase II) would not take place simultaneously, as described in the SMP EIS/EIR. Further, the type of equipment used for Tule Red would be similar to that identified in the SMP EIS/EIR. In addition, Tule Red would incorporate all appropriate BAAQMD BMPs and AQ-MM-2, and AQ-MM-3 of the SMP EIS/EIR (listed in this table). The modeling of three different construction equipment scenarios indicates that none of the BAAQMD district thresholds would be exceeded during either Phase I or Phase II activities (Tables 3-5a through 3-5d). As such, AQ-MM-1 does not need to be incorporated into the Tule Red project. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant with mitigation incorporated.

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a.) Conflict or obstruct implementation of the applicable air quality plan. b.) Violate any air quality standards or contribute substantially to an existing or projected air quality violation. c.) Result in a cumulatively considerable net increase in any criteria pollutants for which the project region is designated a non-attainment area under an applicable federal or state ambient air quality standard.	AQ-4: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration and Management Activities Combined	S	AQ-MM-1 through AQ-MM-3 AQ-MM-4: Limit Construction Activity during Restoration and Management	LS	No description of specific restoration activities.	The worst-case scenario mitigated emissions would exceed the BAAQMD draft construction thresholds for NO_X if all the various restoration activity, new management activity that would increase in frequency, and new management activity were to all happen concurrently. Although multiple phases of construction can overlap, the equipment being used on the marsh at any given time should not exceed the equipment described in Tables 5.7-8 and 5.7-10 of the SMP EIS/EIR (and in the adjacent column in this table).	• Assumes restoration and management construction activity overlap. • Assumes operation of equipment for 8 hours per day. • Estimated construction equipment (and number) for management activity that would increase in frequency: o Tractor/loader/backhoe (3) o Rubber-tired dozer (3) o Excavator (2) o Grader (3)	Similar to Impact AQ-1. In addition, the project site acreage that would be disturbed when compared to baseline conditions would be reduced, and equipment activity would be reduced when compared to baseline between construction Phases 1 and 2 because the site would be managed to promote vegetation growth or would be pre-flooded prior to the breach. Further, management activities for the project site would be overall reduced because the project site would cease to be a managed wetland once Phase 2 was complete and there would no longer be heavy construction equipment used during the summer. Therefore, the impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant with mitigation incorporated (AQ-MM-2, AQ-MM-3, and AQ-MM-4).

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d.) Expose sensitive receptors to substantial pollutant concentrations.	AQ-5: Construction-Related Diesel Health Risk Associated with Restoration	LS	None required	—	No description of specific restoration activities; however, restoration construction activities would occur between June and September over approximately 30 construction seasons.	Diesel particulate emission rates would be low, the emissions would be distributed over a large geographic area rather than clustered near any individual sensitive receptors, and construction activities would occur sporadically over a 30-year period and would not result in long-term emissions of diesel exhaust at the project sites. In addition, diesel exhaust would attenuate to levels well below acceptable exposure limits because of the distances of sensitive receptors from construction activities.	**<u>Environmental Commitments</u>: Air Quality Best Management Practices, including Basic Control Measures, Enhanced Control Measures and Additional Air Quality Best Management Practices**	Similar to the impact analysis in the SMP EIS/EIR, diesel particulate emission rates would be low, and the emissions would be distributed over a large geographic area. Therefore, diesel exhaust would attenuate to levels well below acceptable exposure limits. Furthermore, there are no sensitive receptors within proximity to the project site. In addition, Tule Red would incorporate the Air Quality Best Management Practices EC as described in Chapter 2, *Habitat Management, Preservation*, and Restoration Plan of the SMP EIS/EIR as described in this table, with the exception of Basic Control Measures of treating all graded surfaces to prevent nuisances from dust or spillage on roads or adjacent properties. This is because the majority of the project site would be wet or damp and would not generate substantial quantities of dust during earth moving activities. In addition, the HMMP (Impact HAZ-3) would control and reduce risk of spills. As such, the impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
d.) Expose sensitive receptors to substantial pollutant concentrations.	AQ-8: Construction-Related Diesel Health Risk Associated with Restoration and Management Activity Combined	LS	None required	—	Impacts from restoration and management activity combined would be similar to those described above under AQ-4.	Impacts from restoration and management activity combined would be similar to those described above under AQ-4	• Assumes restoration and management construction activity overlap • Assumes operation of equipment for 8 hours per day	Same as Impact AQ-1 and Impact AQ-5. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
e.) Create objectionable odors that would affect a substantial number of people.	AQ-10: Increase in Construction-Related Odors	LS	None required	—	Described some ground-disturbing activities and disposal and settling of dredged material.	Any odor generated from dredging spoils would not be any more objectionable than the naturally occurring odors around the marsh. Also, ECs related to dust would minimize the potential for odor generation.	**<u>Environmental Commitment</u>: Air Quality Best Management Practices Basic Control Measure, specifically: Treat all graded surfaces to prevent nuisances from dust or spillage on roads or adjacent properties**	The Tule Red project site is a managed wetland site. The majority of the site would be wet when ground-distributing activities would take place. Thus, controlling dust by wetting down the site would not be appropriate, would not be needed, and would not control odor. Further, there are no sensitive receptors located on the adjacent properties. Therefore, implementation of the SMP EIS/EIR EC

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								is not needed. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
BIOLOGICAL RESOURCES (FISH, VEGETATION, WETLANDS, AND WILDLIFE)[1]								
a.) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations by CDFW or USFWS. d.) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites.	FISH-1: Construction-Related Temporary Impairment of Fish Survival, Growth, and Reproduction by Accidental Spills or Runoff of Contaminants (Heavy Metals)	LS	None required	—	Levee construction and breaching (August 1–November 30 [work window for special-status fish species]) and use of equipment near water.	Disturbance of sediment in and around sloughs most likely would result in a release of sediments into the slough channels and possibly a release of soil contaminants into the water column. Refueling, operating, and storing construction equipment could result in accidental spills of pollutants such as hydraulic fluids, oil, or fuel. Pollutants entering water bodies in the plan area would cause mortality to, and reduced growth of, the egg, larval, and juvenile life stages of fish. These pollutants could adversely affect the movement of special-status fish species.	Assumption: • Larval and juvenile delta smelt would not be present August 1–November 30 because most spawning occurs in the spring. **Environmental Commitments**: • **Erosion and sediment control plan** • **SWPPP** • **Hazardous Materials Management Plan (HMMP)** • **Spoils disposal plan** • **Worker training** • **Construction Period Restrictions: Limit in-water work to August 1–November 30**	Construction of Phases 1 and 2 would follow the SMP EIS/EIR ECs to minimize impacts on fish. Phase 1 construction would occur on the landside of the natural berm and open waters, and fish species would generally be protected from these activities. In addition, an HMMP would be included in the SWPPP; however, the HMMP would not include implementation of a Risk Management Plan (RMP). This is because Tule Red is not a large-scale project. The HMMP and SWPPP would reduce the potential for pollutants entering waterways. The project site has had limited herbicide application to control phragmites on-site over the years, as allowed by permits. As discussed in Impact WQ-4, methylmercury production may increase after the breach, which could affect fish; however, over time, it is expected to reduce given the conversion of managed wetlands to tidal habitat. In addition, Phase 2 construction would occur between August 1 and November 30, as prescribed by the EC, and would not expose the most sensitive life stages of special-status species to pollutants in the water. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-2: Construction-Related Temporary Reduction of Special-Status Fish Rearing Habitat Quality or Quantity through Increased Input and Mobilization of Sediment	LS	None required	—	Levee construction, levee breaching, placement of riprap, and dredging	Construction activities would release sediments into sloughs and Suisun Bay, resulting in direct impacts on resident fishes through gill damage and reduced capacity to take in oxygen. Indirect impacts could include reduced fitness as a result of decreased DO intake, increased metabolic costs associated with reduced DO intake ability, and reduced foraging due to decreased visibility.	Assumption: • Delta smelt, longfin smelt, green sturgeon, and Sacramento splittail may occur year-round in the marsh. **<u>Environmental Commitments</u>:** • **Standard Design Features and Construction Practices** • **Erosion and sediment control plan** • **SWPPP** • **Worker training** • **Construction Period Restrictions: Limit in-water work to August 1–November 30** • **HMMP**	The ECs identified for this impact in the SMP EIS/EIR impact analysis are described in Appendix B of this document and are the same as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and in Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR and would be implemented as part of the Tule Red project. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-3: Short-Term Impairment of Delta Smelt Passage and Reduced Availability of Spawning and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	LS	None required	—	Levee breaching.	Project actions could produce tidal velocities in excess of the sustained swimming speed of several sensitive fish species. Long-term impacts of velocity changes in the sloughs as a result of levee breaching could preclude delta smelt from rearing habitat, depending on the breach location and size. A major change in velocities could have a significant impact on the availability of delta smelt habitat. As the restored area evolves into a functioning tidal marsh, it is expected to provide indirect benefits through exported pelagic production for delta smelt. Additionally, restoration activities most likely would be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame. As such, only minimal changes in delta smelt habitat in the marsh would occur at any one time. Overall, delta smelt are expected to benefit; thus, minor temporary losses of habitat would be compensated for through restoration.	Assumptions: • Levee breaching would occur from August 1 to November 30 when delta smelt larvae and juveniles are larger and can avoid adverse effects. • Velocity changes would be addressed adaptively through modifications in breached areas. • Final designs will attempt to account for potential adverse hydrologic modifications. This information will be used to modify or maintain levee breaches as needed to support fish passage and access to rearing habitat for delta smelt. **Environmental Commitments:** • **Any adverse effects on special-status fish species and/or critical habitat will be addressed by the project proponent** • **Any additional measures will be in compliance with ESA.**	The Tule Red project is not expected to produce tidal velocities in excess of the sustained swimming speed of several sensitive fish species (e.g., delta smelt). The velocity accelerations expected in the pelagic zone that delta smelt and other fish inhabit is less than the 1 fps design guidance of the SMP EIS/EIR. If fish do enter the project site, it would have roughened vegetated channel margins, which would provide respite from higher velocities (i.e., 2 to 3 fps) and allow the fish to move out of the site on the ebb tide and return back to relatively calm Grizzly Bay. In addition, the Tule Red project would implement all terms and conditions of the NMFS Programmatic Biological Opinion, except the terms and conditions for Reasonable and Prudent Alternative (RPA) 3 of the NMFS Programmatic Biological Opinion, because they are not applicable to the project for the following reasons: • The Tule Red Restoration Project is in Region 4 of the Suisun Marsh Plan (RPA 3a) • The written annual reports are prepared by the Bureau of Reclamation (RPA 3b). The Tule Red project would implement the programmatic conservation measures identified in the USFWS Programmatic Biological Opinion that may be applicable to special-status fish species. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-4: Short-Term Impairment of Chinook Salmon Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	LS	None required	—	Levee breaching.	Modeling suggested that levee breaches in certain locations could result in velocity modifications in excess of the sustained swimming speeds of juvenile salmon and outside NMFS criteria of 2 feet per second for stream velocities with longer fish passageways (National Marine Fisheries Service 2001). The analysis suggests that velocity modifications would exceed these criteria only in Hunters Cut.	Assumptions: • Velocity changes would be addressed adaptively through modifications to breached areas. • Final designs will attempt to account for potential adverse hydrologic modifications. This information will be used to modify or maintain levee breaches as needed and support fish passage and access to rearing habitat for delta smelt. **<u>Environmental Commitments</u>:** • **Any adverse effects on special-status fish species, critical habitat, or essential fish habitat (EFH) will be addressed by the project proponent.** • **Any additional measures will be followed in compliance with CESA, ESA, and EFH**	Similar to Impact FISH-3, the conservation measures in the NMFS and USFWS Biological Opinions would be incorporated in implementation of the Tule Red project, including the timing restriction for delta smelt and longfin smelt, which would avoid in-water construction in the winter and spring months when the most sensitive life stages (larvae and early juveniles) of special-status species are likely to be present in Grizzly Bay. In addition, the velocity accelerations expected in the pelagic zone, an area that delta smelt and other fish inhabit, are predicted to be less than the 1 fps design guidance of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-5: Short-Term Impairment of Steelhead Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	LS	None required	–	Levee breaching	Various breach locations were modeled, and changes in velocities only rarely exceeded steelhead capabilities to swim upstream.	Assumptions: • Velocity changes would be addressed adaptively through modifications to breached areas. • Migratory pathways will be maintained.	Same as Impact FISH-4. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-6: Short-Term Impairment of Green Sturgeon Passage and Reduced Availability of Holding and Rearing Habitat Resulting from Changes in Channel Morphology and Hydraulics Attributable to Restoration Activities	LS	None required	—	No description of specific restoration activities, but it appears that the discussion is referring to levee breaching.	Green sturgeon are strong bottom-oriented swimmers; it is unlikely they would be affected by temporary changes in hydraulics.	Assumptions: • Velocity changes would be addressed adaptively through modifications to breached areas. • Migratory pathways will be maintained.	Same as Impact FISH-3. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-7: Short-Term Impairment of Sacramento Splittail Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities	LS	None required	—	No description of specific restoration activities, but the discussion is referring primarily to levee breaching.	Depending on the age and size of the splittail in the restoration areas, young splittail would most likely be excluded from edge habitat if velocities are high and vegetation is absent. However, restoration designs will incorporate vegetation on benches and berms (habitat levees or other intertidal habitat), which would provide some rearing habitat and young splittail may also move to more favorable habitat within the marsh. They are not likely to be affected by temporary changes in velocities.	Assumptions: • Velocity changes would be addressed adaptively through modifications to breached areas. • Migratory pathways will be maintained.	Same as Impact FISH-3. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-8: Short-Term Impairment of Longfin Smelt Passage and Reduced Availability of Rearing Habitat Resulting from Changes in Velocity Attributable to Restoration Activities	LS	None required	—	Levee breaching.	Juveniles and adults may move out into the ocean during the summer and fall months when breaching activities occur. They would probably be unaffected by temporary changes in velocities.	Assumptions: • Velocity changes would be addressed adaptively through modifications to breached areas. • Migratory pathways will be maintained.	Same as Impact FISH-3. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-9: Temporary Reduction of Delta Smelt Habitat Quantity or Quality through Removal and Destruction of Cover Attributable to Restoration Activities	LS	None required	—	Levee reconstruction and breaching.	Levee breaching would affect only small areas, and scouring impacts on aquatic vegetation would be minimal compared to existing and created habitat. If the removal of aquatic vegetation or instream woody material from slough channels is necessary in breach locations, this could temporarily remove cover that is an important component of adult spawning and juvenile rearing habitat. However, the restoration designs would include habitat levees or other intertidal habitat that would provide vegetative cover upon breaching, thus offsetting any losses along the slough channel. Because the restoration activities would occur throughout the marsh and be implemented over 30 years, only minimal changes in delta smelt habitat would occur at any time.	No information incorporated	Similar to the SMP EIS/EIR, levee breaching under the Tule Red project would affect only a small area (50 to 120 feet in length along the natural berm adjacent to Grizzly Bay) when compared to the entire project site and the entire Suisun Marsh. Scouring impacts on aquatic vegetation would be minimal compared to existing and created habitat. As described in Appendix D.2, the proposed project is designed to experience some erosion to achieve natural equilibrium. Furthermore, the restoration design includes a habitat levee and other intertidal habitat (tidal pans) that would provide vegetative cover after breaching. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-10: Temporary Reduction of Chinook Salmon Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Project activities are not expected to reduce cover for juvenile Chinook salmon. Project activities would be outside of the riparian vegetation zone and located in brackish water areas. Juveniles would directly use restoration stages, such as subtidal, low-intertidal, and low-marsh areas. Mid-marsh and high-marsh areas most likely will increase secondary production in the marsh, which would benefit juvenile Chinook salmon. Restoration stages that improve marsh connectivity could be used directly for Chinook salmon migration and emigration. Restoration activities most likely would be located throughout the marsh and implemented over 30 years. As such, only minimal changes in Chinook salmon habitat would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.	No information incorporated	Similar to SMP EIS/EIR, restoration activities would be outside of the riparian vegetation zone and located in brackish water areas of an existing managed wetland. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-11: Temporary Reduction of Steelhead Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Cover is not anticipated to be removed in Suisun or Honker Bays. Tidal marsh restoration activities in smaller sloughs could affect rearing or migration during the period of time juveniles would be migrating downstream. However, any in-channel work will be conducted in the months that adult and juvenile steelhead are not present.	No information incorporated	Similar to the SMP EIS/EIR, cover would not be removed in Suisun or Honker Bays because the project site is not located near those areas. Furthermore, restoration activities would not occur in smaller sloughs adjacent to the existing managed wetland site. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-12: Temporary Reduction of Green Sturgeon Habitat Quantity or Quality as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Restoration actions would not be likely to affect migrating sturgeon. However, resulting changes in habitat conditions could have an impact on habitat attributes because of changes in nutrient inputs and benthic communities. Restoration stages would most likely increase prey production in the marsh, which would increase food availability for sturgeon. Restoration activities would most likely be located throughout the marsh and implemented over 30 years. As such, only minimal changes in green sturgeon habitat would occur at any one time.	No information incorporated	The Tule Red project would be located in low-marsh, low-intertidal, and subtidal marsh areas and therefore may increase food availability for sturgeon. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-13: Temporary Reduction of Sacramento Splittail Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	LS	None required	—	Primarily levee breaching.	Project activities that remove aquatic vegetation could affect splittail spawning and rearing. As the restored area evolves into a functioning tidal marsh, it is expected to provide permanent, sustainable, suitable habitat for splittail. Additionally, restoration activities most likely would be located throughout the marsh and implemented over 30 years. As such, only minimal changes in splittail habitat in the marsh would occur at any one time. Adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and creating a fully functioning tidal marsh.	No information incorporated	Similar to the SMP EIS/EIR, levee breaching under the Tule Red project would affect only small area (50 to 120 feet in length along the natural berm) when compared to the entire project site and the entire Suisun Marsh. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-14: Temporary Reduction of Longfin Smelt Habitat Quantity or Quality through Removal and Destruction of Cover as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Longfin smelt are primarily a pelagic species; therefore, it is unlikely they use cover such as aquatic vegetation or other in-water structures provided by the marsh.	No information incorporated	The Tule Red project would not affect the pelagic zone, which is used primarily by longfin smelt. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-15: Improved Fish Habitat Due to Increased Dissolved Oxygen Concentrations in Tidal Channels Attributable to Restoration Activities	Beneficial	None required	—	No description of specific restoration activities.	Restoration activities that convert managed wetlands to tidal wetlands, especially those in areas with poor circulation or other conditions leading to low levels of DO, will promote increased water circulation and decrease the amount of high-sulfide water discharged from managed wetlands into sloughs.	No information incorporated	The conversation of managed wetlands to tidal wetlands would reduce anthropogenic management and resulting disturbances, which have been linked to low DO and high dissolved organic carbon in Suisun Marsh. Seasonal DO variations in the marsh occur, with most DO depressions occurring in early summer and fall. Measured DO data on the project site indicate that very low DO has been documented in October (fall) and March, April, May (spring). The Tule Red project is not expected to further reduce DO levels from their current low levels because managed wetland activities would cease once the project site is restored. An increase in tidal prism and flushing and reduced residence time is expected to result in increased DO concentrations. In addition, improving the low DO problem from the CDFW drain through installation of a spray aeration structure on the existing outlet pipe and constructing a pooling area is expected to increase DO concentrations. Continued DO monitoring and biochemical oxygen demand sampling would ensure maintained DO concentrations downstream (Appendix C). The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-16: Salinity-Related Reduction of Delta Smelt Survival, Growth, Movement, or Reproduction Attributable to Restoration Activities	LS	None required	—	No description of specific restoration activities but includes levee breaching.	• The magnitude of the salinity effects would depend on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands. • Restoration with tidal connection to Suisun Bay or Honker Bay may have the largest salinity effects. The effects would be greatest during periods of low delta outflow when Suisun Bay salinity is highest and the salinity gradient within Suisun Bay and along Montezuma Slough is strongest. • Changes in salinity as a result of levee breaching could affect special-status fish species, but preliminary modeling results suggest that most salinity changes as a result of project activities would be well within the environmental tolerance for delta smelt. • Salinity changes in the existing marsh sloughs would depend on the additional tidal restoration upstream and downstream from the stations as well as the location within the marsh. • There is some potential for small-scale hydrologic modifications that could produce a microcline of low salinity, especially where activities isolate freshwater inputs. These modifications would create habitats and habitat types suitable for delta smelt spawning. However, the potential also exists for those lower salinity zones to attract delta smelt but not be suitable for spawning because of structural, predator, or other issues.	Assumptions: • Seasonal magnitude of salinity in the marsh would continue to be governed primarily by delta outflow and operation of the SMSCG. • Restoration areas will be modeled to determine the appropriate breach sizes and locations. Salinity changes will be addressed adaptively through modifications to breached areas. Final designs will attempt to account for potential adverse hydrologic modifications. **<u>Environmental Commitments</u>:** • **Any adverse effects on special-status fish species, critical habitat, or EFH will be addressed by the project proponent.** • **Any additional measures will be followed in compliance with CESA, ESA, and EFH**	The Tule Red project is not located in Suisun Bay or Honker Bay. The Tule Red project was modeled using the RMA Bay-Delta Model (the same model used in the SMP EIS/EIR). The difference between the baseline and the simulated project condition results in the 2002–2003 period being very small when compared to baseline conditions. Maximum differences depend on the location simulated but range between -1.0% and +0.7% (Appendix D.1). Given the very small maximum differences between the simulated baseline conditions and project conditions at the different modeled locations, salinity-related reduction of delta smelt survival, growth, movement, or reproduction is not anticipated. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-17: Salinity-Related Reduction of Chinook Salmon Survival, Growth, or Movement as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities but includes levee breaching.	There is little or no risk of adverse impacts attributable to water quality or salinity changes associated with restoration activities because of the seasonal timing of the breach and preliminary modeling and design of breach sites.	No information incorporated	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-18: Salinity-Related Reduction of Steelhead Survival, Growth, or Movement as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Because substantial changes in salinity are not expected, and because so few steelhead have been caught in Suisun Marsh, it is unlikely they would be affected by salinity changes. If steelhead were to encounter water quality changes due to restoration activities, it is unlikely they would be affected because they have a large tolerance to salinity changes.	No information incorporated	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-19: Salinity-Related Reduction of Green Sturgeon Survival, Growth, or Movement as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	The salinity tolerance range of green sturgeon is sufficiently large, and their residence in the plan area is sufficiently short. There is little or no risk to green sturgeon associated with restoration activities.	Per Chapter 2 of the SMP EIS/EIR description of restoration, restoration areas will be modeled to determine the appropriate breach sizes and locations. Salinity changes will be addressed adaptively through modifications of breached areas. Final designs will attempt to account for potential adverse hydrologic modifications.	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-20: Salinity-Related Reduction of Sacramento Splittail Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	There is some risk that restoration actions would generate high-salinity zones outside of the tolerances of Sacramento splittail; however, preliminary modeling suggests that this is unlikely.	Per Chapter 2 of the SMP EIS/EIR description of restoration, prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	FISH-21: Salinity-Related Reduction of Longfin Smelt Survival, Growth, Movement, or Reproduction as a Result of Restoration Activities	LS	None required	—	No description of specific restoration activities.	Longfin smelt typically do not use the plan area to spawn, and none of the modeled scenarios results in an increase of salinity greater than 15 parts per thousand. Therefore, there is little or no risk that this taxon would be affected by salinity changes attributable to restoration activities.	Per Chapter 2 of the SMP EIS/EIR description of restoration, prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-22: Disturbance, Injury, or Mortality of Individual Fish Resulting from Work Adjacent to Bodies of Water	LS	None required	—	• Removal and disturbance of aquatic vegetation • Creation and/or modification of exterior levees • Breaching of levees • Movement of construction equipment and personnel • Temporary lighting • Grading, • Construction of access roads and staging areas	The effect of disturbance on fish depends on the sensitivity of the species' life stage and the duration and frequency of disturbance. Disturbance may reduce feeding, interfere with reproduction, and cause movement from habitat. Movement could result in mortality attributable to predation. Long-term disturbance over a substantial proportion of a species' habitat may reduce species population abundance, distribution, and production.	**Environmental Commitments and BMPs**: • **Construction Related Restrictions: In-water activities will be conducted between August and November** • **Instream work will focus on high temperature periods (i.e., August 1 through November 30) when most special-status fish species are absent from the shallow-water habitat in the plan area (BMP)** • **Any adverse effects on special-status species, critical habitat, or EFH attributable to construction activities may require implementation of additional avoidance or MMs. NMFS, USFWS, and CDFW will be consulted, and additional avoidance and MMs may be implemented on a site-specific basis.** • **Worker training** • **Standard design features and construction practices** • **Access point/staging areas** • **Erosion and Sediment Control Plan** • **SWPPP** • **HMMP**	Same as Impact FISH-1 with respect to the HMMP and SWPPP. Same as FISH-3 with respect to the NMFS Programmatic Biological Opinion and USFWS Programmatic Biological Opinion. The Tule Red Restoration Project would implement the ECs and BMPs identified in the SMP EIS/EIR for this impact. For the Access Point/Staging Areas EC,[9] the staging areas will also be identified in construction drawings. For the Standard Design Features and Construction Practices EC,[10] the following revision will be made: "*Minimizing degradation of wetland habitats where feasible* ***by minimizing the disturbance footprint***" Given that this EC identified, where feasible, and the fact that impacts to wetland habitat would be less than significant (Impact VEG-3), the change to the EC would not result in a change to the impact determination. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

[9] Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in which case the maximum setback possible will be used. If an off-road site is chosen, qualified biological and cultural resources personnel will survey the selected site to verify that no sensitive resources would be disturbed by staging activities. If sensitive resources are found, an appropriate buffer zone will be staked and flagged to avoid impacts. If impacts on sensitive resources cannot be avoided, the site will not be used. An alternate site will be selected.

[10] Minimizing degradation of wetland habitats where feasible, i.e., work will be conducted from levee crown.

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	FISH-23: Change in Fish Species Composition Attributable to Changes in Salinity or Water Quality from Managed or Natural Wetland Modifications	LS	None required	—	No description of specific restoration activities.	Habitat modification as a result of restoration activities could have a negative impact on species composition because of changing water quality conditions. However, preliminary modeling suggests that the resulting salinity conditions would be within the normal range for the plan area, and previously published literature suggests that the habitat types created as a result of restoration activities would be suitable for and beneficial to sensitive fish species resident in Suisun Marsh.	Per Chapter 2 of the SMP EIS/EIR description of restoration, prior to implementation, preliminary modeling and design of the potential breach areas will be done to assess effects on hydrologic conditions.	Same as Impact FISH-16. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	FISH-24: Change in Benthic Macroinvertebrate Composition Attributable to Changes in Channel Morphology and Hydraulics as a Result of Tidal Restoration	LS	None required	—	No description of specific restoration activities.	Benthic invertebrate composition could change if channel morphology and hydraulics change as a result of restoration. Higher velocities could occur at certain places in the channel, and if that occurs, the habitat could attract and retain a modified benthic macroinvertebrate community. However, preliminary modeling suggests that the project actions would result in minimal long-term hydrologic modifications.	Per the conceptual model for the SMP, an appropriate level of benthic monitoring or a benthic community evaluation will be conducted and associated with the final site-specific breach design and anticipated influence on existing slough channel modifications from the tidal restoration actions, as needed. This monitoring or evaluation will be implemented to determine effects from tidal restoration activities on the macroinvertebrate community and to ensure that impacts do not exceed the thresholds identified above.	The benthic monitoring is actually part of conceptual model for the marsh and is one of the topics that needs further investigation as part of adaptively managing the restoration projects that occur in the marsh. Tule Red would not incorporate a benthic monitoring component but would monitor various other aspects through adaptive management and provide AMAT, FAST, and other interested parties information regarding restoration progress and meeting the goals and objectives of the project. Impacts would be less than significant.
	FISH-25: Change in Primary Productivity as a Result of Tidal Restoration	Beneficial	—	—	No description of specific restoration activities.	Project activities would benefit the actual or available primary productivity of the plan area as a whole by increasing nutrient exchange and nutrient turnover rates. Nutrient levels would increase in an area where water quality is improved. In theory, primary production would increase, and zooplankton would respond, assuming the system is bottom-up controlled.	No information incorporated	The proposed project is designed to benefit fish species by producing food resources (e.g., detritus, phytoplankton, invertebrates) (ESA 2015). As such, it is expected to increase food production. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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b.) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by CDFW or USFWS. e.) Conflict with local policies or ordinances protecting biological resources such as a tree preservation policy or ordinance.	VEG-1: Short-Term Loss or Degradation of Tidal Wetlands and Tidal Perennial Aquatic Communities in Slough Channels Downstream of Restoration Sites as a Result of Increased Scour	LS	None required	—	• Levee breaching • Lowering existing levees	Temporary increased scour could occur as a result of greater flows near breach sites and, as a result, existing tidal wetlands in the vicinity of the affected levee sections may be affected (e.g., temporary conversion of a small amount of tidal wetlands to tidal perennial aquatic habitat). Furthermore, existing tidal perennial aquatic habitat may be degraded because of increased scour. However, tidal wetland restoration sites would more than offset any temporary loss or degradation of tidal wetland habitat or tidal perennial aquatic habitat.	Breach locations would be chosen to minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes.	The breach location for the Tule Red project was selected to meet the biological goals and objectives of restoring the project site while ensuring tidal velocities, scour, and erosion do not adversely affect off-site areas. The Tule Red project is not expected to increase scour downstream. Modeling results predict that, in Grizzly Bay (modeled at approximately 1,500 feet out into the bay from the site), velocities are only 0.2 fps. The 0.2 fps velocity is consistent with existing-condition velocities, indicating the local impacts on velocity do not extend out this far. The results of the numerical modeling and observations of other tidal marsh sites around Suisun and San Pablo Bay do not indicate that a scour hole is likely to form at the entrance to project site. The invert of the tidal channel across the mud flat is typically higher than inside the marsh itself. As the flow moves out of the marsh and onto the mud flat, it is less laterally confined, reducing the unit discharge, velocity, and, therefore, applied hydraulic shear stress. This reduces the likelihood of a deeper scour hole forming. Surveys from the Sonoma Wetlands project show typical channel depths across the mud flat of a few feet. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	VEG-2: Loss or Degradation of Tidal Wetlands Adjacent to Restoration Sites as a Result of Levee Breaching/ Grading	LS	None required	—	• Levee breaching • Lowering existing levees	Existing tidal wetlands in the vicinity of the affected levee sections may be lost because of construction-related activities. Although a relatively small amount of tidal wetlands may be lost or degraded during levee breaching, the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be affected.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. A relatively small amount of tidal wetlands may be lost or degraded during levee breaching (between 50 and 120 linear feet); the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be affected (a gain of 334 acres, for a total of 454 acres of tidal wetlands). No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
	VEG-3: Loss of Managed Wetlands as a Result of Tidal Wetland Restoration	LS	None required	—	• Levee breaching • Lowering existing levees • Construction of habitat levees, benches, and other features	There would be an overall decrease in the quantity of managed wetlands (5,000–7,000 acres) in Suisun Marsh. The construction of habitat levees or other levees may result in fill of managed wetlands, but this would not result in a loss of jurisdictional wetlands because the managed wetlands would be converted to tidal wetlands and associated open water habitat and include the removal of some exterior levees. The construction of habitat levees, benches, and other features would provide some of the functions and values as the managed wetlands. The tidal wetlands would provide habitat and food sources that benefit tidal wetland-dependent species and many, but not all, managed wetland–dependent species.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Although project implementation would result in temporary disturbance of wetlands due to construction and a net loss of up to 10 acres of waters of the United States, the overall structure and function of the tidal wetland ecosystem, including tidal exchange and foodweb production, is determined to substantially increased in both quantity and quality (ESA 2015). As such, the restoration design of the proposed project meets the SMP EIS/EIR intent of including habitat levees, benches, and other features that would provide some of the functions and values as the managed wetlands. As the tidal wetlands become established, they would increase a variety of wetland functions and values. Overall, there would continue to be approximately 52,000 acres of managed wetlands in Suisun Marsh and approximately 28,294 acres in Region 4 (where the project site is located), which would provide the type of function and value associated with managed wetlands. Therefore, considering the function and value the tidal wetlands would provide, as well as the number of acres converted in Region 4 (approximately 1%), impacts on managed wetlands would be less than significant.

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	VEG-4: Loss of Upland Plant Communities and Associated Seasonal Wetland Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	• Levee breaching • Lowering existing levees	Levee breaching or the lowering of existing levees may disturb upland plant communities that occur on the interior levee surfaces or on natural or altered land surfaces protected by the levees. Natural seasonal wetlands may occur in the upland communities or adjacent to the marsh.	Upland areas and associated natural seasonal wetland habitat would be protected. This includes the selection of breach sizes and locations in consideration of habitats that would be affected.	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. As documented in Appendix E, *Special-Status Plant Species Surveys*, of this document and Figure 3-1, the current site of the breach is composed of primarily non-upland plant communities (i.e., tule). No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	VEG-5: Spread of Noxious Weeds as a Result of Restoration Construction	LS	None required	—	No description of specific restoration activities.	Soil-disturbing activities during construction could promote the introduction of plant species that currently are not found in the project area, including exotic pest plant species.	Proposed restoration sites would be managed to promote tidal wetland vegetation so that when inundation occurs, there would be minimal potential to support nonnative species. **Environmental Commitments: Non-Native Plant Control, including:** • **Use certified weed-free imported erosion control materials (or rice straw in upland areas)** • **Coordinate with county agricultural commissioner and land management agencies to ensure that appropriate BMPs are implemented** • **Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds** • **Clean equipment at designated wash stations after leaving noxious weed infestation areas** • **Treat isolated infestations of noxious weeds identified in the project area with approved eradication methods at an appropriate time to prevent further formations of seeds, and destroy viable plant parts and seed** • **Minimize surface disturbance to the greatest extent possible** • **Use certified weed-free native mixes for any necessary restoration planting or seeding, as provided in the revegetation plan developed in cooperation with CDFW. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.** • **Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Currently, there are known invasive species at the project site, including phragmites (*Phragmites australis)*, which is controlled on the project site during the summer management period by herbicide application during flowering. Many of the occurrences of phragmites are on the natural berm adjacent to Grizzly Bay, which cannot be removed without undermining the structural integrity of the berm. This would compromise the design and objectives of the proposed project. Although phragmites is an invasive species that is known for capitalizing on disturbances and the proposed project does include grading and disturbing approximately 150 acres, the proposed project would include multiple ECs, as described under Nonnative Plant Control in Table 1 of Appendix B, *Tule Red Tidal Restoration Environmental Commitments and Mitigation Measures*, of this document, to avoid introducing invasive nonnative species and substantially improving conditions for invasive species. These environmental commitments are the same as Appendix F, *Mitigation Monitoring and Reporting Program*, of the SMP EIS/EIR, with the one exception of including the option of using a naturalized seed mix, instead of using certified weed-free native mixes for any restoration planting as provided in the revegetation plan developed in cooperation with CDFW. Furthermore, the velocities expected during the initial breach and as the project site reaches equilibrium are not velocities that would lead to tidal muting. Therefore, the breach is not expected to increase the spread of invasive plant species. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	VEG-6: Loss of Special-Status Plants or Suitable Habitat as Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities, other than reference to “construction activities” and levee breaching.	Construction activities associated with tidal wetland restoration and scour adjacent to levee breaches could affect populations of soft bird’s beak, Suisun thistle, Mason’s lilaeopsis, delta tule pea, delta mudwort, and Suisun Marsh aster. Any potential impacts on suitable special-status plant species habitat from temporary tidal restoration actions would be more than offset by the range of marsh elevations and associated habitats that would be created and restored by the tidal restoration actions, resulting in more suitable habitat for all special-status plant species and contributing to the recovery of these species.	Breach size and location would be selected to minimize effects of scour on special-status species. **<u>Environmental Commitments</u>:** • **If initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species’ habitat.** • **General Best Management Practices** • **Worker Training** • **Special- Status Plant Species Protection** • **Biological monitoring**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. There are no known special-status plant species within the project site (Appendix E). In addition, the project site would be managed as a managed wetland prior to grading for restoration purposes. Managed wetland activities include disking and other vegetation control measures that greatly reduce the likelihood of special-status plant species inhabiting the project site. Furthermore, the project site would be flooded prior to breaching (Phase 2) the existing natural berm, which would discourage special-status species from colonizing the project site. The proposed project would incorporate the ECs regarding special-status plants prior to construction with the exception of the sole use of handheld tools, the use of exclusion fencing, and the removal of woody vegetation by trimming vegetation to approximately 1 foot above ground level. The ECs, as described in Appendix B, would to verify the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. The extent of mitigation of direct loss of or indirect impacts on special-status plants would be based on these survey results. If found, the locations of special-status plants in proposed construction areas will be recorded using a global positioning system (GPS) unit and flagged. Any special-status plant species observed during surveys will be reported to the USFWS and CDFW so the observations can be added to the California Natural Diversity Database (CNDDB). No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	VEG-7: Degradation of Native Plant Species and Spread of Invasive Plant Species as a Result of Increased Public Access	LS	None required	—	No description of specific restoration activities.	Increased public access could result in increased pedestrian traffic in the vicinity of sensitive habitat or special-status plant populations.	**Environmental Commitment:** • **Access may be restricted around restoration sites where necessary to protect special-status plant populations though appropriate management plans and the design of the tidal marsh restoration. This may include signage, buffers, seasonal restrictions, and design or no access, depending on the sensitive species in question.** • **Biological Resources Best Management Practices - General Best Management Practices**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Similar to Impact VEG-6, there are no known special-status plant species within the project site. The project site would not be available to public access during the initial restoration of the project site (Phase I, Phase II, and immediately thereafter). In the future, the project site would be turned over to CDFW to manage; CDFW management plans would govern the ability of the public to access the site. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
	VEG-8: Loss or Degradation of Tidal Native Plant Species and Spread of Invasive Plant Species as a Result of Tidal Muting	LS	None required	—	• Levee breaching • Lowering existing levees	Tidal muting due to levee breaching could result in a temporary reduction in the tidal water surface elevation range.	Breach locations would be chosen to minimize temporary upstream tidal muting.	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The northern breach location of the proposed project, which was selected to reduce impacts, helps to minimize temporary upstream tidal muting. As described in Impact FISH-3 and Impact WTR-2, the velocities expected during the initial breach and as the site reaches equilibrium are not velocities that would lead to tidal muting. The breach has been designed to ensure that tidal flows remain below 3 fps to prevent tidal muting or scouring. Therefore, the breach is not expected to cause degradation of existing tidal native plant species and the spread of invasive plant species. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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a.) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations by CDFW or USFWS. d.) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impeded the use of native wildlife nursery sites?	WILD-1: Loss or Disturbance of Salt Marsh Harvest Mouse Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities, other than reference to “construction of habitat levees that include benches or berms.”	Conversion of habitat in managed wetlands to tidal wetlands would result in a temporary reduction in SMHM habitat. However, restored areas would be expected to provide permanent suitable and sustainable habitat. Habitat levees would provide habitat for the salt mouse harvest mouse as the remainder of the tidal wetland areas become established. Additionally, restoration activities would most likely be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame.	**Environmental Commitments:** • **Biological Resources Best Management Practices - General Best Management Practices** • **Worker Training** • **Special-Status Wildlife Species Protection (Mammals)—measures specific to SMHM** • **Biological Monitoring** Project proponents of restoration can propose alternative measures for protecting sensitive species through project-level formal or informal consultations. Conservation Measures (CMs) of the USFWS Programmatic Biological Opinion 1. A USFWS-approved biologist, with previous SMHM monitoring and surveying experience, will conduct preconstruction surveys for the mouse prior to project initiation. If an SMHM is discovered, construction activities will cease in the immediate vicinity of the individual until USFWS is contacted and the individual has been allowed to leave the construction area. 2. Disturbance to wetland vegetation will be avoided to the extent feasible in order to reduce potential impacts on SMHM. If wetland plants cannot be avoided, it will be removed by hand (and/or by another USFWS- and CDFW-approved method). The USFWS-approved biologist will be on-site to monitor all wetland vegetation removal activities. 3. The upper 6 inches of soil excavated within SMHM habitat will be stockpiled separately and replaced on top of the backfilled material. 4. Vegetation will be removed using hand tools (and/or by another USFWS- and CDFW approved method). 5. Vegetation must be cleared to bare ground. 6. Vegetation should be removed from all areas (driving roads, action area, or anywhere else where vegetation could be stepped on).	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The proposed project would minimize SMHM habitat within the footprint of construction while preserving large undisturbed areas of vegetation for SMHM refuge. The proposed project would disturb only 150 acres within the project site, compared to the typical disturbance of 175 acres under managed wetland conditions. The management activities prior to flood-up include vegetation control through disking. This would greatly reduce the likelihood of harvest mouse habitat existing on the project site. Per the SMP EIS/EIR, project proponents have consulted with USFWS/CDFW to provide alternative measures for protecting SMHM, consistent with the intent of the measures identified in the USFWS Programmatic Biological Opinion. As such, the following would occur: • Approval of another vegetation removal method (i.e., equivalent measure) for CM2 and CM4 has been requested and would be implemented. This method would not include hand grubbing. • CM3 would not be implemented because it is not applicable, given the project site would undergo standard managed wetland activities that would involve disking. • CM7 would not be implemented because it is not applicable; work within the project site would be done prior to breaching. Thus, the project site would not experience extreme high tides. • Installation of temporary exclusion fencing (as identified under CMs 8 and 9) would not be required because of prior earthwork for the Tule Red Restoration Project; wetland vegetation would be removed using a method approved by USFWS, thereby eliminating

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							7. Work will be scheduled to avoid extreme high tides when there is potential for SMHM to move to higher, drier grounds. All equipment will be staged on existing roadways away from the project site when not in use. 8. To prevent SMHM from moving through the project site during construction, temporary exclusion fencing will be placed around a defined work area before construction activities start and immediately after vegetation removal. The fence should be made of a material that does not allow SMHM to pass through or over, and the bottom should be buried to a depth of 2 inches so that mice cannot crawl under the fence. Any supports for the SMHM exclusion fencing must be placed on the inside of the project area. 9. Prior to the start of daily construction activities during initial ground disturbance, the USFWS-approved biologist will inspect the SMHM-proof boundary fence to ensure that it has no holes or rips and the base is still buried. The fenced area also will be inspected to ensure that no mice are trapped in it. Any mice found along and outside the fence will be closely monitored until they move away from the construction area. 10. If an SMHM is discovered, construction activities will cease in the immediate vicinity of the individual until USFWS is contacted and the individual has been allowed to leave the construction area. 11. A USFWS-approved biologist with previous SMHM experience will be on-site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The USFWS-approved biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the USFWS-approved biologist has requested work stoppage because of take of any of the listed species, USFWS and CDFW will be notified within 1 day by email or telephone.	SMHM refugia and the need for exclusion fencing prior to earthwork. Following vegetation removal, the area would be flooded to prevent reestablishment of vegetation. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	WILD-2: Loss or Disturbance of California Clapper Rail Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	Figure 15 of the SMP EIS/EIR identifies levees affected by California clapper rail restrictions. Restoration activities in tidal wetlands and tidal sloughs in Suisun Marsh could disrupt clapper rail breeding and foraging habitat. There could be a minor, temporary loss of foraging habitat as a result of construction-related activities throughout the marsh. Increased scour and tidal muting that could occur as a result of restoration could result in the temporary loss of California clapper rail foraging habitat. Conversion of managed wetlands to tidal wetlands would result in increased clapper rail breeding and foraging habitat. It is expected that suitable adjacent areas would continue to provide habitat for clapper between breaching the levee and the establishment of a fully functioning tidal wetland. Additionally, restoration activities would most likely be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame.	Project Design Features: • Breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible. **Environmental Commitments: Protection of Special Status Species - Birds and California clapper rail, including:** • **Construction activity, including vegetation clearing, would be limited to months outside the breeding season.** • **If construction activities are necessary during the breeding season, preconstruction surveys of suitable nesting habitat in and adjacent to the construction areas would be performed to identify the general location of clapper rail nest sites in the project area. Nesting habitat areas will be flagged for avoidance if construction activities would occur during the nesting season. Disturbance in these areas will be avoided until after the nesting season.** • **Staging areas would be sited at least 100 feet from water bodies.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Appendix E of this document summarizes known information about California clapper rail presence on the Tule Red project site. The project site is located in Region 4 of Suisun Marsh and outside of the SMP EIS/EIR Figure 15 California clapper rail restrictions. Clapper rails are historically restricted to the western regions of the marsh, which are more saline and provide higher tidal wetland zones. Since 2010, the project site has been actively managed. There have been no direct tidal circulations and no network of tidal sloughs (characteristics needed to support clapper rails). In addition, during that time, there have been no observations of clapper rails. Given this, there is a very low likelihood of California clapper rail presence on the project site. However, as identified by the SMP EIS/EIR and Appendix B of this document, if construction activities are necessary during the breeding season, preconstruction surveys for California clapper rail will be conducted by a USFWS-approved biologist at and adjacent to areas of potential tidal and managed wetlands habitat for California clapper rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	WILD-3: Loss or Disturbance of California Black Rail Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities	Construction-related activities, the inundation of suitable habitat in managed wetlands, and the impacts of increased scour and tidal muting could result in the temporary loss of black rail breeding and foraging habitat. Additionally, restoration activities would most likely be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame.	Same ECs as listed for clapper rail in Impact WILD-2.	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Similar to Impact WILD-2, Appendix E of this document summarizes known information about California black rail presence on the project site. However, as identified by the SMP EIS/EIR and Appendix B of this document, if construction activities are necessary during the breeding season, preconstruction surveys for California black rail will be conducted by a USFWS-approved biologist at and adjacent to areas of potential tidal and managed wetlands habitat for California black rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
	WILD-4: Loss or Disturbance of Suisun Shrew Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities, other than reference to "construction of habitat levees that include benches or berms."	Construction-related activities, the inundation of suitable habitat in managed marshes, and the impacts of increased scour and tidal muting could result in the temporary loss of Suisun shrew breeding and foraging habitats. As the restored area evolves into a functioning vegetated tidal wetland, it is expected to provide permanent suitable and sustainable habitat for Suisun shrew. Habitat levees would provide opportunities for the establishment of high marsh/upland transition habitat. Temporary losses of suitable habitat would be offset by restoration of tidal wetlands.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The proposed project would minimize Suisun shrew habitat within the footprint of construction while preserving large undisturbed areas of vegetation for Suisun shrew refuge. The proposed project would disturb only 150 acres within the project site, compared to the typical disturbance of 175 acres under managed wetland conditions. The management activities prior to flood-up include vegetation control through disking. This would greatly reduce the likelihood of Suisun shrew breeding and foraging habitats to exist on the project site. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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	WILD-5: Loss or Disturbance of California Least Tern Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	Breeding season impacts will be avoided and temporary losses of suitable habitat offset by the restoration of tidal wetlands.	**<u>Environmental Commitments</u>:** **Protection of Special Status Species - Birds and Least terns, including** • **No activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys).**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Similar to Impact WILD-2, Appendix E contains information about the known presence of the California least turn on the project site. Least turns are typically nest in shallow scrapes in sand or fine substrate gravel with sparse vegetation near open water. There are no sandy areas or areas with fine gravel substrate on the project site, and the active management of the site would discourage least turn from using it. However, as identified by the SMP EIS/EIR and Appendix B of this document, no activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys). No additional ECs or MMs are needed for Tule Red.
	WILD-6: Loss of Suisun Song Sparrow and Salt Marsh Common Yellowthroat Suitable Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	Restoration activities in tidal and managed wetlands could disrupt breeding habitat and foraging habitat in tidal wetlands. Breeding season impacts will be avoided and temporary losses of suitable habitat offset by the restoration of tidal wetlands.	**<u>Environmental Commitments</u>:** **Protection of Special Status Species – Birds, including:** • **Preconstruction surveys to identify nest sites.** • **Construction-related activities would be limited to months outside of breeding season in the vicinity of active nests.** • **Sensitive resources, such as nests, would be flagged and avoided.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The Tule Red project will incorporate all the ECs noted here and as described Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red.

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	WILD-7: Loss or Disturbance of Raptor Nest Sites or Foraging Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	A temporary reduction in foraging habitat could occur for those species that forage in managed wetlands. However, restoration activities would most likely be located throughout the marsh and implemented over the 30-year plan period rather than concentrated in a small geographic area or time frame. It is expected that suitable adjacent areas would continue to provide habitat for raptors between breaching the levee and the establishment of a fully functioning tidal wetland. Breeding season impacts will be avoided and temporary losses of suitable habitat offset by the restoration of tidal wetlands.	**<u>Environmental Commitments</u>: Protection of Special Status Species - Birds and Raptors, including:** • **Preconstruction surveys to identify nest sites.** • **Construction-related activities would be limited to months outside of breeding season in the vicinity of active nests.** • **All woody and herbaceous vegetation would be removed from the construction areas during the nonbreeding season (September 1–February 1) to minimize effects on nesting birds.** • **Any sensitive resources, such as nests, would be flagged and avoided.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. Conditions on the project site are such that raptors are highly unlikely to use the site for nesting (i.e., no trees). However, some raptors, such as the short-eared owl and the northern harrier, are ground nesters. Therefore, the Tule Red project will incorporate all the ECs noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red.
	WILD-8: Loss or Disturbance of Western Pond Turtle as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	The conversion of suitable habitat in managed wetlands to tidal wetlands would result in the permanent or temporary loss of breeding habitat for western pond turtles. Most impacts on pond turtles will be avoided and permanent or temporary loss of suitable habitat offset by the restoration of tidal wetlands and enhancement of managed wetlands	**<u>Environmental Commitments</u>: Western Pond Turtle, including:** • **Preconstruction surveys will be performed in all managed wetlands and adjacent sloughs that provide suitable habitat. If pond turtles are identified, the area will be surveyed for nesting sites if construction activities would occur during the nesting season.** • **If pond turtles are identified in managed wetlands to be breached, the ponds and associated drainages will be dewatered, and to the extent feasible, any turtles observed will be captured and released to other suitable locations within a nearby managed wetland or drainage.** • **Breaching of levees in occupied breeding habitat would occur outside of the breeding months of April to July.** • **Breach sites and other restoration features would be designed to avoid sensitive habitats to the extent possible.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The Tule Red Restoration Project would incorporate all the ECs noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red.

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	WILD-9: Loss or Disturbance of Tricolored Blackbird as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	Conversion of suitable habitat in managed wetlands to tidal wetlands may result in a permanent or temporary reduction in suitable habitat. Impacts on tricolored blackbirds will be minimized and any loss of suitable habitat compensated for by the enhancement of managed wetlands.	**<u>Environmental Commitments</u>: Protection of Special Status Species – Birds, including:** • **Preconstruction surveys to identify nest sites in project area.** • **Construction activity in the vicinity of active nests would be limited to months outside the breeding season** • **Any sensitive resources, such as nesting colonies, would be flagged and avoided.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The Tule Red Restoration Project would incorporate all the ECs noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red.
	WILD-10: Effects on Southern Resident Killer Whales as a Result of Changes in Salmon Populations	NI	None required	—	No description of specific restoration activities.	Restoration could have an effect on salmonid populations, which would indirectly affect southern resident killer whales. If Chinook salmon populations are negatively affected, a reduction in prey availability for the southern resident killer whales could occur. Reductions in prey availability may force the whales to travel longer distances to find prey or select lesser-quality prey, resulting in reduced reproductive rates and higher mortality. However, tidal wetland restoration is expected to increase rearing habitat for juvenile Chinook salmon in Suisun Marsh. Tidal wetlands are more productive and would allow better growth and survival of Chinook salmon. The portion of the killer whale prey base that comes from Suisun Marsh is small compared to Pacific Northwest and Central Valley streams.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red.

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	WILD-11: Loss or Disturbance of Waterfowl and Shorebird Habitat as a Result of Tidal Wetland Restoration	LS	None required	—	No description of specific restoration activities.	Enhancement activities would offset this loss by improving remaining managed wetlands and therefore improving habitats that support waterfowl and shorebirds. Most of the diving ducks in the marsh will benefit during the tidal marsh establishment period and will continue to use deeper areas of wetlands and channels as the tidal wetlands become established. Additionally, as tidal wetlands are established, shorebirds are expected to benefit as a result of more natural habitat developed through restoration activities	**Environmental Commitments: Special Status Species – Birds, including:** • **Preconstruction surveys would be performed to identify nest sites in the project area** • **Construction activity in the vicinity of active nests would be limited to months outside the breeding season.** • **Any sensitive resources, such as nests, would be flagged and avoided.**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. The Tule Red Restoration Project would incorporate all the ECs noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. No additional ECs or MMs are needed for Tule Red.
e.) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance. f.) Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local regional, or state habitat conservation plan.	LU-3	See LU-3, below.	See LU-3, below.	See LU-3, below.	Impact LU-3 under Land Use addresses these two Appendix G thresholds.	See Impact LU-3.	See Impact LU-3.	See Impact LU-3.

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GREENHOUSE GASES (CLIMATE CHANGE) [1]								
a.) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment	CC-1: Construction-Related Changes in Greenhouse Gas Emissions	LS	None required	—	Construction activities related to both tidal restoration <u>and</u> managed wetland activities.	Construction activities would result in temporary increased emissions over the 30-year implementation period. These activities would occur intermittently over time, and generation of substantial GHG emissions is not expected during construction. Approximately 276.3 tons of CO_2 per year would be generated from restoration activities alone. Construction emissions would most likely be offset though changes in net GHG sources and sinks.	No information incorporated	The SMP EIS/EIR estimated that approximately 276.3 tons of CO_2 per year would be generated from restoration activities alone; however, this estimation was generated using the outdated URBEMIS emissions model. Based on emissions modeling using the current CalEEMod emissions model, which generally has higher GHG emission factors than the URBEMIS emissions model, CO_2e MT/yr emissions generated by the proposed project are expected to range from 429 MT/yr to 517 MT/yr for Phase 1 Scenarios A through C and approximately 63 MT/yr for Phase 2. As identified in the SMP EIS/EIR, construction emissions would be offset though changes in net GHG sources and sinks because the Tule Red project site is a tidal restoration habitat project and would become a sink for CO_2. In addition, the CO_2 emissions currently generated every year under the managed wetland activities would no longer occur (estimated with URBEMIS at 322 MT/yr), further reducing CO_2e emissions associated with the proposed project. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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a.) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment b. Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of a greenhouse gas.	CC-2: Permanent Changes in Greenhouse Gas Sources and Sinks	Beneficial	None required	—	Construction activities related to both tidal restoration <u>and</u> managed wetland activities.	• Improved recreational access may result in a slight increase in the number of users and the associated vehicle use, but it is not expected that this increase would result in a substantial increase in permanent or short-term GHG emissions. • Implementation of the proposed project could increase or decrease net GHG emissions related to the Suisun wetlands, depending on the specific location of the restored wetlands (i.e., west versus east). o Carbon benefits from sequestration in a brackish wetland may exceed emissions from methane production. As such, implementation of the plan alternatives in the western portion of the Suisun wetlands could result in a net decrease in GHG emissions o Carbon benefits from sequestration in a freshwater wetland may be overwhelmed by methane production. Thus, implementation of the plan alternatives in the eastern portion of the Suisun wetlands could result in a net increase in GHG emissions. • Implementation of SMP alternatives could result in a large reduction in CO_2 emissions if peat soil oxidation is taken into account. • One-time construction emissions (all construction activities under SMP) would be offset within approximately 6 to 9 years.	No information incorporated	Same as Impact CC-1. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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None.	CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated With Sea Level Rise	—	—	—	No description of specific restoration activities.	• Restoration of wetland function would decrease the risk of shoreline flooding in the Suisun Bay area. Suisun Marsh habitat/ecosystem health would not be adversely affected by climate change–induced sea level rise within the 30-year planning horizon because: • Although the marsh is susceptible to inundation due to 100-year storm events, because of the proposed levee improvements and the ability of the tidally restored wetlands to accrete sediment and eventually support vegetated tidal marsh, the marsh would most likely not become consistently inundated. • Gradually sloping wetland/upland transition zone surfaces would provide an elevation gradient over which tidal wetland could shift upslope when floodwaters rise. Beyond 30-year planning horizon, sea level rise associated with climate change could overwhelm levees and result in marsh inundation. Marsh inundation would result in erosion/loss of wetland habitat, altered species composition, changing freshwater inflow and salinity, an altered foodweb, and impaired water quality.	Assumptions: • For at least 30 years, the improved levees would hold under the water force associated with predicted sea level rise. • Restoration impacts were not analyzed separately from managed wetland activities; rather, it was just an analysis on all "construction activities."	Similar to the SMP EIS/EIR impact analysis, the proposed project is expected to regularly accrete sediment on the existing natural exterior berm (as it has been doing for several decades), which would reduce the likelihood of continual inundation associated with sea level rise (see Table 5.1 in Appendix D.2). Grizzly Bay has a high suspended sediment load; the adjacency of the project site and the direct connection to the bay are ideal for accommodating sea level rise. The existing elevations of the managed marsh (between 3 and 5.5 feet NAVD88) are ideal for capturing sediment deposited from the adjacent Grizzly Bay once the channels and breach to the bay have opened the site up to tidal influence. Sediment deposition at the edge of the bay has led to advancement of the shoreline at a current rate of 6 to 10 feet per year; modeling by NHC indicates sediment will deposit on the marsh plain at rates that exceed sea level rise (Appendix D.2). In addition, the gradually sloping wetland upland transition zone along the habitat berm would provide an elevation gradient over which tidal wetlands could shift upslope when floodwaters rise. The stability of the habitat levee should minimize future management requirements, even with elevated sea levels. No additional ECs or MMs are needed for Tule Red. Impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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CULTURAL RESOURCES (CULTURAL RESOURCES) [1]								
a.) Cause a substantial adverse change in the significance of a historical resource, as defined in Section 15064.5. b.) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5.	CUL-1: Damage to Montezuma Slough Rural Historic Landscape and Mein's Landing as a Result of Ground-Disturbing Activities along Montezuma Slough	S	<u>CUL-MM-1: Document and Evaluate the Montezuma Slough Rural Historic Landscape, Assess Impacts, and Implement Mitigation Measures to Lessen Impacts</u>	SU	• Maintenance of levee and water control features • Levee lowering or breaching • Upgrading or constructing new exterior levees adjacent to restoration areas • Inundation of restoration areas	Ground-disturbing activities such as levee modifications, conversion of managed wetlands and uplands to managed wetlands, replacement of infrastructure, and enhancement of vernal pool and riparian habitat may result in damage to character-defining features of the Montezuma Slough Rural Historic Landscape.	In subsequent project-level evaluation, if a state or federal lead agency finds in inventory that the Montezuma Slough Rural Historic Landscape does not constitute a historic property or historical resource, implementation of the mitigation measure would reduce the severity of the impact to less than significant.	The site is not located within proximity to Montezuma Slough Rural Historic Landscape or Mein's Landing. Therefore, CUL-MM-1 identified in the SMP EIS/EIR is not applicable to Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
a.) Cause a substantial adverse change in the significance of a historical resource, as defined in Section 15064.5. b.) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5. c.) Directly or indirectly destroy a unique paleontological resource site or unique geologic feature.	CUL-2: Damage to or Destruction of Other Known Cultural Resources as a Result of Ground-Disturbing Activities in Lowland and Marsh Areas	S	<u>CUL-MM-2: Evaluate Previously Recorded Cultural Resources and Fence NRHP- and CRHR-Eligible Resources prior to Ground-Disturbing Activities</u>	LS	• Maintenance of levee and water control features • Levee lowering or breaching • Upgrading or constructing new exterior levees adjacent to restoration areas • Inundation of restoration areas	Twenty-four previously recorded cultural resources are located in lowland and marsh areas within the marsh and therefore could be affected by tidal marsh restoration in those areas. The resources are considered historic properties and historical resources. However, the majority of these resources are recommended as ineligible for the NRHP/CRHR based on not meeting significance criteria (Reclamation 2011, Table 7.7-10).	No information incorporated	Of the 24 resources identified in the SMP EIS/EIR, 13 are in Region 4 of the marsh (where the project site is) (Reclamation 2011, Table 7.7-10). All but two are recommended as ineligible (NRHP/CRHR) based on not meeting state and federal cultural significance criteria. The remaining two are identified as undetermined but are not near the project site (a lowland grassland area and the Montezuma wetlands flume structure) (Reclamation 2011, Table 7.7-10). As described in Appendix H, *Cultural Resources Report*, the cultural resources evaluation of the Tule Red project site indicates no known significant cultural (historic or archaeological) resources are located within the site. In addition, there is very low potential for unknown significant cultural (historic or archaeological) resources to exist because the project site was underwater until approximately the mid-1950s and heavy sedimentation has buried older surfaces to a considerable depth. The sedimentation is based on the continual accretion of sediment to the site from Grizzly Bay. Impacts would be less than significant. However, the Tule Red project would incorporate the following ECs: *Prior to ground-disturbing activities in restoration areas, SFCWA will conduct a cultural resources inventory of the restoration area according to the standards (a) through (e) cited in CUL-MM-1 of Section 7.7 of the SMP EIS/EIR).* *If any cultural resources are determined to be historic properties and ground-disturbing activities are found to result in adverse effects, the Corps or SFCWA will resolve the effects in accordance with Section 106 of the NHPA or CEQA, as applicable.* *If no cultural resources are identified in specific restoration areas, or identified resources are not determined to be significant, no additional cultural work will be required.*

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	CUL-3: Damage to Known Cultural Resources as a Result of Inundation	S	CUL-MM-3: Protect Known Cultural Resources from Damage Incurred by Inundation through Plan Design (Avoidance) CUL-MM-4: Resolve Adverse Effects prior to Construction	SU	• Maintenance of levee and water control features • Levee lowering or breaching • Upgrading or constructing new exterior levees adjacent to restoration areas • Inundation of restoration areas	Twenty-four previously recorded cultural resources are located in lowland and marsh areas in the marsh and therefore could be affected by inundation of such areas. Inundation would degrade character-defining elements of cultural resources, such as historic buildings and structures as well as archaeological sites. Prolonged and repeated inundation would lead to structural degradation (oxidation and weakening of metals) and the decay of archaeological site constituents.	No information incorporated	Same as Impact CUL-2.

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a.), b.), and c.), identified above	CUL-4: Inadvertent Damage to or Destruction of As-Yet-Unidentified Cultural Resources as a Result of Ground-Disturbing Activities in Restoration Areas	S	CUL-MM-5: Conduct Cultural Resource Inventories and Evaluations and Resolve Any Adverse Effects	SU	• Maintenance of levee and water control features • Levee lowering or breaching • Upgrading or constructing new exterior levees adjacent to restoration areas • Inundation of restoration areas	Construction in unsurveyed areas would most likely result in damage to or destruction of unknown cultural resources that may meet the criteria of a historic property, historical resource, or unique archaeological resource. Region 1 possesses the highest percentage of restoration activities occurring within areas sensitive for the presence of buried archaeological resources (34.8%), even considering that a larger proportion of Region 3 would see restoration activities than would Region 1. Region 2 has the lowest percentage (2.1) of areas sensitive for buried archaeological resources. The likelihood of restoration activities being situated in areas sensitive for the presence of surface-manifested prehistoric resources is highest in Region 3 (30.4%) and lowest in Region 4 (8.0%).	**Environmental Commitment: Inadvertent Discovery of Unknown Cultural Resources**.	The Tule Red project is located in Region 4, a region that, according to the SMP EIS/EIR, has the lowest likelihood of restoration activities being situated in areas sensitive for the presence of surface-manifested prehistoric resources. The cultural resources report (as described in Impact CUL-2) confirmed this low probability. Therefore, the MMs identified in the SMP EIS/EIR are not applicable to Tule Red. However, the Tule Red project would incorporate the following EC, which is similar to the Inadvertent Discovery of Unknown Cultural Resources EC in the SMP EIS/EIR, with the inclusion of the bolded text for conditions specific to the proposed project: *If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work* ***within 100 feet of the find*** *immediately and notify the* ***SFCWA*** *and the Corps.* ***All construction personnel will leave the area. Vehicles and equipment will be left in place until a qualified archaeologist identifies a safe path out of the area. The on-site supervisor will flag or otherwise mark the location of the find and keep all traffic away from the resource. The on-site supervisor will immediately notify the lead state or federal agency of the find.*** *The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.* Impacts would be less than significant.
d.) Disturb any human remains, including those interred outside of formal cemeteries.	CUL-5: Damage to or Destruction of Human Remains as a Result of Ground-Disturbing Activities	LS	None required	—	• Maintenance of levee and water control features • Levee lowering or breaching • Upgrading or constructing new exterior levees adjacent to restoration areas • Inundation of restoration areas	Tidal marsh restoration, creation, and protection; conversion of managed wetlands and uplands; vernal pool habitat enhancement; riparian habitat enhancement (passive flooding, setback and perimeter levee building); and levee management have the potential to damage or destroy human remains during ground-disturbing activities.	**Environmental Commitment: Inadvertent Discovery of Cultural Resources**	As described in Appendix H, a cultural resources evaluation of the Tule Red project site indicates that no significant cultural resources were identified. In addition, there are no known significant historical or archaeological resources within the project area. Therefore, the potential for the inadvertent discovery of unknown cultural resources is low,

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								and impacts would be less than significant. However, Tule Red would incorporated the following, which is the Inadvertent Discovery of Cultural Resources EC in the SMP EIS/EIR: *If human remains of Native American origin are discovered during ground-disturbing activities on non-federal land, SFCWA or the Corps must comply with state laws relating to the disposition of Native American burials, which fall within the jurisdiction of the NAHC (PRC 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, SFCWA or the Corps will not allow further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:* *j. The Solano County Coroner has been informed and has determined that no investigation of the cause of death is required; and* *k. If the remains are of Native American origin, the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods, as provided in PRC 5097.98; or* *1. The NAHC is unable to identify a descendant or the descendant failed to make a recommendation within 48 hours after being notified by the NAHC.* *2. If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.*

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GEOLOGY AND SOILS AND MINERAL RESOURCES (GEOLOGY AND LEVEE STABILITY) [1]								
c.) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.	GEO-1: Potential to Create Unstable Cut or Fill Slopes	LS	None required	—	• Grading to create habitat features • Excavation of levee portions to inundate restoration area • Placement of fill to improve interior and exterior levees and create islands or other upland transition areas • Placement of riprap and other bank protection	Project activities are not expected to create unstable cut or fill slopes and would most likely benefit slopes in both newly created tidal and existing managed wetlands.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
Geology and Soils b.) Result in substantial soil erosion or the loss of topsoil.	GEO-2: Potential for Accelerated Soil Erosion	LS or B	None required	—	Ground-disturbing activities such as: • Earthwork to breach levees • Fill placement to expand and maintain the levees that are not removed	Ground-disturbing activities would have the potential to increase the rate and extent of soil erosion. Restoring tidal action to portions of Suisun Marsh would increase the mobility of sediment in reconnected tidal channels and mudflat areas. This would entail some scour and localized sediment deposition, but the cycle of tidally driven sediment erosion, transport, and redeposition would reflect the restoration of natural processes interrupted by the existing levee and dike system, which would be beneficial.	Per Chapter 2 of the SMP EIS/EIR, the description of restoration site activities, restoration sites will be managed to establish vegetation before breaching. **Environmental Commitment:** • **Standard Design Features and Construction Practices** • **SWPPP** • **Erosion and Sediment Control Plan**	Through a process of refined breach location selection, the Tule Red project decided a breach located in the northern part of the existing exterior natural berm would result in the fewest scour and hydrologic changes (Appendix D.2). Previously, removing both the existing tide gates without a breach had been considered, but this would most likely result in severely muted tidal cycle, erosion of the existing berm protecting the Grizzly Island Wildlife Area and the neighboring duck club, and hydraulic impacts on neighboring properties that drain/flood from the tidal channels connected to the project site (i.e., dampening of flood/drain levels). The Tule Red Restoration Project will incorporate the ECs noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. Although the SWPPP would include an HMMP, implementation of the HMMP would not be necessary to prevent the loss of topsoil or substantial soil erosion. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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Geology and Soils b.) Result in substantial soil erosion or the loss of topsoil.	GEO-3: Potential Loss of Topsoil Resources	LS	None required	—	Ground-disturbing activities such as: • Earthwork to breach levees • Fill placement to expand and maintain the levees that are not removed	Construction of new project facilities would require removal of the existing topsoil layer Other ground-disturbing activities—such as earthwork to breach levees and fill placement to expand and maintain the levees that are not removed—also would have some potential to result in removal and loss of topsoil resources where they are present.	**Environmental Commitments**: • **Standard Design Features and Construction Practices** • **SWPPP** • **Erosion and Sediment Control Plan**	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
Mineral Resources a.) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. Mineral Resources b.) Result in the loss of availability of a known locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.	GEO-4: Reduction in Availability of Non-Fuel Mineral Resources	LS	None required	—	No description of specific restoration activities.	Known mineral resources are not within the project area and are located only in limited areas on the periphery, it is not expected that restoration would result in changes in land uses related to mineral extraction.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
Mineral Resources a.) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.	GEO-5: Reduction in Availability of Natural Gas Resources	LS	None required	—	No description of specific restoration activities.	To the extent that restored marsh habitat is viewed as incompatible with natural gas extraction, the proposed action could render natural gas extraction less feasible in the future.	Per Chapter 2 of the SMP EIS/EIR, the description of restoration site activities, restoration activities would occur only on lands purchased from willing sellers, and natural gas still would be extracted in other areas in and around the marsh.	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

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c.) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. d) Be located on expansive soil, as defined in Table 18-1 B of the Uniform Building Code (1994), Creating a substantial Risk to Life or Property.	FC-3: Temporary Decrease in Levee Stability Resulting from Construction Activities	LS	None required	—	• Construction of new levee sections • Rehabilitation of levees	During construction of new levee sections or rehabilitation of levees to bring them up to a minimum standard, the levee may be subject to ground shaking and increased ground pressures from heavy equipment or placement of fill. This additional loading may exceed the potential for the existing levee material or levee foundation material to support the levee section (i.e., shear strength) and cause rapid settling or fracture of the levee section.	**<u>Environmental Commitment</u>: Standard Design Features and Construction Practices, including: control construction equipment access and the placement of fill to maintain acceptable loading, based on the shear strength of the foundation material.**	The Tule Red Restoration Project would incorporate the EC noted here and as described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan*, of the SMP EIS/EIR. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
a.) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo earthquake fault zoning map issued by the State Geologist ii. Strong seismic ground shaking iii. Seismically related ground failure, including liquefaction iv. Landslides	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities in the SMP would not involve building structures and would not involve bringing people to an area of potential geologic or seismic risk, beyond those who already use the area for recreation. Construction workers who restore specific restoration sites would be on-site for a relatively short time when compared to geologic events and times. In other words, the probability of construction workers experiencing a geologic or seismic event resulting in an impact would be extremely low given the relatively infrequent occurrence of large seismic events over time and the fact that construction associated with restoration activities would be very short (i.e., less than 2 years).	None.	The Tule Red project would not involve the construction or operation of buildings and would not bring a substantial number of people to Suisun Marsh; therefore, the Tule Red project has no ability to expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death associated with geologic activities. Impacts would not occur.

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e.) Have soil incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities in the SMP would not need septic tanks or alternative wastewater disposal systems. Construction contractors would be expected to provide adequate facilities for workers on a restoration site; however, these would not be permanent facilities and would be removed once construction is completed.	None.	The Tule Red project does not involve the construction or operation of septic tanks; therefore, it would not result in impacts on soils that would be incapable of supporting septic tanks. Impacts would not occur.

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HAZARDS AND HAZARDOUS MATERIALS (PUBLIC HEALTH, ENVIRONMENTAL HAZARDS, AND TRANSPORTATION) [1]								
None.	HAZ-1: Increased Risk of Mosquito-Borne Diseases	LS	None required	—	No description of specific restoration activities.	Tidal restoration projects in Suisun Marsh generally have the potential for producing large numbers of mosquitoes.	**Environmental Commitment: Mosquito abatement best management practices.**	Under the proposed project, there would be several areas within the project site for retaining tidal water to increase food production. Specifically the project is to provide adequate residence times for cultivating and rearing zooplankton. The project site marsh plain (the largest part of the site) is designed below mean high water and above mean seal level, which means it will be flooded and drained on each high-tide cycle, limiting the potential for standing water, which is favored by mosquitos. A tidal pond is also part of the project, and modeled results indicate a residence time between 6 and 14 days (Appendix D.1), with depths between 2 and 7 feet. For breeding, mosquitos typically prefer shallow (less than 6 inches deep), stagnant water, and thick vegetation, including floating submerged plants (Walton 2004). The Tule Red Restoration Project will incorporate the EC noted here and as described in Appendix F and Chapter 2 of the SMP EIS/EIR, with the following exception: "*If necessary, **implement a sampling and treatment program** ~~obtain an engineering survey to locate~~ for any depressions that would retain tidal water ~~and design site restoration to promote water drainage~~*." Given the expected conditions under tidal restoration and the implementation of the EC, even with the change, the impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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a.) Create a significant hazard to the public or environment through the routine transport, use, or disposal of hazardous materials. b.) Create a significant hazard to the public or environment through the reasonably foreseeable upset and accidental conditions involving the release of hazardous materials into the environment. d.) Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, create a significant hazard to the public or the environment.	HAZ-2: Exposure to or Release of Hazardous Materials during Construction	LS	None required	—	No description of specific restoration activities.	Fuel and lubricant fluids associated with construction equipment could expose construction workers and the environment to hazardous materials if materials are improperly handled. Digging could affect underground gas pipelines. If pipelines are damaged during digging, a release of natural gas or other materials could expose construction workers and the environment to hazardous materials.	<u>Project design features</u>: Avoid affecting existing pipelines and other facilities. **<u>Environmental Commitments</u>:** • **Standard design features and construction practices** • **Access points/staging areas** • **HMMP** • **SWPPP**	A Phase I Study of the project site, completed in 2011, including site reconnaissance and records review, did not find documentation or physical evidence of soil or groundwater impairments on the project site, and the title report did not document existing pipelines within the project site (Erikson pers. comm.; First American Title Insurance Company [unknown date]). Tule Red would incorporate the ECs noted here and as described in Appendix F and Chapter 2 of the SMP EIS/EIR, with the following exceptions: • For a component[11] of the Access Point/Staging Areas EC, staging areas will be identified in construction drawings. • For a component of the Standard Design Features and Construction Practices EC, the following revision will be made: o *"Minimizing degradation of wetland habitats where feasible* ***by minimizing the disturbance footprint,*** *~~i.e., work will be conducted from levee crown~~."* • An HMMP would be included in the SWPPP; the HMMP would not include implementation a risk management plan, which, as the SMP EIS/EIR indicates, is for large-scale projects. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

[11] "Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in which case the maximum setback possible will be used. If an off-road site is chosen, qualified biological and cultural resources personnel will survey the selected site to verify that no sensitive resources are disturbed by staging activities. If sensitive resources are found, an appropriate buffer zone will be staked and flagged to avoid impacts. If impacts on sensitive resources cannot be avoided, the site will not be used. An alternate site will be selected."

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	HAZ-3: Release of Hazardous Materials into Surrounding Water Bodies during Construction	LS	None required	—	• Levee breaching	Levee breaching in the area of Montezuma Slough could flood the nearby isolated pond containing a leaking underground fuel tank (LUFT), causing water contamination. Because the SMP area has a history of agricultural use and may have areas of previously unknown contamination related to this use, project construction or maintenance activities could encounter unknown contamination.	<u>Project design features</u>: Restoration design will avoid the LUFT area. **<u>Environmental Commitments:</u>** • **Standard Design Features and Construction Practices** • **HMMP**	The LUFT identified in the SMP EIS/EIR is approximately 3 miles north of the project site; therefore, levee breaching on the project site would not affect this LUFT. In addition, a Phase I study of the project site, completed in 2011, including site reconnaissance and records review, did not find documentation or physical evidence of soil or groundwater impairments on the project site (Erikson pers. comm.). Finally, the title report for the project site does not identify an existing hazardous materials, overhead power lines, or subsurface oil pipelines or natural gas lines on the project site (First American Title Insurance Company [unknown date]). The Tule Red project would incorporate the EC noted here and as described in the SMP EIS/EIR, Appendix F and Chapter 2, with the following exceptions: • An HMMP would be included in the SWPPP; the HMMP would not include implementation a risk management plan, which, as the SMP EIS/EIR indicates, is for large-scale projects and projects dealing with acutely hazardous materials such as chlorine gas, ammonia gas, hydrogen chloride, flammable gases. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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g.) Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan. Transportation/Traffic e.) Result in inadequate emergency access.	HAZ-4: In-Channel Construction-Related Increase in Emergency Response Times	LS	None required	—	• In-channel work, including levee breaching	Construction equipment is not expected to impede emergency access provided by levee roads. Upon completion of construction, no changes in emergency access or response times would occur.	**Environmental Commitment:** • **Traffic and Navigation Control Plan and Emergency Access Plan** • **Standard Design Features and Construction Practices**	There would be no changes within Suisun Marsh channels due to implementation of the Tule Red project, and accordingly, there would be no impact on navigation. The existing exterior natural berm is not currently used for emergency access, and therefore, breaching would not impede emergency access. The existing levee, which would become the exterior levee, could be used for emergency access; however, it would remain as is (with a gravel road) and would not impede emergency access. Therefore, the SMP EIS/EIR EC would not be applicable. Impacts would be less than significant.
None.	HAZ-5: Increased Human and Environmental Exposure to Mercury	LS	None required	—	• Levee breaching	Remobilization of sediments into the water column caused by restoration activities such as levee breaching can lead to temporary localized increases in suspended solids (SS) and DO. However, construction activities would be spread throughout the marsh and over the 30-year implementation period.	Per the conceptual model for the SMP, in cooperation with regional monitoring and research efforts, sediment and fish monitoring will be conducted at several restoration sites.	As discussed in Impact WQ-4, tidal habitat may reduce the potential conversion of mercury to methylmercury. As appropriate, monitoring would occur on the Tule Red restoration site to adaptively manage the site over time. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
e.) For a project located within an airport land use plan, or where such a plan has not been adopted, within 2 miles of a public airport or public use airport, result in a safety hazard for people residing in or working in the project area. f) For a project within the vicinity of a private air strip, result in a safety hazard for people residing or working in the project area.	TN-4: Impacts on Air Traffic Attributable to Restoration Activities	LS	None required	—	No description of specific restoration activities.	Compared to the existing tidal marsh and managed wetland acreage, the overall increase in acreage in these habitats would not significantly change wildlife or bird usage of the marsh. Restoration and managed wetland activities would occur far enough away from the airport that bird activity would not affect air traffic patterns.	No information incorporated	No ECs or MMs were identified in the SMP EIS/EIR impact analysis. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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a.) Create a significant hazard to the public or environment through the routine transport, use, or disposal of hazardous materials. b. Create a significant hazard to the public or environment through the reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.	HAZ-7: Increased Human and Environmental Exposure to Natural Gas and Petroleum	S	UTL-MM-2: Avoid Ground-Disturbing Activities within Pipeline Right-of-Way UTL-MM-3: Relocate or Upgrade Utility Facilities that Could Be Damaged by Inundation UTL-MM-4: Test and Repair or Replace Pipelines that Have the Potential for Failure	LS	No description of specific restoration activities.	Restoration would result in permanent tidal inundation, which would increase the potential for the environment and humans to be exposed to natural gas and petroleum because, should a leak occur, it would be more difficult to contain than it would be under existing conditions.	No information incorporated	Same as Impact HAZ-3. Impacts would be less than significant.
c.) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because there are no existing or proposed schools within 0.25 mile of the marsh.	None.	The Tule Red project site is not within 0.25 mile of an existing or proposed school; it is located within the middle of Suisun Marsh and immediately adjacent to open water. Therefore, there is no potential to affect schools. Impacts would not occur.
h) Expose people or structures to a significant risk of the loss, injury, or death involving wildland fires, including in areas where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because, given the location of the marsh (surrounded by water and wet most of the time), wildland fires could not occur. In addition, the activities in the marsh would not be located in areas where wildlands are adjacent to urban areas such that a wildland fire risk would occur. Finally, activities within the SMP would not bring people to wildland areas with a risk of fire and would not increase the number of people living in wildlands, resulting in a risk of fire.	None.	The Tule Red project site is located within the middle of Suisun Marsh and immediately adjacent to open water (Grizzly Bay); it does not involve the construction structures. Therefore, there is no potential to expose people or structures to a significant risk of the loss, injury, or death involving wildland fires. Impacts would be less than significant.

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HYDROLOGY AND WATER QUALITY (WATER SUPPLY AND MANAGEMENT, WATER QUALITY, GROUNDWATER, FLOODING, AND SEDIMENT TRANSPORT) [1]								
None.	WTR-1: Reduction in Water Availability for Riparian Water Diversions to Managed Wetlands Upstream or Downstream of Restoration Areas	LS	None required	—	No description of specific restoration activities.	The impact would be due to a change in timing related to water availability for the managed wetlands and changes in tidal elevations. Tidal flows into restored tidal wetlands may affect the tidal range in sloughs adjacent to the restored tidal wetlands. The changes in tidal elevation could affect the timing of water availability to the riparian diversions. For one season or a portion of one season, the timing of water availability may experience a small change on a diurnal basis due to reduced tidal elevation differences.	The RMA hydrodynamic model was used to evaluate impacts and showed the following: • RMA model assumed all tidal wetland restoration occurred at one time and looked at the immediate effect on tidal elevations of the total restoration • The simulations did not consider how sea level rise may interact with the tidal restoration actions when predicting tidal elevation changes • The simulations did not look at tidal elevation changes from tidal restoration actions after the change to determine if the potential tidal elevation changes would continue over any part of the SMP planning horizon	There are no water users downstream of the project site because Grizzly Bay is located downstream of the project site. The breach was moved to the northern end of the project site to avoid potential impacts on the Roaring River Distribution System, which is south and east of the project site. Thus, the breach location is not expected to affect this system. The project site is not hydrologically connected to the Grizzly King site and therefore is not expected to affect this area. Tidal velocities and elevations are expected to be within baseline conditions or those predicted by the SMP EIS/EIR per hydrologic modeling (Appendix D.2, *Hydraulic and Geomorphic Basis of Design Report*, and NHC pers. comm.). The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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None.	WTR-2: Increased Tidal Velocities from Breaching of Managed Wetlands Levees	LS	None required	—	• Levee breaches	Tidal velocities in the marsh channels and sloughs are generally moderate, with maximum velocities of between 1 and 2 fps, depending on the size of the channel cross section and the upstream tidal volume (upstream area). These maximum tidal velocities occur regularly (four times each day). An increase in average channel velocity of more than 2 fps or an increase of more than 1 fps in an existing channel is considered a significant change in tidal velocities and may result in local sediment scour or vegetation disruption. Breaches will be designed to ensure that tidal flows remain below 3 fps to prevent tidal muting or scouring caused by the increased water surface gradient during peak tidal flows in channels with relatively high velocities.	Tidal restoration breach location, number, and size would be chosen on a project-specific basis and based on two considerations: • To maximize the ecological benefits of the restoration, and • To minimize **upstream** tidal muting, tidal elevation changes, slough channel scour, and hydraulic changes; restoration projects would be designed to ensure that changes in tidal flows remain below about 1 fps. In general breaches on larger channels or multiple breaches would reduce the effects of the increased tidal flows on tidal elevations and velocities. If feasible, based on site-specific conditions, breach locations would be located in areas that have minimal or no existing tidal wetlands on channel berms or in locations where the tidal wetland habitat value is lowest (e.g., riprap levee sections). Project Design Features: • Restoration designs will incorporate breach locations to minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes. This can be accomplished by locating breaches on larger channels or allowing more openings to reduce the effects of the increased tidal flows on tidal elevations and velocities.	As described in Appendix D.2, *Hydraulic and Geomorphic Basis of Design Report*, internal tidal channels (i.e., not connected to other sloughs or waterways) would have velocities of 2 to 3 fps. In Grizzly Bay (modeled at approximately 1,500 feet out into the bay from the site), velocities are only 0.2 fps (NHC pers. comm.). The 0.2 fps velocity is consistent with existing-condition velocities, indicating the local impacts on velocity do not extend out that far (NHC pers. comm.). As such, the impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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a.) Violate any water quality standards or waste discharge requirements. f.) Otherwise substantially degrade water quality.	WQ-1: Increased Salinity in Suisun Marsh Channels from Increased Tidal Flows from Suisun Bay (Grizzly Bay) as a Result of Restoration	LS	None required	—	No description of specific restoration activities.	Additional tidal wetland within the marsh would increase tidal flows throughout the marsh channels and could increase the salinity in the channels between Suisun Bay and the new tidal wetlands. The magnitude of the salinity effects would depend on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands. Restoration with tidal connection to Suisun Bay or Honker Bay may have the largest salinity effects, and the effects would be greatest during periods of low delta outflow when Suisun Bay salinity is highest and the salinity gradients within Suisun Bay and along Montezuma Slough are strongest. Models suggest that monthly salinity changes would most likely be less than about 5% to 10% of the baseline monthly salinity value.	Seasonal magnitude of salinity in the marsh would continue to be governed primarily by delta outflow and operation of the SMSCG.	The Tule Red project site was selected because of its large frontage on Grizzly Bay, a known habitat for delta smelt, longfin smelt, and listed salmonids; its existing ground elevations of 3 to 6.5 feet; and the existing setback levee, built to an elevation of 10 feet. The proposed project was modeled using the RMA Bay-Delta Model, which was used on the SMP EIS/EIR (Appendix D.1, *Salinity Modeling Analysis of the Proposed Tule Red Tidal Marsh Restoration*). The model results confirmed that the very small changes in salinity in four areas (Jersey Point, Emmaton, and Mallard Island and the south delta export locations) are within the objectives of the SMP EIS/EIR for maintaining increases in baseline salinity to below 10% (Appendix D.1). Therefore, as confirmed by model results, the seasonal magnitude of the marsh would continue to be governed primarily by delta outflow and the operation of the SMSCG (Appendix D.1). The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	WQ-2: Changes to Salinity of Water Available for Managed Wetlands from October to May	LS	None required	—	No description of specific restoration activities.	Models predict that salinity changes at Suisun Marsh monitoring locations, including the eastern channels, would be much less than the maximum allowed by monthly objectives. Any change in salinity would be substantially less than 10% with respect to the objectives for those locations. Additionally, the seasonal salinity pattern (determined primarily by delta outflow) would remain similar, and any potential change to salinity should not reduce the value of marsh channel water for managed wetland flood and drain operations.	No information incorporated	There are no managed wetlands downstream of the project site; therefore, restoration is not expected to change the salinity of water available for managed wetlands downstream. In addition, modeling results showed very little changes in salinity as a result of restoration (Appendix D.1, *Salinity Modeling Analysis of the Proposed Tule Red Tidal Marsh Restoration*). No ECs or MMs were identified in the SMP EIS/EIR impact analysis. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	WQ-3: Increased Salinity at Delta Diversions and Exports	LS	None required	—	No description of specific restoration activities.	The largest increase in upstream salinity would be much less than 10% of the average baseline salinity, with no month increasing by more than 10% of any pertinent salinity objective. Tidal restoration would be designed consistent with modeling, which indicates that any increases in salinity in channels and sloughs upstream can be eliminated by physically connecting tidal wetlands to existing marsh channels rather than directly to Suisun Bay.	No information incorporated	Same as Impact WQ-2. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
	WQ-4: Possible Changes to Methylmercury Production and Export as a Result of Tidal Restoration	LS	None required	—	No description of specific restoration activities.	Tidal wetland restoration in Suisun Marsh will not result in increased methylmercury compared to the baseline export of mercury (total or methyl-) in sediment or soils from managed wetlands to tidal sloughs during flood and drain activities.	Per the conceptual model for the SMP, in cooperation with regional monitoring and research efforts, sediment and fish monitoring will be conducted at several restoration sites.	The project site has documented levels of total Hg and MeHg, similar to other managed wetlands in Suisun Marsh (Appendix C, *Methylmercury and Dissolved Oxygen Technical Memorandum*). As described in Appendix C, tidal wetlands have very little active management when compared to managed wetlands and are expected to have a lower potential for MeHg formation as a result. Converting managed wetlands to tidal systems would reduce episodic discharges of high MeHg and low DO water as a result of greater flow. reducing concentrations and MeHg formation in slough sediments. For example, restoration at Blacklock in Suisun showed that long-term MeHg concentrations had declined following conversion because of higher hydrologic exchange between the marsh and surrounded slough waters (Appendix C). As appropriate, monitoring may occur on the Tule Red restoration site as part of permitting and/or coordination with the Regional Water Quality Control Board to adaptively manage the site over time and monitor total Hg and MeHg (Appendix C). The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	WQ-6: Temporary Changes in Water Quality during Construction Activities	LS	None required	—	No description of specific restoration activities, except levee breaching.	Remobilization of sediments into the water column caused by restoration activities such as levee breaching can lead to temporary localized increases in SS and DO. However, construction activities would be spread throughout the marsh and over the 30-year implementation period.	**<u>Environmental Commitments</u>:** • **Erosion and Sediment Control Plan** • **SWPPP** • **HMMP**	The Tule Red project would incorporate the ECs noted here and as described in Appendix F and Chapter 2 of the SMP EIS/EIR, with the following exception: • An HMMP would be included in the SWPPP; the HMMP would not include implementation of a risk management plan, which, as the SMP EIS/EIR indicates, is for large-scale projects. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.
b.) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of a pre-existing nearby well would drop to a level that would not support existing land uses or planned uses for which permits have been granted).	GW-6: Potential for Altered Salinity in Shallow Suisun Marsh Groundwater	LS	None required	—	No description of specific restoration activities.	Restoring tidal connectivity and increasing the acreage of tidal wetland in Suisun Marsh would increase the area exposed to saline and brackish surface water. However, in normal water years, restoration would most likely have little to no effect because of freshwater flushing. In dry periods, when recharge is diminished, there could be infiltration of saline waters into shallow subsurface areas in the marsh. Wells in Suisun Marsh are not used for potable, municipal, or agricultural supply; even if producing aquifers were affected, there would be little or no effect on the use of well water.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
d.) Substantially alter the existing drainage patter of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface water runoff in a manner that would result in flooding on- or off-site.	FC-1: Increased Potential for Catastrophic Levee Failure and Flooding Resulting from Restoration Activities that Expose Interior Levees to Tidal Action	LS	None required	—	• Levee breaches and "other wetland restoration actions"	As a result of levee breaches and other actions that may be implemented as part of SMP tidal wetland restoration actions, interior levees may become exterior levees, thereby increasing their exposure to tidal action for which they were not intended.	Improvements would be implemented prior to breaches that would expose them to tidal action to ensure that there is no point during which an unimproved interior levee would be exposed to tidal action.	The exiting interior levee on the project site would be improved through the construction of a habitat berm (Hultgren-Tillis 2015). This berm would protect Grizzly King and the Grizzly Island Wildlife Area from tidal action (Hultgren-Tillis 2015). No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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i.) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam.	FC-2: Changes in Flood Stage and Flow Capacity in Suisun Marsh Channels as a Result of Increased Tidal Prism and Flood Storage Capacity	Beneficial	—	—	No description of specific restoration activities.	Hydraulic modeling suggests that the addition of tidal prism through the breaching of levees and restoration of tidal wetlands would reduce tidal stages in the adjacent channels. The reduction in stage in channels adjacent to restoration areas would most likely be a beneficial change relative to flooding because the channels would have a greater carrying capacity during storm events, and levees within the restoration area would be improved to meet exterior levee standards.	No information incorporated	The Tule Red project site is located within the Suisun Marsh and immediately adjacent to open water (Grizzly Bay); it does not involve the construction of structures. Therefore, there is no potential to expose people or structures to a significant risk of loss, injury, or death involving flooding. In addition, tidal velocities and elevations are expected to be within baseline conditions or those predicted by the SMP EIS/EIR per hydrologic modeling (Appendix D.2, *Hydraulic and Geomorphic Basis of Design Report*, and NHC pers. comm.). No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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c.) Substantially alter the existing drainage patter of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on-or off-site.	ST-1: Increased Scour in Bays or Channels Upstream and Downstream of Habitat Restoration Areas	LS	None required	—	• Breaching levees	Each new levee breach would experience local scour as increased volumes of water pass through the opening on the tidal cycle and during flood events. Some adjacent channels would scour and increase their conveyance areas to supply additional tidal water volumes to the new habitats.	<u>Project Design Features</u>: • Breach locations would be selected to minimize scour and channel hydraulic changes. • Project proponents will use an accurate tidal hydraulics and salinity model (e.g., the RMA Bay-Delta model or other appropriate model) to simulate the proposed action and ensure that impacts related to scour, sedimentation, salinity, and other hydraulic processes do not exceed those described in the SMP EIS/EIR. This information will be used to adjust designs of restoration projects and other activities to minimize adverse impacts on tidal elevations and velocities, or other site-specific characteristics, in the restoration site and/or in marsh channels adjacent to restoration projects; minimize salinity effects at upstream delta locations; and potentially create benefits related to scour and sedimentation. • Site-specific hydraulic simulation modeling and scour analysis would occur.	Through a process of refined breach location selection, the Tule Red project breach location was selected for the northern part of the existing exterior natural berm would result in the fewest sour and hydrologic changes. Previously, removing both the existing tide gates without a breach had been considered, but this would most likely result in a severely muted tidal cycle, erosion of the existing berm for protecting the Grizzly Island Wildlife Area and the neighboring duck club, and hydraulic impacts on neighboring properties that drain/flood from the dial channels connected to the project site (i.e., dampening of flood/drain levels). As discussed in Impact VEG-1 and Appendix D.2, the Tule Red project is not expected to increase scour downstream. Modeling results predict that in Grizzly Bay (modeled at approximately 1,500 feet out into the bay from the site), velocities are only 0.2 fps (NHC pers. comm.). The 0.2 fps velocity is consistent with existing-condition velocities, indicating the local impacts on velocity do not extend out that far (NHC pers. comm.). The results of the numerical modeling and observations of other tidal marsh sites around Suisun and San Pablo Bay do not indicate that a scour hole is likely to form at the entrance to the project site (NHC pers. comm.). The invert of the tidal channel across the mud flat is typically higher than inside the marsh itself. As the flow moves out of the marsh and onto the mud flat, it is less laterally confined, reducing the unit discharge, velocity, and therefore applied hydraulic shear stress. This reduces the likelihood of a deeper scour hole forming (NHC pers. comm.). Thus, site-specific hydraulic simulation modeling and scour analysis has occurred as prescribed by the SMP. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red.

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	ST-2: Deposition of Sediment in the Restored Tidal Wetlands	LS or B	None required	—	• Breaching exterior levees and dikes	Suspended sediment from the water column will be deposited as a result of levee and dike breaching, removal of the levee or dike, and restoring tidal function to the managed wetland areas. Natural deposition within the tidal wetlands would restore a range of wetland elevations, providing the expected tidal habitat conditions.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
None.	ST-3: Changes in Regional Sedimentation and Scour Patterns in Suisun Marsh	LS	None required	—	• Breaching exterior levees and dikes • Dredging	The increased marsh area would effectively increase the tidal prism. An increase in the tidal prism would increase local channel velocities and provide greater low-velocity tidal habitats in the restored wetland areas, which would change overall sedimentation in Suisun Marsh. Some channels may experience local scour attributable to increased velocity as more water travels to the restoration areas. Restoration areas would have greater capacity to trap or accept deposited sediments. Areas that are typically targeted for dredging would most likely remain areas of deposition; therefore, the local supply of sediments for levee maintenance and strengthening is not expected to be reduced.	No information incorporated	Similar to Impact ST-1. In addition, the Tule Red project would not require dredging, and therefore, the analysis associate with dredging activities within the SMP EIS/EIR is not applicable to the Tule Red project. Impacts would be less than significant.
e.) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP would not create additional sources of runoff or involve stormwater drainage systems.	None.	The Tule Red project would incorporate a SWPPP; it does not involve construction of stormwater drainage systems; therefore, there is no potential for the Tule Red project to exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. Impacts would be less than significant.
g.) Place housing within a 100-year flood hazard area, as mapped on a federal flood hazard boundary or flood insurance rate map or other flood hazard delineation map.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP do not involve housing.	None.	The Tule Red project would not involve construction of housing; therefore, there is no potential for the Tule Red project to place housing within a 100-year flood hazard area. Impacts would be less than significant.

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h.) Place structures that would impede or redirect floodflows within 100-year flood hazard areas.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP do not involve building structures.	None.	The Tule Red project would not involve the construction of structures; therefore, there is no potential for the Tule Red project to place structures that would impede or redirect floodflows within 100-year flood hazard areas. Impacts would be less than significant.
j.) Inundation by seiche, tsunami, or mudflow.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP would not increase the potential for: • Seiche, given that seiches occur primarily in lakes; the SMP is not located near or on a lake • Mudflow, given mudflows need significant slop and runoff to occur and most of the area of the SMP is flat Although a tsunami could affect the marsh, the SMP would not increase the potential for being affected by a tsunami, and activities under the SMP (restoration of tidal wetlands and levee maintenance) would allow the marsh to be better protected in case of a tsunami.	None.	The Tule Red project would not involve the construction of structures and would not bring substantial numbers of people to Suisun Marsh; therefore, there is no potential for the Tule Red project to expose people or structures to inundation by seiche, tsunami, or mudflow. Although a tsunami could affect the project site, restoration activities would not increase the potential for being affected by a tsunami, and activities under the SMP (restoration of tidal wetlands and levee maintenance) would allow the marsh to be better protected in case of a tsunami. Impacts would be less than significant.
LAND USE (LAND USE)[1]								
b.) Conflict with an applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, the general plan, specific plan, local costal program, or zoning ordinance) adopted for the purposes of avoiding or mitigating an environmental effect.	LU-1: Alteration of Existing Land Use Patterns	LS	None required	—	No description of specific restoration activities.	The entire marsh would remain classified as marsh or agricultural land. If agricultural lands are obtained for restoration and converted to marsh, the newly designated use would be consistent with Solano County General Plan policy for agriculture, which states that agricultural land may be redesignated to marsh. Although there could be a shift in site-specific uses, the overall current use of the marsh for recreational activities (hunting, fishing, wildlife viewing, walking, etc.) would not change.	No information incorporated	The Tule Red project meets all the criteria of a covered action, as defined by the Delta Plan and PRC 21056; therefore, it is subject to the policies of the Delta Plan. The criteria are as follows: • Will occur, in whole or in part, within the boundaries of the delta or Suisun Marsh (the Tule Red project site is located within Region 4 of Suisun Marsh) • Will be carried out, approved, or funded by a state or local public agency (the Tule Red project proponent is currently SFCWA, but the long-term goal is to transfer the project site to CDFW)

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								• Is covered by one or more provisions of the Delta Plan (the following policies are applicable to the Tule Red project: ER P2, Restore Habitats at Appropriate Elevations; ER P3, Protect Opportunities to Restore Habitat; ER P5, Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species; DP P2, Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitat) • Will have a significant impact on the achievement of one or both of the co-equal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the delta (will restore 420 acres of existing managed wetlands to tidal habitat). • The Tule Red project is consistent with the Delta Plan and the land use designations for the marsh given that it is a restoration project intended for the benefit of fish species and terrestrial biological species. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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	LU-2: Conflict with Existing Land Use Plans, Policies, and Regulations	NI	—	—	No description of specific restoration activities.	The Solano County General Plan, Suisun Marsh Protection Plan, and the Suisun Marsh Protection Act of 1977 are the primary policies that have jurisdiction and provide land use guidance in the plan area. The plans and act call for the preservation and enhancement of aquatic habitat wherever possible. The SMP is aligned with and intended to further these and other preexisting goals. The Travis Air Force Base Land Use Compatibility Plan includes a restriction on land use in the marsh regarding the height of any structures. The proposed project would not build any new structures beyond duck clubs and other small facilities.	No information incorporated	The Tule Red project is consistent with the Solano County General Plan, the Suisun Marsh Protection Plan, and the Suisun Marsh Protection Act of 1977. The Tule Red project would not construct new structures, and therefore, conditions outlined in the Travis Air Force Base Land Use Compatibility Plan do not apply. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would not occur.
c.) Conflict with any applicable habitat conservation plan or natural community conservation plan.	LU-3: Conflict with Any Applicable Habitat Conservation Plan or Natural Community Conservation Plan	NI	—	—	No description of specific restoration activities.	The SMP would not conflict with the existing Suisun Marsh Protection Plan, and there are no other known conservation plans that affect the project area.	No information incorporated	Same as Impact LU-1. Impacts would be less than significant.
a.) Physically divide an established community.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this Appendix G impact because activities in the SMP would not physically divide an established community because it would continue to support and maintain some of the private land uses within the existing marsh.	None.	The Tule Red project does not involve dividing an established community because no communities exist on the project site. Impacts would not occur.

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NOISE (NOISE) [1]								
a.) Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. d.) Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity, above levels existing without the project.	NZ-1: Temporary Increases in Ambient Noise during Construction Activities Associated with Restoration	LS	None required	—	No description of specific restoration activities.	Most noise associated with construction activities would be highly localized. Noise from trucks would occur on roads throughout the plan area and on roads used to access specific project sites. Because noise-sensitive land uses are sparsely located throughout the plan area, it is unlikely that noise from these activities would have a substantial impact on any sensitive receptors.	**<u>Environmental Commitment</u>: Noise compliance.**	Construction activities could occur from sunup to sundown depending on the construction scenario used as described in Tables 3-4a through d. However, there are no residences or sensitive receptors near the project site. Therefore, the noise compliance EC would not need to be implemented as part of the Tule Red project. Impacts would be less than significant.
b.) Expose persons to or generate excessive groundborne vibration or groundborne noise levels.	NZ-2: Temporary Exposure of Sensitive Land Uses to Groundborne Vibration or Noise from Construction Activities	LS	None required	—	No description of specific restoration activities.	Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. However, residences are not anticipated to be located within 75 feet of heavy equipment operation.	No information incorporated	Same as Impact NZ-1. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
a.) Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. c.) Result in a substantial permanent increase in ambient noise levels in the project vicinity, above levels existing without the project.	NZ-3: Permanent Increases in Ambient Noise	LS	None required	—	No description of specific restoration activities.	Noise generated from individual site-specific projects would occur sporadically over the 30-year implementation period. This could result in slight isolated occurrences of increased noise that, together, would represent an overall permanent (30-year) increase in ambient noise in Suisun Marsh. Because specific projects would occur throughout the plan area over time, it is not expected that overlaps in substantial noise generation would occur in the same areas of the marsh and affect the same sensitive receptors at the same time in a manner that would be considered permanent.	No information incorporated	Similar to Impact NZ-1. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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a.) Expose persons to generate noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. d.) Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity, above levels existing without the project.	NZ-4: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations	LS	None required	—	• Truck removal • Import of levee materials • Import of riprap and other construction materials	Noise from project-related trucking operations is not predicted to exceed 60 dBA L_{eq} within about 100 feet of the trucking activity. It is unlikely that trucking noise would exceed 60 dBA L_{eq} at the outdoor use areas of any residences.	No information incorporated	Same as Impact NZ-1. Impacts would be less than significant.
e.) For a project located within an airport land use plan, or where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels. f.) For a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this Appendix G impact, given that the marsh is not located within an airport land use plan or the vicinity of a private airstrip.	None.	The Tule Red project site is not covered under an airport land use plan or in the vicinity of a private airstrip; therefore, there is no potential for noise from airstrip uses to affect the project site. Impacts would not occur.

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RECREATION (RECREATIONAL RESOURCES) [1]								
a.) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated. b.) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment.	[No impact headers, just a discussion]	[No determina-tion][12]	None required	—	No description of specific restoration activities.	• Recreation areas that could be affected by restoration activities include Belden's Landing, Peytonia Slough Ecological Preserve, Hill Slough Wildlife Area, Grizzly Island Wildlife Area, Rush Ranch, and some private duck clubs. • Most land-based activities would be unaffected by actions related to implementing the SMP or its alternatives. Non-motorized recreational boating (e.g., kayaking and canoeing) would be most affected if velocity changes were substantial in sloughs where breaching occurs. • Restoration activities that affect the waterside of exterior levees could temporarily disrupt recreational boating, personal watercraft use, and fishing in the area. In-channel or near-channel work may require that a portion of the channel be temporarily blocked to reduce the risk of boating hazards. • The conversion to tidal wetlands may alter use patterns in these areas by dabbling ducks, which are favored by local marsh hunters and clubs. This waterfowl guild includes mallard, gadwall, northern shoveler, northern pintail, green-winged teal, and Canada goose. Additionally, the shift from managed to tidal wetlands as a result of the club owners willful sale of their property may reduce the total number of private hunters allowed in the marsh on busy days, such as opening day of the	**Environmental Commitments: Traffic and Navigation Control Plan and Emergency Access Plan, and Recreation Best Management Practices, including:** • **Construction and restoration activities will occur in a manner that allows boating access through half the channel cross section at all times** • **Construction will not occur during major summer holiday periods** • **Warning signs and buoys will be posted at, upstream of, and downstream of all construction equipment, sites, and activities** • **Adequate warning will be provided regarding activities and equipment in construction sites**	No recreational or recreational boating facilities are associated with the project. Therefore, the ECs would not need to be implemented as part of the Tule Red project. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

[12] The SMP does not propose construction or a change related to existing recreation facilities that can be evaluated in terms of impacts or significance under CEQA, but it does affect certain recreational opportunities. The discussion in this section is therefore strictly a National Environmental Policy Act (NEPA) analysis regarding potential effects on recreation resources, access, and social effects such as recreational uses.

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						hunting season, because of the reduction in the number of acres of managed wetlands. It is expected, however, that existing and newly restored public lands and the remaining duck clubs would provide plenty of hunting opportunities during most days of the year. • Hunting and other recreational activities would still occur on public lands, and public opportunities may increase as a result of the tidal restoration. • Fishing opportunities may increase with the increase in tidal wetland and open-water habitats with navigable waters. • The plan would result in a net increase in navigable areas, thereby increasing potential boating opportunities in the marsh.		

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TRANSPORTATION AND TRAFFIC (TRANSPORTATION AND NAVIGATION)[1]								
a.) Conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation, including, but not limited to, intersections, streets, highways, and freeways, pedestrian and bicycle paths, and mass transit. b.) Conflict with an applicable congestion management program, including, but not limited to, level-of-service standards and travel demand measures, or other standards established by the county congestion management agency, for designated roads or highways.	TN-1: Temporary Addition of Vehicles to Roadway System and Alteration of Patterns of Vehicular Circulation during Construction Activities	LS	None required	—	• Construction activities • Importation of fill and other materials	• Construction-related impacts could result from trips made by workers while traveling to or from a project site and trucks that deliver construction equipment. • During critical construction periods, public access would be restricted or controlled. Materials may be brought to a project area by barge and/or by truck. Short-term construction traffic would include work crews and trucks that deliver equipment and materials. The substantial amounts of fill that are hauled to project areas by trucks, as well as construction-related equipment and workers' vehicles, could result in adverse impacts on transportation, including rail and public transit, depending on the number of trucks, total truck trips, and the roadways used.	**Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	The Tule Red project would not require the import or export of fill materials. Therefore, the SMP EIS/EIR analysis that applies to those activities would not be applicable. As such, this EC would not need to be implemented. Impacts would be less than significant.

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d.) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).	TN-2: Temporary Increases in Road Hazards during Construction Activities	LS	None required	—	No description of specific restoration activities.	• The majority of the proposed project would be constructed away from existing major road networks and areas of residential or urban development. As such, the likelihood of accidents involving construction equipment and potentially dangerous situations for the general public is low. • Hazards increase when roads are narrow or have characteristics that make maneuvering difficult, large equipment and/or equipment that is difficult to maneuver is transported, or the roadways include those that are used by the general public to access various areas of the marsh.	Project Design Feature: Restoration design planning will take into account access to the site, but potential road hazards may remain. **Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	The Tule Red project would involve limited work on the exterior natural berm adjacent to Grizzly Bay for approximately 2 weeks within a 2-month period. This work would have a limited extent (70 to 120 feet in length) for a limited duration (less than 2 weeks); therefore, it has little potential to result in a navigation hazard for boaters in Grizzly Bay. In addition, the bay is large enough for ships and boats to navigate away from any localized increase in velocities around the breach area. Finally, the exterior natural berm is not currently used for emergency access. Therefore, the EC cited in Section 5.6 of the SMP EIS/EIR, as well as Appendix F of the SMP EIS/EIR, is not applicable. Impacts would be less than significant.
None.	TN-3: Damage to Roadway Surfaces from Construction Activities	LS	None required	—	• Transport of construction material	Implementing the proposed project would require the transport of construction equipment and material, including, but not limited to, long-reach excavators, excavators, dozers, box scrapers, tractors, pipes, riprap, etc. Some roads within the marsh may not be designed to accommodate such traffic; therefore, there is potential for damage to roads by construction activities, construction vehicles, and the transport of equipment.	**Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	Same as Impact TN-2. Impacts would be less than significant.
c.) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks.	TN-5: Impacts on Land Use Attributable to Restoration Activities within Travis Air Force Base Zone	LS	None required	—	No description of specific restoration activities.	Suisun Marsh restoration would occur in Zone D of the Travis Air Force Base zoning areas. Zone D land use is restricted only by the height of the features that would be built. None of the proposed SMP activities are expected to result in major structures that would be considered tall enough to conflict with Zone D land use.	No information incorporated	The Tule Red project would not construct buildings. No additional ECs or MMs are needed for Tule Red. The impact analysis in the SMP EIS/EIR is appropriate for Tule Red, and impacts would be less than significant.

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None.	TN-6: Temporary Reduction in Boat Access during Construction Activities	LS	None required	—	• In-channel work	In-channel work may require the reduction of some channel area available for boating and other navigation. It is expected that in-channel work related to levee breaching for restoration, specifically dredging or levee repair, would be conducted sporadically throughout the marsh over the 30-year period, would be temporary, and would not result in permanent reductions in navigable areas. The only major navigational channel is located in Suisun Bay, and plan activities are not expected to affect this area.	**Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	Same as Impact TN-2. Impacts would be less than significant.
None.	TN-7: Decrease in Rail Line Integrity and Disruption to Rail Service	LS	None required	—	• Levee breaches and other restoration activities	Restoration or other activities could affect the integrity of levees that hold the rail line for the Union Pacific Railroad by causing increased inundation and erosion, depending on the specific location and type of SMP activities implemented. Work occurring within a particular right-of-way, as determined by the railroads, may result in delays or other temporary disruptions to rail service, depending on the type of activities implemented.	Project design features: • Breaches will be designed to avoid levees where rail lines are situated • Restoration activities will be designed to protect rail lines **Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	There are no rail lines within the Tule Red project site. Same as Impact TN-2. Impacts would be less than significant.
None.	TN-8: Short-Term Reduction in Navigable Areas Resulting from Increased Velocities after Restoration Activities	LS	None required	—	• Levee breaches	Levee breaches associated with restoration activities could result in changes in velocities adjacent to the breach location. Increased velocities in these areas are expected to be temporary and localized to the immediate breach site location but could interfere with navigation by temporarily creating areas within the marsh that are unsafe or not navigable.	**Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	Same as Impact TN-2. Impacts would be less than significant.
None.	TN-9: Temporary Reduction in Boat Access during Dredging Activities	LS	None required	—	Dredging	Dredging could result in temporary reductions in boat access in isolated areas throughout the marsh.	**Environmental Commitment:** **Traffic and Navigation Control Plan and Emergency Access Plan**	Implementation of the Tule Red project would not entail dredging activities; as such, the EC identified in Section 5-6 of the SMP EIS/EIR is not applicable. Impacts would be less than significant.

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None.	TN-10: Increases in Navigable Areas of Suisun Marsh	Beneficial	—	—	No description of specific restoration activities.	Restoration would lead to an increase in navigable areas, depending on which areas are restored, the beginning elevations, sedimentation rates, and sea level rise.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
a.) Conflict with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation, including, but not limited to, intersections, streets, highways, and freeways, pedestrian and bicycle paths, and mass transit. b.) Conflict with an applicable congestion management program, including, but not limited to, level of service standards and travel demand measures or other standards established by the county congestion management agency for designated roads or highways.	TN-11: Operations and Maintenance Increase in Traffic	LS	None required	—	No description of specific restoration activities.	Upon completion of construction of restoration, minimal traffic would be generated.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
f.) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities or otherwise decrease the performance or safety of such facilities.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP would not conflict with public transit or bicycle or pedestrian facilities within the marsh.	None.	The Tule Red project does not involve public transportation or substantial changes to roads used by public transit; therefore, there is no potential for the Tule Red project to conflict with adopted policies, plans, or programs regarding public transit or bicycle or pedestrian facilities or otherwise decrease the performance or safety of such facilities. Impacts would not occur.

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UTILITIES AND SERVICE SYSTEMS AND PUBLIC SERVICES (UTILITIES AND PUBLIC SERVICES) [1]								
None.	UTL-1: Damage to Pipelines and/or Disruption of Electrical, Gas, or Other Energy Services during Construction or Restoration Activities	S	<u>UTL-MM-1: Relocate Overhead Power Lines or Other Utilities that Could Be Affected by Construction</u> <u>UTL-MM-2: Avoid Ground-Disturbing Activities within Pipeline Right-of-Way</u>	LS	No description of specific restoration activities.	• Construction of the proposed restoration would have no impact on water conveyance or treatment facilities, stormwater drainage facilities, or communication facilities. • Restoration activities may occur on properties with overhead lines, underground pipelines, or wells. Ground-disturbing and other activities have the potential to damage these facilities or otherwise cause outages.	**<u>Environmental Commitment:</u> Standard Design Features and Construction Practices, specifically: Stop work immediately if a conflict with a utility facility occurs and contacting the affected utility to (1) notify it of the conflict, (2) aid in coordinating repairs to the utility, and (3) coordinate to avoid additional conflicts in the field.**	Same as Impact HAZ-3. There are no overhead power lines or underground pipelines on the project site. Therefore, the MMs identified in the SMP EIS/EIR are not applicable to the Tule Red project. The EC related to Standard Design Features and Construction Practices would be incorporated into the proposed project. Impacts would not occur.
None.	UTL-2: Damage to Utility Facilities or Disruption to Service as a Result of Restoration	S	<u>UTL-MM-3: Relocate or Upgrade Utility Facilities that Could Be Damaged by Inundation</u> <u>UTL-MM-4: Test and Repair or Replace Pipelines that Have the Potential for Failure</u>	LS	No description of specific restoration activities.	Areas restored to tidal wetlands would change the general nature of properties from seasonally flooded to tidally inundated year-round. This has the potential to affect facilities that were installed prior to inundation that were not designed to exist in a tidally inundated environment. Inundation could change how owners/operators of utility facilities that were installed prior to inundation respond to emergencies such as leaks and ruptures. Because many of the pipelines in the marsh are older than their design life, the potential exists for these pipes to leak or rupture.	No information incorporated	Same as Impact HAZ-3. There are no overhead power lines or underground pipelines on the project site. Therefore, the MMs identified in the SMP EIS/EIR are not applicable to the Tule Red project. Impacts would not occur.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR: Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
Utilities and Service Systems f.) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs. Utilities and Service Systems g.) Comply with federal, state, and local statues and regulations related to solid waste.	UTL-3: Reduction in Capacity of Local Solid Waste Landfills	LS	None required	—	No description of specific restoration activities.	Construction related to the proposed restoration is not expected to generate substantial amounts of solid waste. Materials removed from levees would be reused on-site as part of the restoration. Dredged material would be used for levee reinforcement, and the small amount of waste generated during construction over the 30-year plan implementation period is not expected to decrease the lifespan of landfills substantially in the plan vicinity.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
Public Services a.) Result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities or the need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, to maintain acceptable service ratios, response times, or other performance objectives for public services (i.e., fire protection and police protection).	UTL-4: Increase in Emergency Service Response Times	LS	None required	—	No description of specific restoration activities.	The proposed restoration would result in a temporary increase in the number of construction vehicles traveling on local roadways. These construction vehicles are not expected to cause a substantial reduction in response times for emergency service providers because there would be a minimal number of construction vehicles, activities would occur throughout the marsh, and roads in the marsh generally operate at a high level of service. Emergency access via the water would not be disrupted because in-water work would not result in channel inaccessibility or other delays.	No information incorporated	The impact analysis in the SMP EIS/EIR is appropriate for Tule Red. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
Public Services a.) Result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities or the need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, to maintain acceptable service ratios, response times, or other performance objectives for public services (i.e., schools, parks, other facilities).	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because, typically, changes to service ratios associated with parks, schools and other community services (e.g., libraries) are related to large changes in population. The activities under the SMP do not involve any changes that would result in substantial population growth within the marsh or the surrounding areas.	None.	The Tule Red project does not involve constructing or operating public facilities or inducing significant population growth in the marsh area; therefore, it has no potential to result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities or the need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, to maintain acceptable service ratios, response times, or other performance objectives for public services (i.e., schools, parks, other facilities). Impacts would not occur.
Utilities and Service Systems a.) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board. e.) Result in a determination by the wastewater treatment provider that serves or may serve the project site that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate these specific Appendix G impacts because no wastewater infrastructure is located in unincorporated Solano County. Wastewater needs in these locations are met by septic systems that have been installed by individual landowners. These systems are not connected to sewer lines but, rather, are self-contained systems that are permitted and inspected by Solano County. Furthermore, activities under the SMP would not require wastewater systems.	None.	The Tule Red project would not require the use of wastewater facilities because it is a tidal habitat restoration project; therefore, it has no potential to exceed the wastewater treatment requirements of the applicable Regional Water Quality Control Board or require the use of existing capacity from wastewater system(s). Impacts would not occur.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
Utilities and Service Systems b.) Require or result in the construction of new water or wastewater treatment facilities, or the expansion of existing facilities, the construction of which could cause significant environmental effects.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP would not require the construction of new water or wastewater facilities or the expansion of such facilities.	None.	The Tule Red project would not require the construction of new water or wastewater facilities because it is a tidal habitat restoration project; therefore, it has no potential to require or result in the construction of new water or wastewater treatment facilities or the expansion of existing facilities, the construction of which could cause significant environmental effects. Impacts would not occur.
Utilities and Service Systems c.) Require the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.	None	—	—	—	Entire SMP EIS/EIR.	The marsh is dependent on levees for flood and high-tide protection of land, structures, and key infrastructure; these levees would be maintained and upgraded through implementation of the plan. Any environmental impacts associated with levee maintenance, as described under the SMP, would be disclosed in the impacts described throughout the entire SMP document.	None.	The existing interior levee would be upgraded to an exterior levee as part of the Tule Red project, which would include a habitat berm of varying slopes. No additional ECs or MMs are needed for Tule Red. Impacts would be less than significant.
Utilities and Service Systems d.) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed	None	—	—	—	None.	The SMP EIS/EIR did not evaluate this specific Appendix G impact because activities under the SMP would not require water supplies beyond those that are already in the marsh (e.g., those existing water supplies that provide surface water to existing managed wetlands).	None.	The Tule Red project would not require a water supply because it is a tidal habitat restoration project; therefore, it has no potential to need new or expanded water entitlements. Impacts would be less than significant.

CEQA Guidelines Appendix G Impact	SMP EIS/EIR Impact	SMP EIS/EIR: Significance before Mitigation	SMP EIS/EIR Mitigation Measures (MMs)	SMP EIS/EIR: Significance after MMs	SMP EIS/EIR Description of Restoration Activities Evaluated	SMP EIS/EIR Impact Analysis Summary	SMP Assumptions or Environmental Commitments (ECs) Identified in Impact Analysis or Chapter 2 of the SMP EIS/EIR	Tule Red Project[1]
POPULATION AND HOUSING (NONE) [1]								
a.) Induce substantial population growth in an area, either directly or indirectly. b.) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere. c.) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere.	None	—	—	—	None.	The SMP EIS/EIR did not evaluate these specific Appendix G impacts because activities under the SMP would not result in direct or indirect population growth, the construction of homes, or the displacement of people. Activities under the SMP would manage existing managed wetlands and restore tidal habitat. Neither of these activities involves population growth or housing.	None.	The Tule Red project would not substantially increase population, the need for housing, or the need for replacement housing because it is a tidal habitat restoration project and does not involve the construction of housing. Therefore, it has no potential to induce substantial population growth in an area, displace substantial numbers of existing homes, or displace substantial numbers of people. Impacts would not occur.

Table Notes:

[1] Unless otherwise noted, the Tule Red Restoration Project (proposed project) would incorporate all applicable ECs and/or BMPs described in Appendix F, *Mitigation Monitoring and Reporting Program*, and Chapter 2, *Habitat Management, Preservation, and Restoration Plan, of* the SMP EIS/EIR.

[2] First resource identified is the resource identified in the initial study checklist of Appendix G of the State CEQA Guidelines; resources in parenthesis indicate resources evaluated in the SMP EIS/EIR.

[3] ECs identified in the SMP EIS/EIR (2011) are bolded.

[4] "No information incorporated" means the SMP EIS/EIR impact analysis did not refer to specific ECs or specific assumptions related to restoration.

[5] Where specific SMP restoration activities in the impact analysis are not noted, assume the following (from Chapter 2):

- Site Preparation
  - Grade and prepare to recreate flows and hydraulic conditions
  - Fill ditches in with dirt, brush boxes, or other material, may include digging starter channels
  - Establish vegetation communities prior to inundation
  - Implement moist soil management
  - Maintain levees and water control structures
- Upgrade or Construct New Exterior Levees
  - Upgrade existing interior levees w/brush boxes or other biotech wave dissipaters, or construct new exterior levees
  - Construct habitat levees, depending on cost and availability of fill, by widening existing interior levees, or construct new interior levees or islands
  - Construct habitat levees from available resources, including dredged channel material and excavated material
- Breaching Levees
  - Breach edges may require scour protection with rock, geotextiles, or piles, or long reaches of the levee may be graded down to lower elevations
  - Breach location, number, and size will be chosen to maximize ecological benefits and minimize upstream tidal muting, tidal elevation changes, slough channel scour, and hydraulic changes

[6] MMs identified in the SMP EIS/EIR (2011) are underlined.

NI = No impact

LS = Less than significant impact

B = Beneficial

S = Significant

SU = Significant and Unavoidable

Chapter 4
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Chapter 5
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Chapter 5
Physical Environment

This chapter provides environmental analyses relative to physical parameters of the project area. Components of this study include a setting discussion, impact analysis criteria, project effects and significance, and applicable mitigation measures. This chapter is organized as follows:

- Section 5.1, "Water Supply, Hydrology, and Delta Water Management";
- Section 5.2, "Water Quality";
- Section 5.3, "Geology and Groundwater";
- Section 5.4, "Flood Control and Levee Stability";
- Section 5.5, "Sediment Transport";
- Section 5.6, "Transportation and Navigation";
- Section 5.7, "Air Quality";
- Section 5.8, "Noise"; and
- Section 5.9; "Climate Change."

Section 5.1
Water Supply, Hydrology, and Delta Water Management

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on water supply, hydrology, and Delta water management.

Delta water management for agriculture, water supply diversions, and exports and the salinity of water diverted for waterfowl habitat in the managed wetlands of the Marsh officially became linked in the 1978 State Water Board Delta Water Control Plan and the water right decision (D-1485) Suisun Marsh salinity standards (objectives). D-1485 required DWR and Reclamation to prepare a plan to protect the beneficial use of water for fish and wildlife and meet salinity standards for the Marsh. Initial facilities included improved RRDS facilities to supply approximately 5,000 acres on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly Islands with lower salinity water from Montezuma Slough, and the MIDS and Goodyear Slough outfall to improve supply of lower salinity water for the southwestern Marsh. These initial facilities were constructed in 1979 and 1980; the required Suisun Marsh Plan of Protection was prepared and approved in 1984. This section describes the impacts of the SMP alternatives on water supply in Suisun Marsh. The impacts on hydrodynamics (water flows and tidal elevations) also are described in this section; water quality effects (i.e., salinity and contaminants) are described in the next section (Section 5.2).

SWP and CVP projects affect Suisun Marsh salinity by regulating Delta outflow through upstream reservoir storage and releases and Delta exports. D-1485 (since 1978) and the currently applicable D-1641 (since 1995) require DWR and Reclamation to meet various Delta outflow and salinity objectives in the Delta and in the Marsh. These objectives limit the allowable exports during some periods of relatively low Delta inflows. The State Water Board suggested in D-1485 that "Full protection of Suisun Marsh now could be accomplished only by requiring up to 2 million acre-feet (maf) of freshwater outflow in dry and critical years in addition to that required to meet other standards." This was strong motivation for DWR and Reclamation to prepare a plan of protection for Suisun Marsh that would use other facilities or management actions to provide appropriate salinity in the Marsh. The SMSCG on Montezuma Slough near Collinsville, which began operating in October 1988, were constructed by DWR and Reclamation to improve the salinity in the Marsh channels without requiring the additional Delta outflow that the State Water Board had anticipated.

Summary of Impacts

Table 5.1-1 summarizes impacts from implementing the SMP alternatives on water supply, hydrology, and Delta water management. There are no significant impacts on water supply or Delta water management from implementing the SMP alternatives.

Table 5.1-1. Summary of Water Supply, Hydrology, and Delta Water Management Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
WTR-1: Reduction in Water Availability for Riparian Water Diversions to Managed Wetlands Upstream or Downstream of Restoration Areas	A, B, C	Less than significant	None required	–
WTR-2: Increased Tidal Velocities from Breaching of Managed Wetlands Levees	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
WTR-3: Improved Water Supply as a Result of Improved Flooding and Draining of Managed Wetlands	A, B, C	Beneficial	–	–
WTR-4: Increased Tidal Flows and Improved Water Supply as a Result of Dredging	A, B, C	Beneficial	–	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section to describe the conceptual linkage between Marsh management alternatives and Delta water management:

- *Comprehensive Review of Suisun Marsh Monitoring Data 1985–1995* (California Department of Water Resources 2001).
- *Suisun Marsh Ecological Workgroup Final Report* (California Department of Water Resources 2001).

- *Conceptual Model for Managed Wetlands in Suisun Marsh* (California Department of Fish and Game 2007).
- RMA modeling of the Marsh and tidal restoration alternatives (Appendix A, "Numerical Modeling in Support of Suisun Marsh PEIR/EIS Technical Memorandum, March 2008").
- *Draft Suisun Marsh Tidal Marsh and Aquatic Habitats Conceptual Model* (Conceptual Model 2010).
- *Design Guidelines for Tidal Wetland Restoration in San Francisco Bay* (PWA and Phyllis Faber 2004).

Regulatory Setting

Tidal hydraulic conditions and potential impacts are of concern to several federal and state agencies. Actual regulations, however, are limited and indirect.

Several federal agencies such as National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and the Corps participate in the monitoring and analysis of tidal conditions in the San Francisco Estuary. FEMA regulates (i.e., evaluates) the 100-year flood frequency tidal elevation, which is determined to be about 7 feet above mean sea level (msl) (National Geodetic Vertical Datum [NGVD] 1929 datum) or 10 feet NAVD 1988 datum.

Several state agencies such as the State Water Board, DWR, and DFG have interests, jurisdictions, and regulatory authority within the Marsh, as generally described in Chapter 1. No specific regulations, however, govern tidal elevations, tidal flows, or tidal velocities in the Marsh channels. Several local agencies such as Solano County have interests, jurisdictions, and regulatory authority within the Marsh. The following sections describe the regulations applicable to water supply and Delta water management, including tidal hydraulic processes.

Federal

Many federal regulations intended to protect sensitive species are in place that affect water supply operations in Suisun Marsh and throughout the Delta. In the Marsh, NMFS and USFWS have implemented some restrictions on the unscreened diversions for the protection of winter-run Chinook salmon and delta smelt, respectively. The winter-run restriction applies from November–January for unscreened diversions, and limits each diversion to 25% of each diversion's capacity. Diversions are also not allowed from February 21 to March 31 on diversions without fish screens. The delta smelt restriction applies in April and May when unscreened diversions are restricted to 20% or 35% of each diversion's capacity, depending upon the presence of delta smelt in the Marsh. These protective measures require more skillful water management to provide sufficient soil leaching, soil moisture, and water depth in ponded areas during the winter and spring months. In addition to the Suisun Marsh specific water supply restrictions, the 2008 USFWS and 2009 NMFS BOs for the Coordinated Operation of the CVP and SWP (Operations BOs) dictate some water supply operations in the Marsh (operation of the SMSCG).

State

The State Water Resource Control Board Water Right Decisions and Water Quality Control Plans (WQCPs or Basin Plans) provide the framework for water supply in the Delta and for salinity standards for the water applied to managed wetlands in the Marsh.

The 1978 Bay-Delta WQCP and D-1485 in 1978 introduced the initial salinity objectives in the Marsh to protect the beneficial uses of water for fish and wildlife in the Marsh. The State Water Board directed DWR and Reclamation to prepare a plan of protection for Suisun Marsh. This provision initiated the development of facilities and management assistance within the Marsh. The 1995 Bay-Delta WQCP (State Water Resources Control Board 1995) and D-1641 (State Water Resources Control Board 1999) generally renewed the salinity objectives and management guidelines to protect the beneficial uses of water for fish and wildlife in the Marsh.

State permits and authorizations from DFG intended to protect state listed species including longfin smelt, delta smelt and Chinook salmon, are in place that affect water supply operations in Suisun Marsh and throughout the Delta.

Local

The SRCD has the primary local responsibility for water management practices on privately owned lands within the primary management area of the Suisun Marsh and provides local jurisdiction for the assistance with the management of water diversions and drainage facility operations. The Marsh water rights are riparian or pre-1914; the general requirements for reasonable beneficial uses apply.

Existing Conditions

Tidal Hydraulics of Suisun Bay and Suisun Marsh

Rainfall and Watershed Runoff

The largest gaged creek inflows enter from Suisun Creek to Chadbourne Slough and Green Valley Creek to Cordelia Slough in the northwest Marsh. Runoff from these 30– and 50–square mile watersheds is usually of short duration (1–5 days) with peak daily flows of about 800 cubic feet per second (cfs) to 1,350 cfs for an inch of runoff. Base flow is on the order of 3–5 cfs. Ledgewood Creek flows into Peytonia Slough with a similar runoff assumed (no gage). The Fairfield and Suisun wastewater treatment plant discharges about 20 cfs into Boynton Slough and has a (new) second discharge location into Peytonia Slough just north of Cordelia Road. Development on the periphery of the Marsh also contributes to runoff. Rainfall generally is retained in the managed wetlands and reduces the salinity until discharged with the normal managed wetlands discharges.

Tidal Elevations

Figure 5.1-1 shows the measured tidal elevations for July 2002 at Martinez, located at the downstream end of Suisun Bay. The tides are semi-diurnal (two tide cycles each lunar day of 24.86 hours) with unequal tide elevations on most days.

Table 5.1-2 gives the tidal range for the Port Chicago NOAA tide gage located upstream of Martinez. Using the 1929 NGVD datum (msl), the average (mean) tide elevation (MTL) is about 1.1 feet msl. The 1929 NGVD datum is used for most USGS 1:24000 quad sheets and was the datum for the RMA Bay-Delta model used for analysis of tidal effects. The average high tide or mean high water (MHW) elevation is about 3 feet, and the average of the highest tide or mean higher high water (MHHW) each day is about 3.5 feet. The average of the low tide elevations or mean low water (MLW) is about –0.7 foot, and the average (mean) lower low tide elevation (MLLW) is about –1.5 feet. The average tidal range therefore is defined as the difference between MHW and MLW, which is about 3.7 feet. But as Figure 5.1-1 indicates, the tidal range during a day can be higher or lower, depending on the 14.8-day cycle of spring (highest tidal range) and neap (lowest tidal range) tides. Spring tides can vary by 6 feet, from –1.5 feet to 4.5 feet msl.

Table 5.1-2. Tidal Elevation Statistics in Suisun Bay (Port Chicago NOAA Tidal Gage)

Tidal Elevation	1929 NGVD Datum	MLLW Datum	1988 NAVD Datum
Mean Higher High Water	3.45	4.91	6.13
Mean High Water Elevation	2.95	4.41	5.63
Mean Tide Elevation	1.12	2.58	3.8
Average Low Tide Elevation	-0.72	0.74	1.96
Average Lower Low Tide Elevation	-1.46	0.0	1.22

Figure 5.1-2 shows the measured monthly range of tidal elevations at Martinez for water years 1976–1991. The minimum tide elevation within each month varies somewhat from about –2.5 feet to about –2.0 feet msl. The 10% tidal

elevation (exposed to air for 10% of the month) varies from about –1.5 feet to –1.0 foot msl. The 30% tidal elevation (exposed 30% of the month) varies from about 0.0 feet to 0.5 foot msl. The 50% tidal elevation (median, exposed 50% of the month) varies from about 0.75 foot to 1.25 feet msl. The 70% tidal elevation (exposed 70% of the month) varies from about 1.75 feet to 2.25 feet msl. The 90% tidal elevation (exposed 90% of the month) varies from about 2.75 feet to 3.25 feet msl. The maximum monthly tidal elevation varies from about 4 feet to 5 feet msl. The MHW and MHHW correspond to the lower and upper range of the 90% monthly tidal elevation. The MLW and MLLW correspond to the upper and lower range of the 10% monthly tidal elevation. MTL corresponds to the 50% (median) tidal elevation.

Tidal Volumes

The ocean tides provide the water movement and water exchange within the Marsh. Water flows into the Marsh channels during flood (rising elevation) tides and fills the Marsh to the high tide elevation. Water flows out of the Marsh channels during ebb tides (declining elevation), draining the Marsh to the low tide elevation. Each channel will convey the water needed to fill or drain the upstream tidal volume, sometimes called the tidal prism. This is the volume between the MHW and the MLW elevations. If the Marsh had vertical walls, this volume would be the upstream surface area times the average tidal range of 3.7 feet (MHW – MLW). The highest tide each day has a larger tidal prism, defined as the difference in volume between MHHW and MLLW, a tidal range of almost 5 feet. The tidal prism upstream of a station can be measured with a tidal flow gage or simulated with a tidal hydraulic model.

Table 5.1-3 gives the surface area for tidal channels and tidal wetlands within the existing Marsh, estimated from the RMA tidal hydraulic model, which is based on existing bathymetric survey data. The area and volume estimates from the DWR tidal model of the Delta (DSM2) are given for comparison; the RMA model has a more detailed bathymetry for the Marsh channels. The volume of the Marsh channels and sloughs below MLLW (i.e., subtidal) is about 36,000 acre-feet (af). The volume of Marsh channels and tidal wetlands at MHHW is about 58,000 af. The intertidal volume is therefore about 22,000 af. The existing intertidal volume of the Marsh is about 40% of the total volume at MHHW, and the existing subtidal Marsh volume is about 60% of the total volume at MHHW. Most of the subtidal volume is in Montezuma Slough, Suisun Slough, and a few other large tidal sloughs. The average tidal volume (tidal prism) between MHW (55,500 af) and MLW (38,000 af) is about 17,500 af. The tidal exchange is therefore a large fraction (30%) of the Marsh MHHW water volume.

The surface area of the Marsh open to tidal action is about 3,700 acres at MLLW (elevation –1.4 feet msl) and about 5,800 acres at MHHW (elevation 3.4 feet msl). The intertidal area within the Marsh is about 2,100 acres. Because the area is 3,700 acres with a volume of 36,000 af at MLLW, the average depth of these subtidal channels and sloughs is about 10 feet. Zone 1 and Zone 4 are representative areas of managed wetlands that might be converted to tidal

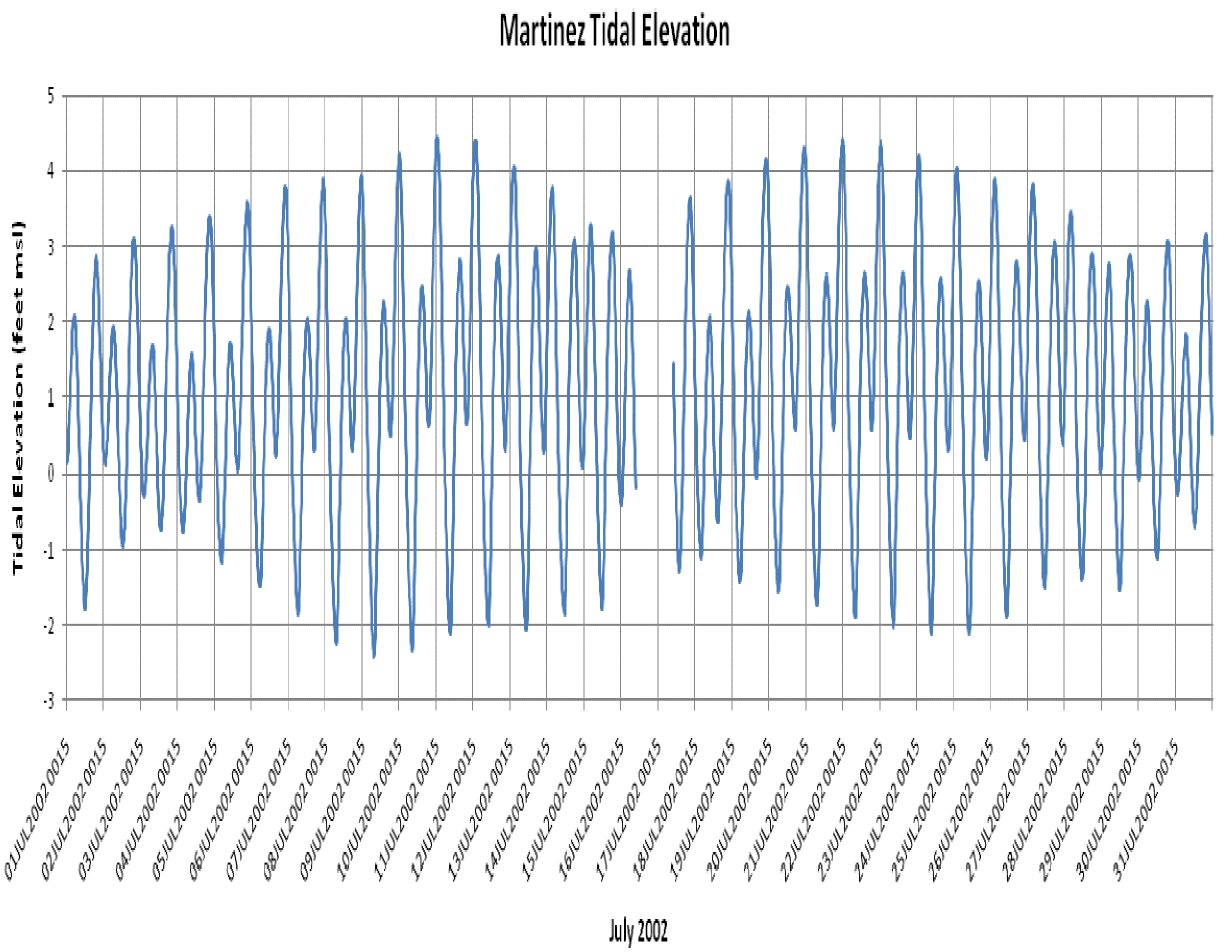
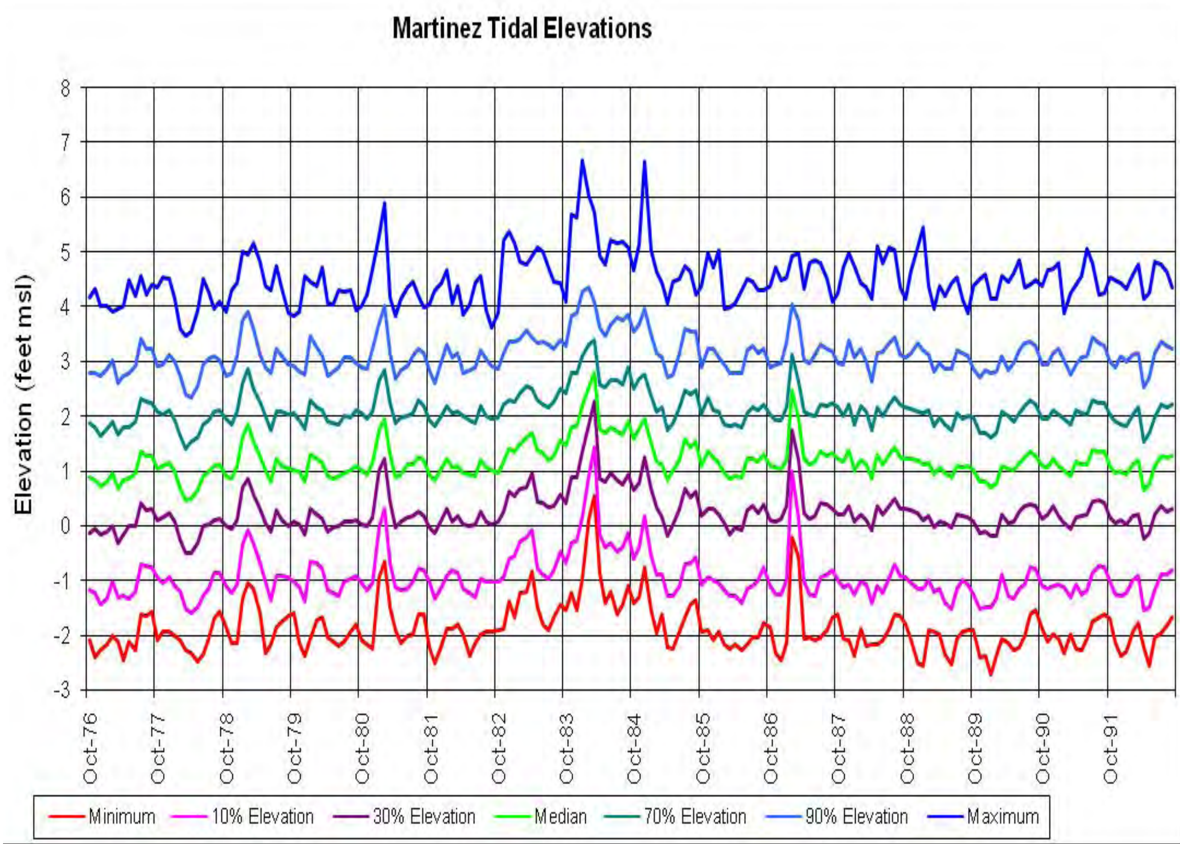


Figure 5.1-1
Measured Tidal Elevations at Martinez in July of 2002



Note: Highest tides correspond to major outflow periods in 1983 and 1984.

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Figure 5.1-2
Measured Monthly Distribution of Tidal Elevations at Martinez for Water Years 1976–1991

wetlands, as described in the Assessment Methods section and in Appendix A. The Zone 1 and Zone 4 areas and volumes are shown here to demonstrate that the intertidal and subtidal distribution of tidal marsh would be similar to the existing area and volume distribution of tidal channels within the Marsh.

Table 5.1-3. Summary of Suisun Marsh Tidal Geometry

Elevation (feet msl)	Tidal Range	Baseline Area (acre)	Baseline Volume (acre-feet)	DSM2 Area (acre)	DSM2 Volume (acre-feet)	Zone 1 Area (acre)	Zone 1 Volume (acre-feet)	Zone 4 Area (acre)	Zone 4 Volume (acre-feet)
5		7,326	68,485	3,804	54,128	1,949	14,502	3,302	27,174
4		6,531	61,481			1,951	12,553	3,310	23,869
3.4	MHHW	5,793	57,787			1,966	11,378	3,319	21,880
3	MHW	5,350	55,560	3,708	46,615	1,976	10,589	3,325	20,551
2		4,682	50,607			1,985	8,610	3,337	17,220
1	MTL	4,378	46,085			1,989	6,626	3,339	13,881
0		4,094	41,829	3,513	35,751	1,991	4,638	3,340	10,542
-1	MLW	3,797	37,870			1,540	2,939	3,105	7,265
-1.4	MLLW	3,700	36,367			1,328	2,350	2,988	6,054
-2		3,455	34,210	3,288	28,946	835	1,601	2,598	4,302
-3		2,909	30,975			383	880	1,402	2,133
-4		2,618	28,202			146	568	477	1,022
-5		2,405	25,678	2,364	20,199	114	455	138	624

Tidal Channels

Tidal channels perform two fundamental functions in the Marsh plain. First, tidal channels are the conduits through which water, sediment, nutrients, and aquatic organisms circulate into, around, and out of the Marsh. This transport function directly controls most of the physical conditions in a tidal marsh to which plants and wildlife are subject. Channels also provide habitat for a wide variety of fish and wildlife species. Vegetation along the channels provides edge habitat for birds and other wildlife species. Channels may provide shallow-water habitat for dabbling and diving ducks and other waterfowl. Channels provide forage and rearing habitat and movement corridors for a wide variety of fish species. Most tidal channels in Suisun Marsh are bordered by levees that protect managed wetlands. These levees are often a mix of dredged sediment and artificial materials such as riprap and often have fringing vegetation. Channel sediments are primarily mud (silt- and clay-size particles).

Montezuma Slough is the major tidal channel within the Marsh. The length of Montezuma Slough is about 32 km from the mouth at Suisun Bay (western end) to the head near Collinsville (western end). The major tributary channel to Montezuma Slough is Nurse Slough. Nurse Slough joins Montezuma Slough near the middle and extends about 5 km north along the east edge of Potrero Hills. Little Honker Bay is located on Nurse Slough adjacent to the Blacklock tidal wetlands, north of Kirby Hills. Denverton Slough extends north from Little Honker Bay.

Suisun Slough is the second major tidal channel within the Marsh. It has a length of about 21 km from the mouth at Suisun Bay (southern end) to Suisun City (northern end). Cordelia Slough joins Suisun Slough from the west, about 3 km upstream from the mouth of Suisun Slough. Cordelia Slough extends about 12 km along the northwest edge of the Marsh. Cordelia Slough crosses under the Southern Pacific Railroad and connects with Chadbourne Slough and several other small channels. Goodyear Slough joins Cordelia Slough near its mouth.

Hunter Cut connects Montezuma Slough and Suisun Slough about 7.5 km north of the mouth of Suisun Slough. Several small tidal sloughs branch from Suisun Slough. Wells Slough connects with Chadbourne Slough. Cutoff Slough connects Suisun Slough and Montezuma Slough about 15 km upstream from the mouth of Suisun Slough. Sheldrake Slough joins Suisun Slough from the west. Boynton Slough joins Suisun Slough from the west, and receives the freshwater discharge (of about 20 cfs) from the Fairfield–Suisun City wastewater treatment plant. Hill Slough joins Suisun Slough from the east and extends to the north of Potrero Hills. Peytonia Slough joins Suisun Slough just south of Suisun City.

Several other channels (historical tidal sloughs) have been isolated from tidal influence by the levees around the managed wetlands. The largest of these are Roaring River, Grizzly Slough, Frost Slough, Island Slough, and upper Tree Slough, which once were connected to Montezuma Slough, and Volanti Slough, which once connected with Suisun Slough.

Tidal Wetlands

Most of the historical tidal wetlands in the Marsh were separated from tidal flows with levees and converted (i.e., drained) for agricultural use. Later, these areas were converted to managed wetlands for waterfowl hunting and are regularly flooded in the late fall and early winter. Several of the major areas still open to tidal flows in the Marsh are ecological preserves. A total of 7,672 acres of tidal wetlands remains. Rush Ranch tidal wetlands are located north of Cutoff Slough. Hill Slough tidal wetlands are near the northern end of Suisun Slough, flowing to the north of Potrero Hills. Peytonia Slough Ecological Reserve is located at the northern end of Suisun Slough. Blacklock is a recently (2006) restored 70-acre tidal wetlands on Nurse Slough (little Honker Bay). Figure 5.1-3 shows the locations of these major existing tidal wetlands within the Marsh.

There are tidal wetlands along the Marsh sloughs and channels called fringe wetlands. These fringe wetlands are located along the levee bank or berm adjacent to the levee. The wetland usually extends about 5–10 feet from the levee, representing just an acre per mile. The total area of these intertidal bands

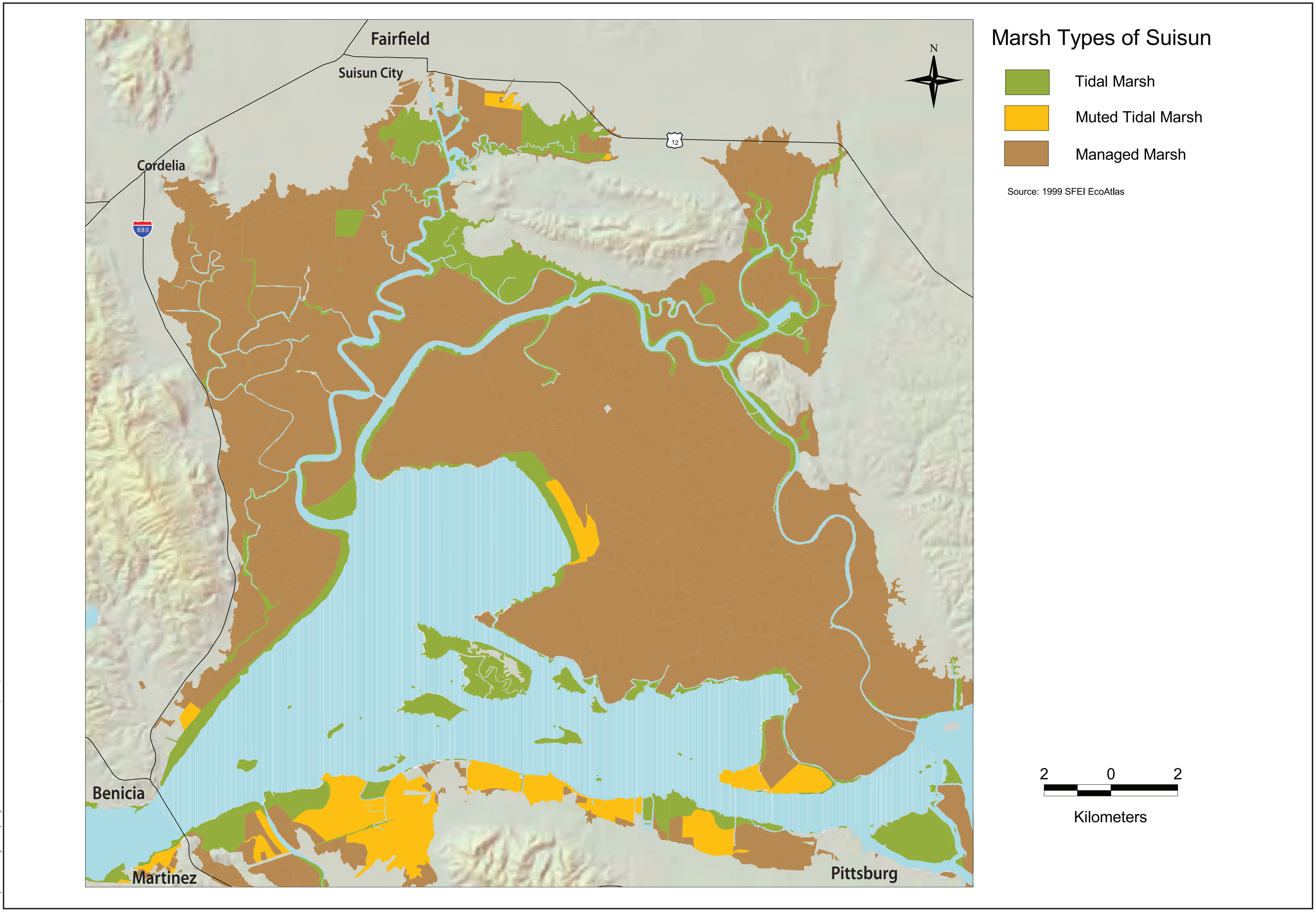

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Figure 5.1-3
Marsh Types in Suisun Marsh

along the channel banks is estimated to be 1,500 acres, which is the majority of the existing intertidal area in the Marsh.

Tidal marsh vegetation may be restricted to particular tidal inundation bands. For example, channels with bottom elevations below the MLLW are almost always inundated. This portion of the tidal marsh channels is called subtidal or shallow-water habitat. Bulrushes, cattails, tules, and other emergent vegetation can grow in the subtidal zone with elevations of less than –1.5 feet msl (MLLW). Some emergent vegetation can grow in the shallow habitat below MLLW, but most emergent vegetation is located above MLLW.

In the San Francisco Bay area, intertidal marsh vegetation is generally confined to above MTL, with mud-flats below this elevation. Low marsh in San Francisco Bay generally is defined as elevations of 1 foot msl to 3 feet msl (MTL to MHW). Dominant low marsh vegetation in Suisun Marsh includes bulrushes, tules, and cattails. The middle marsh is defined as a narrow band between elevation 3.0 feet and 3.5 feet (MHW to MHHW). This zone typically is dominated by saltgrass and pickleweed. The high marsh is defined as 3.5 to 5 feet msl (MHHW to spring-tide high water).

Managed Wetlands

About 52,112 acres in the Marsh are diked with low levees and managed as waterfowl habitat, but most are privately owned waterfowl hunting clubs. These managed wetlands are separated from the tidal sloughs by exterior levees, and water exchange is controlled by gated culverts. Waterfowl club managers control the timing and duration of flooding to promote growth of waterfowl food plants within the confines of existing regulatory constraints. Water levels are manipulated to optimize wetland plant diversity while preventing salt accumulation in the managed wetland soils. This is achieved by using the existing managed wetland topographical variation and contouring and ditching low areas to ensure adequate drainage to avoid trapping water in sinks and elevating salinities as a result of evaporation of remaining water.

Flooding and draining of these managed wetlands depends on the tidal elevation and location in the Marsh. Water is flooded onto the managed wetlands during periods of high tide when the channel elevation is higher than the flooded elevation. The managed wetlands cannot be flooded higher than MHHW unless a pump is used. Drainage without a pump cannot lower the water elevation below MLLW. Therefore, the land elevations of most of the managed wetlands are intertidal. Some of the lands are below MLLW and must be drained with ditches and pumps. Some subtidal areas in the managed wetlands that cannot be drained are managed as permanent ponds, with circulation, which provides habitat for resident and migratory waterfowl and wildlife.

Tidal Flows in Suisun Marsh

Tidal flow propagates into Suisun Marsh through western Grizzly Bay and creates large tidal exchanges at the mouth of Montezuma Slough (peak flow of about 50,000 cfs) and Suisun Slough (peak flow of about 15,000 cfs). The tides in the eastern Marsh are significantly less energetic, and peak tidal flows in the eastern end of Montezuma Slough are about 10,000 cfs. Tidal exchange occurs from both ends of Montezuma Slough, although the tidal flows are smaller (averaging about 5,000 cfs) at the upstream end (head) near Collinsville.

Tidal Flows in Suisun Slough

The mouth of Suisun Slough is the most downstream (western) channel in the Marsh. Suisun Slough supplies tidal flows to Cordelia Slough, Goodyear Slough, Wells-Chadbourne Slough, Cutoff Slough, Boynton Slough, Peytonia Slough, and Hill Slough.

Figure 5.1-4 shows the simulated tidal stage and tidal flow at the mouth of Suisun Slough (Godfather gage) and above Hunter Cut for July 2002. The tidal elevation in Suisun Slough is nearly identical to the tidal elevation at Martinez. The tidal elevation has a slight gradient in Suisun Slough, with a positive (downstream) elevation difference of about 0.5–1.0 foot during ebb tide, and a negative (upstream) elevation difference of about 0.5–1.0 foot during flood tide. At slack tide the water elevations are about equal throughout the Marsh channels. Figure 5.1-4 also shows the simulated tidal flows at the mouth of Suisun Slough for July 2002. Tidal flows are greatest at the beginning of ebb tide, when water begins to drain from the largest water surface area. The ebb-tide (i.e., downstream) flow decreases as the tidal elevation declines. Ebb tide flows are greatest during spring-tide periods when the higher high tide is followed by the lower low tide. The flood-tide (i.e., upstream) flows are more uniform throughout the month.

These tidal elevation changes and corresponding tidal flows can be summarized by calculating the cumulative tidal volumes during each ebb or flood tide. Figure 5.1-5 shows the simulated tidal volumes in Suisun Slough for July 2002. The tidal exchange occurs about twice each day as the tidal elevations rise and fall twice each day. The flood-tide volumes are fairly uniform, while the ebb tide volumes are more variable, ranging from less than 2,000 af to more than 5,000 af during the month. The average tidal volume at the mouth of Suisun Slough is about 3,000 af during each flood and ebb tide. Because a considerable tidal flow moves up Montezuma Slough to Hunter Cut and across to Suisun Slough, the tidal volume in Suisun Slough above Hunter Cut is greater than at the mouth of Suisun Slough. The tidal volume above Hunter Cut averages about 4,000 af during each ebb and flood tide.

Figure 5.1-5 also shows the tidal volumes for the mouth of Cordelia Slough, located about 1.5 miles upstream from the mouth of Suisun Slough and for the mouth of Hill Slough, located about 13.5 miles upstream from the mouth of Suisun Slough. The average tidal volume for Cordelia Slough is about 1,000 af. This includes tidal exchange into Goodyear Slough and portions of Chadbourne

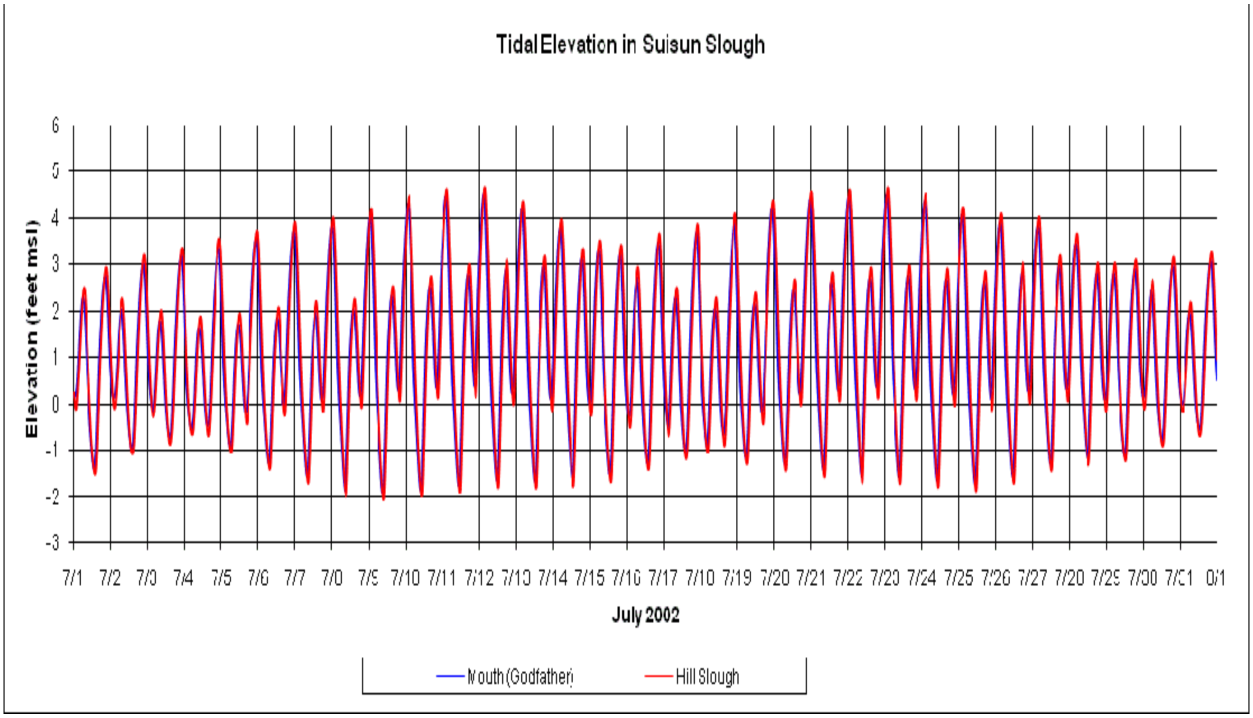

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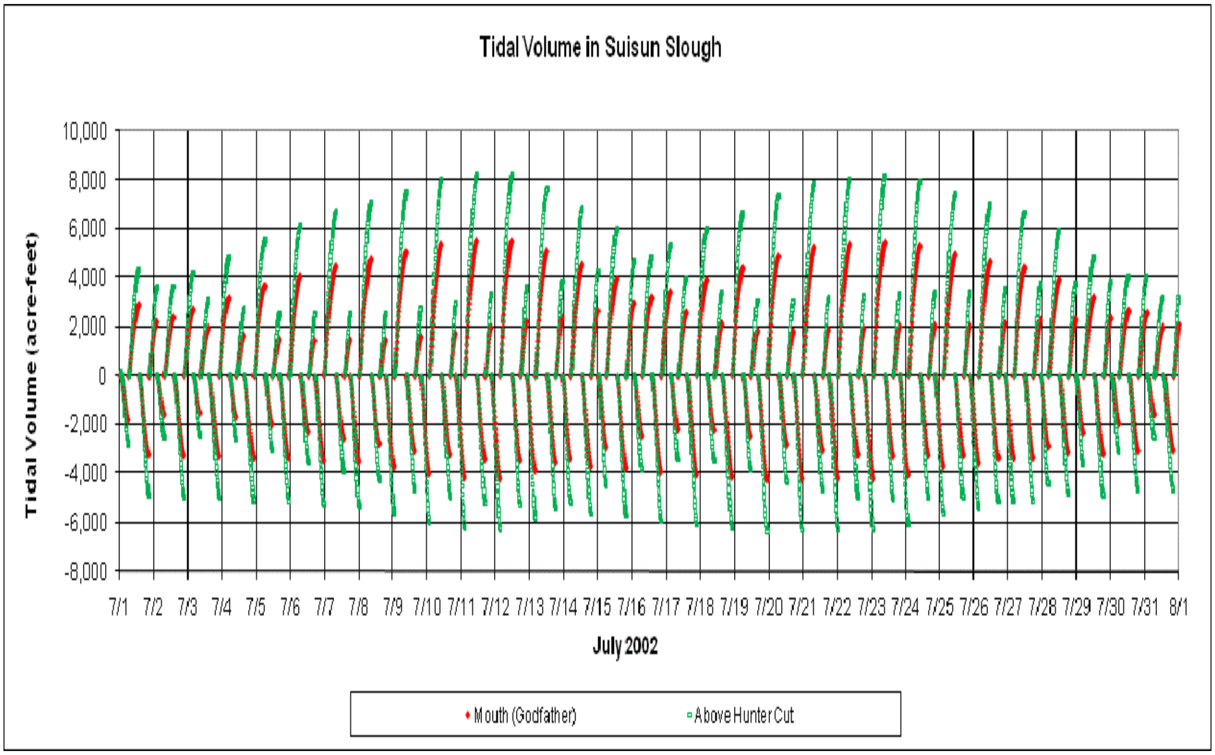
Figure 5.1-4
Tidal Elevations and Tidal Flows in Suisun Slough for July 2002



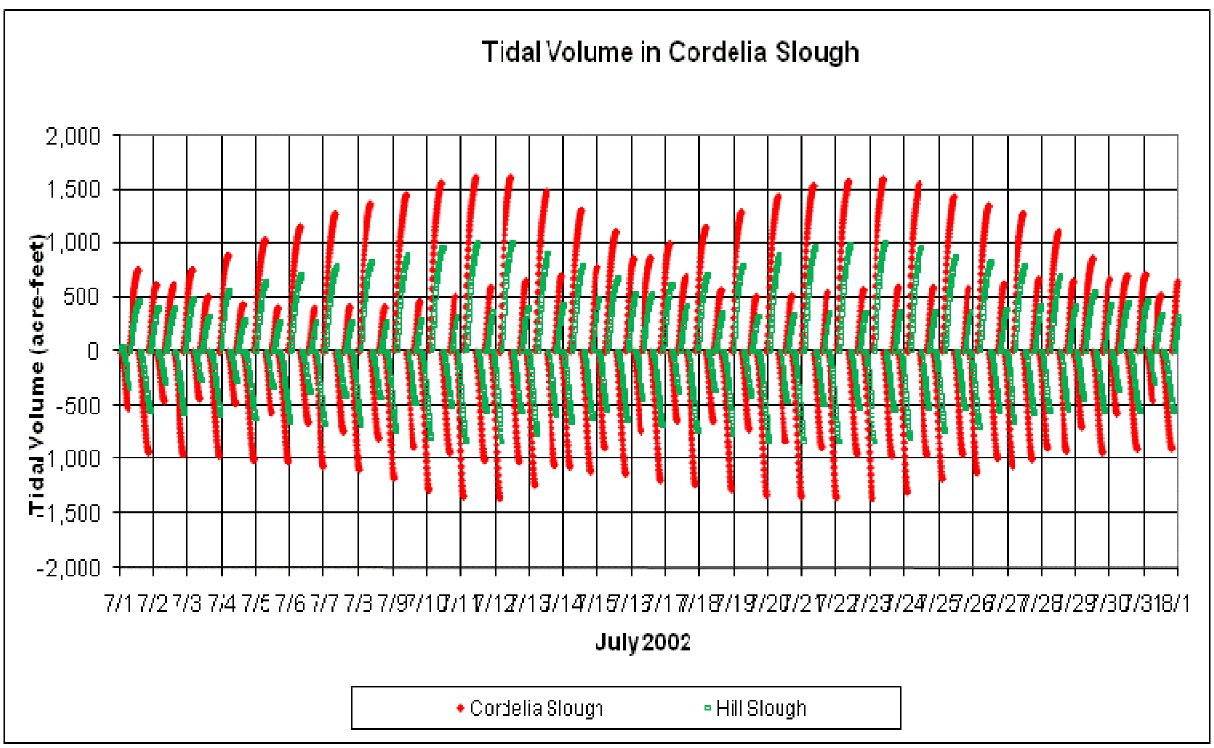


Figure 5.1-5
Simulated Tidal Volumes in Suisun Slough and Tributary Sloughs in July 2002

Slough on the northeast side of the Southern Pacific Railroad. The average tidal volume at the mouth of Hill Slough is about 500 af.

Other tributary channels to Suisun Slough have similar tidal volumes corresponding to the upstream intertidal area and volume. Some of these tributary sloughs include tidal wetlands, but most of these tidal flows fill and drain the tidal slough channels and the fringe wetlands located along the margins of these tidal channels. Table 5.1-3 provides a summary of the subtidal and intertidal area and volume in each of these Suisun Slough tributaries. The average tidal volume is also given for reference.

Tidal Flows in Montezuma Slough

The downstream end of Montezuma Slough is just upstream (east) of the mouth of Suisun Slough. Almost all of the tidal exchange into Suisun Marsh comes from this northern end of Suisun Bay (Grizzly Bay). A small amount of tidal exchange enters the upstream end of Montezuma Slough. The tidal exchange at the upstream end of Montezuma Slough near Collinsville is nearly balanced without much net flow downstream in Montezuma Slough. For July 2002 conditions, the simulated net flow was –56 cfs (upstream toward Collinsville).

Figure 5.1-6 shows the simulated tidal elevation and tidal flows at the head of Montezuma Slough and upstream of Hunter Cut in Montezuma Slough. The simulated peak ebb tidal flows in Montezuma Slough upstream of Hunter Cut ranged from less than 30,000 cfs during neap tide to more than 45,000 cfs during spring tides. The simulated peak flood tidal flows upstream of Hunter Cut ranged from about 20,000 cfs to 30,000 cfs. The simulated tidal flows at the upstream end of Montezuma Slough (head) were about 7,500 cfs to 10,000 cfs. Careful examination of Figure 5.1-6b indicates that the tidal flow at the head of Montezuma begins entering the Marsh from the Sacramento River as high tide approaches (because of the net Delta outflow). This tidal flow into the Marsh continues for the first half of ebb tide, but then the flow direction reverses and water moves upstream (east) toward Collinsville in the second half of the ebb tide. This suggests that the two ends of Montezuma Slough act as separate tidal sloughs, with a null-zone (i.e., no net flow) located somewhere upstream of Nurse Slough (near Meins Landing).

Figure 5.1-7 shows the simulated tidal volumes at the two ends of Montezuma Slough. Because a major portion of the Montezuma Slough flow connects with Suisun Marsh through Hunter Cut, the tidal volumes upstream of Hunter Cut are also shown in Figure 5.1-7. The average tidal volume at the mouth of Montezuma Slough is about 11,000 af. The average tidal volume above Hunter Cut is about 7,500 af. The average tidal volume in Hunter Cut is about 3,500 af. The average tidal flow at the head of Montezuma Slough near Collinsville is about 2,300 af.

Figure 5.1-7 also shows the simulated tidal volumes in Montezuma Slough at Belden’s Landing and in Nurse Slough, which is the major tributary to Montezuma Slough. The average tidal volume in Nurse Slough is about 2,500 af. The average tidal volume at Belden’s Landing is about 5,700 af. Because the flows at Belden's Landing and at the head of Montezuma Slough are in the same direction, the majority of the Nurse Slough tidal volume enters from downstream in Montezuma Slough.

In summary, the simulated tidal flows entering the Marsh channels during each flood tide and leaving the Marsh channels during each ebb tide are a total of about 16,500 af. This is very close to the average tidal volume of 17,500 af estimated from the tidal marsh geometry. This difference is largely attributable to the tidal flow locations being slightly upstream from the mouth of Suisun Slough and Montezuma Slough. As already described, the subtidal volume of 38,000 af (MLW) is about twice the intertidal exchange volume. About one-third of the maximum Marsh volume is replaced during each tidal cycle.

Montezuma Slough Salinity Control Gate Operations

The SMSCG were constructed in 1987 and began operating in 1988 to reduce salinity in the Marsh channels during the salinity control season of October through May, when D-1485 objectives were specified. The relatively complex tidal flows in and out of the head of Montezuma Slough near Collinsville require that the gates be operated in real-time with monitoring of the tidal elevations and flows. Operation of the gates generally involves closing the gates whenever tidal flows would be upstream from Montezuma Slough to the Sacramento River. The gates remain open when tidal flows move into Montezuma Slough to provide the maximum inflow of fresh water to Montezuma Slough. Operations are regulated by the Operations BOs.

The summary of simulated tidal volume at the head of Montezuma Slough can be used to describe the basic SMSCG operations on tidal flows. The average tidal volume for both ebb and flood tides is about 2,300 af during each tidal period (two each day). Therefore, by blocking the upstream tidal volume, a net inflow of about 4,600 af/day of low salinity Sacramento River water will be "pumped" into the upper end of Montezuma Slough. However, the tidal range in Montezuma and Nurse Sloughs will remain about the same, so the flood tide volume entering from the mouth of Montezuma Slough (estimated as 11,000 af) will remain the same, but the ebb tide volume will be increased to 13,200 af). Gate operations will create a net downstream flow in Montezuma Slough of about 2,300 af during each tidal cycle. Because this is about 20% of the flood tide volume entering from the mouth of Montezuma Slough, the salinity gradient within Montezuma Slough will be shifted downstream. The salinity effects of this tidal pumping produced by the SMSCG operations will be more fully described in Section 5.2, Water Quality.

Tidal Velocities in Suisun Marsh

Tidal velocities in the Marsh channels and sloughs are controlled by the tidal flows and the cross sections in the Marsh channels and sloughs. Figure 5.1-8 shows the simulated tidal velocities in several of the major sloughs for July 2002. The peak velocities are generally less than 2–3 feet per second (fps). The natural processes of scouring and deposition produce channel sections that are in equilibrium with these processes and the upstream tidal area (volume). Velocities of more than 3 fps are likely to scour mud and sand bottoms.

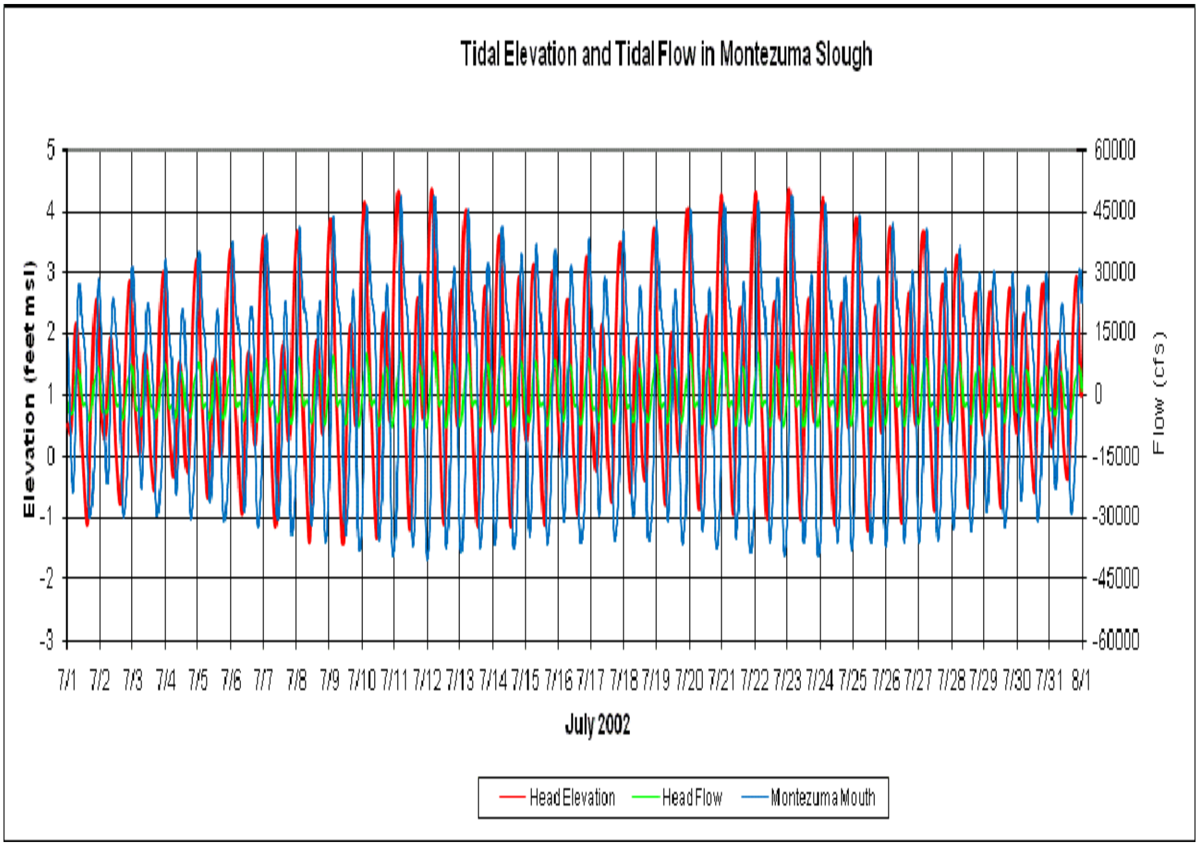


Figure 5.1-6a. Simulated Tidal Elevations and Tidal Flows at the Mouth and Head of Montezuma Slough for July 2002

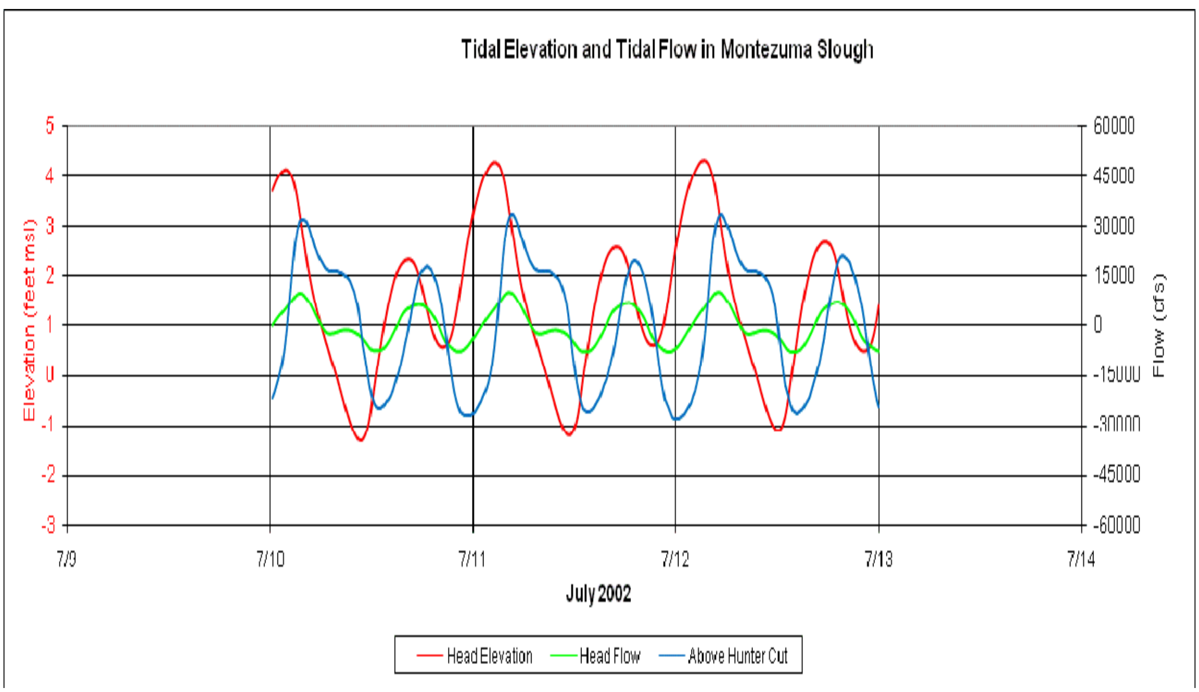


Figure 5.1-6b. Detail of Tidal Simulation for July 10–12, 2002

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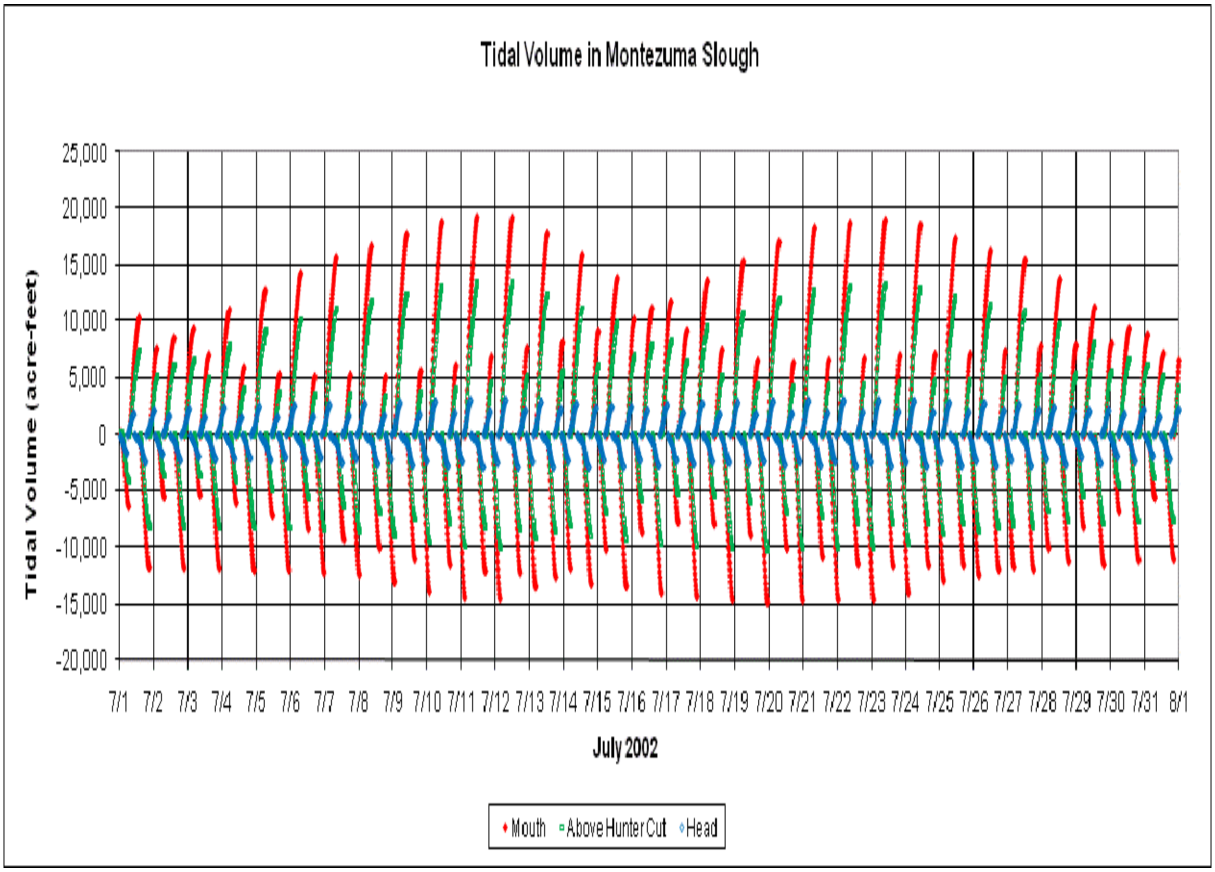
Figure 5.1-6



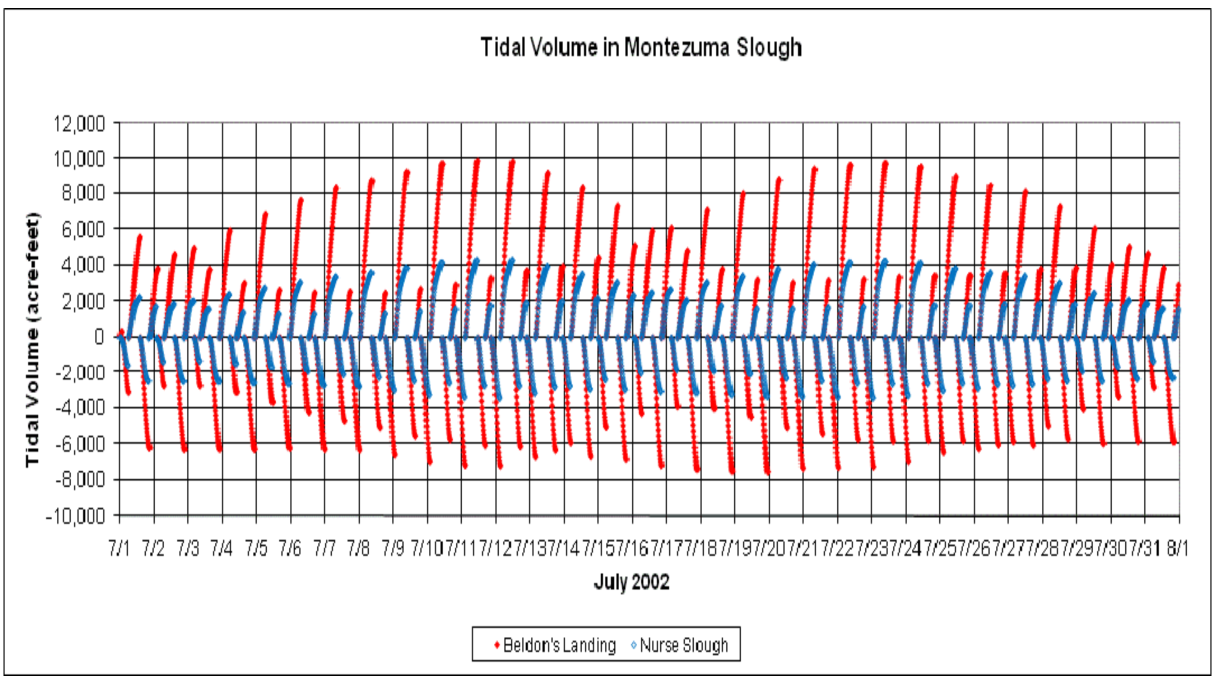


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Figure 5.1-7
Simulated Tidal Volumes in Montezuma Slough and Nurse Slough for July 2002

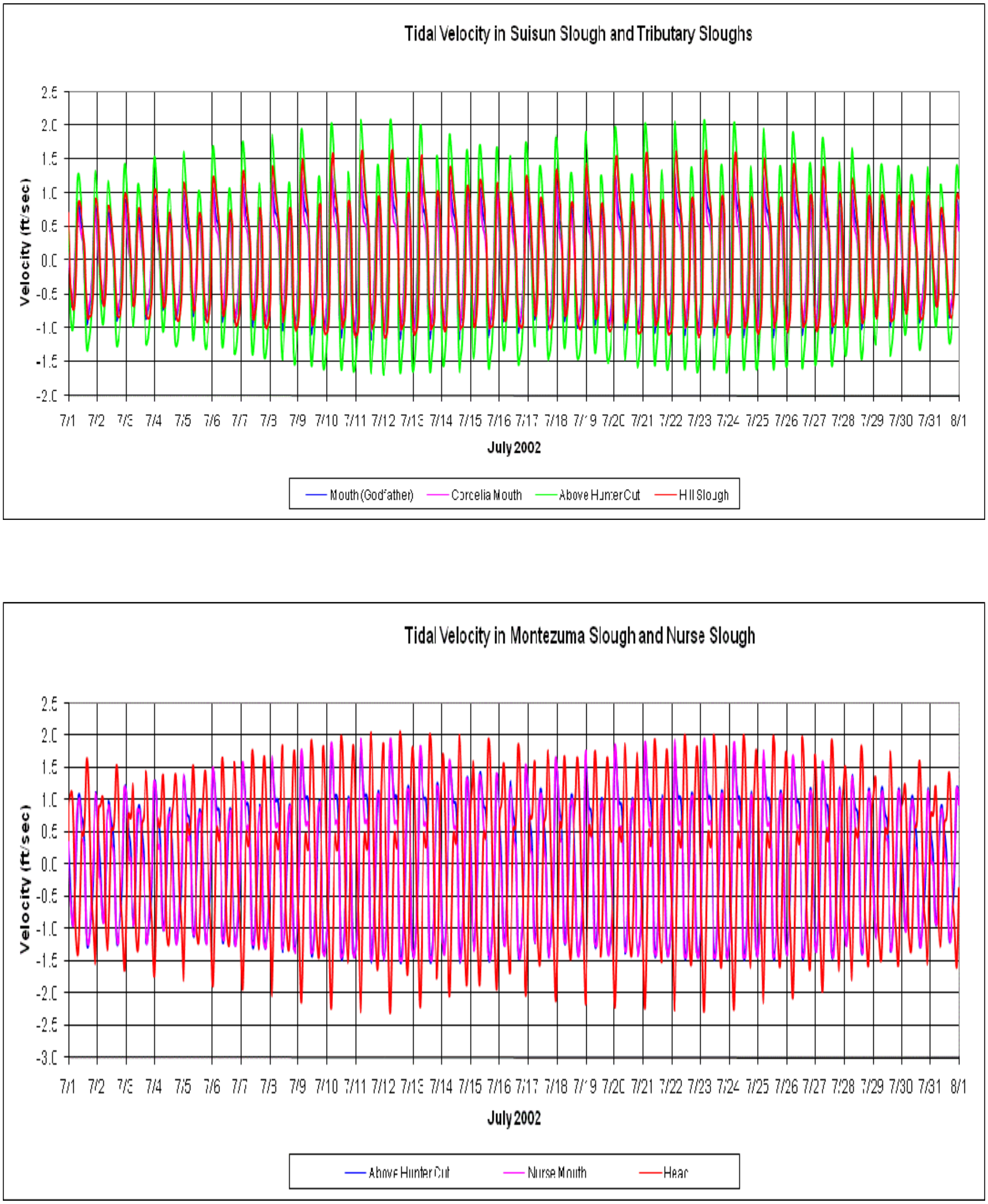

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Figure 5.1-8
Simulated Tidal Velocities in Marsh Channels (Sloughs) for July 2002

Cohesive clay sediment may be less susceptible to scour. Velocities in some connecting channels, such as Hunters Cut, may be higher because of the tidal elevations differences between the channels. Higher velocities also may be expected in levee breaches and main channels of restored tidal wetlands.

Water Supply in Suisun Marsh and Delta

Recent Historical Delta Outflow

Table 5.1-4 gives the monthly historical Delta outflow in 1968–2007. The last column gives the annual total water volume in thousands of acre-feet (taf). The table is arranged by water years because the flooding in the Marsh managed wetlands for waterfowl habitat begins in October. This period corresponds to the historical record when Marsh salinity and Delta water management have been considered linked. These historical Delta outflows were regulated by D-1485 outflow and salinity objectives in the Delta and in the Marsh from 1978 to 1994, and by D-1641 objectives that include similar salinity objectives in the Delta and in the Marsh, revised Delta outflow requirements for the location from the Golden Gate Bridge of the 2 parts per thousand (ppt) salinity gradient (X2), and new limits on the export/inflow ratio (E/I) from 1995 to 2007.

The historical Delta outflow is important for this environmental evaluation of potential impacts from implementing the plan because it controls Marsh salinity and the subsequent beneficial uses for fish and wildlife in the managed wetlands. Table 5.1-5 gives the general relationship between Delta outflow and salinity near the downstream (western) end of the Marsh (Fleet) and at the upstream (eastern) end of the Marsh (Collinsville). See Figure 1-6 for map of Marsh. Also shown is the relationship between Delta outflow and the X2 location. The range of regulated Delta outflow ranges from about 3,000 cfs to about 12,000 cfs. Over this range of outflow, the EC at Fleet varies from 25,000 microSiemens per centimeter (µS/cm) to about 11,000 µS/cm. The corresponding range of EC at Collinsville varies from about 12,000 µS/cm to about 1,500 µS/cm. The X2 location varies from about 91 km (near Emmaton) to 75 km (near Chipps Island or Mallard Slough). These outflow-EC relationships will be described more fully in Section 5.2, Water Quality.

Table 5.1-4. Historical Monthly Average Delta Outflow (cfs) for Water Years 1968–2007 (Source: DWR DAYFLOW database)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (taf)
1968	16,719	16,202	20,498	24,257	52,061	40,314	9,932	6,737	3,666	3,684	5,264	6,004	**12,348**
1969	5,453	11,120	25,682	123,140	159,046	93,506	69,375	64,564	46,596	13,143	12,458	20,188	**38,377**
1970	19,484	19,964	46,190	193,121	111,326	55,986	11,027	10,761	6,214	5,256	7,947	14,587	**30,094**
1971	13,423	26,117	85,369	64,190	34,196	32,049	36,972	26,406	21,218	11,654	12,988	19,660	**23,217**
1972	13,957	13,743	23,967	21,339	21,968	18,127	7,542	5,140	2,891	6,211	6,487	10,476	**9,181**
1973	11,935	25,944	27,133	101,686	102,165	76,907	22,191	11,699	7,212	4,599	5,963	11,153	**24,384**
1974	14,071	59,945	76,406	138,699	59,178	77,575	109,547	25,544	16,943	9,366	12,784	20,981	**37,423**
1975	18,529	23,991	28,018	17,489	57,330	66,834	34,519	28,796	22,508	11,129	9,523	13,419	**19,891**
1976	16,901	17,921	19,954	9,310	7,471	7,788	8,729	3,937	3,775	4,186	4,394	3,583	**6,541**
1977	3,611	3,643	4,213	4,363	4,878	3,007	2,977	3,909	2,383	3,049	2,383	2,717	**2,477**
1978	2,046	4,003	8,570	66,157	56,159	85,619	61,170	40,759	8,945	3,854	5,814	11,718	**21,313**
1979	9,600	10,928	8,780	30,522	46,341	38,087	14,485	13,435	5,316	5,264	3,357	4,972	**11,403**
1980	7,799	12,172	19,029	118,220	121,655	99,152	28,628	20,804	14,790	11,065	4,122	9,803	**28,117**
1981	7,321	6,662	12,487	18,325	21,171	26,483	11,648	9,143	4,596	5,306	3,148	4,696	**7,873**
1982	5,214	36,001	86,287	97,674	92,555	80,088	142,192	57,782	28,123	16,741	13,309	25,802	**40,910**
1983	22,975	39,152	88,908	89,762	175,756	266,623	118,100	98,659	70,929	43,759	24,484	31,442	**64,266**
1984	32,283	74,137	154,587	100,906	41,515	34,916	14,637	11,093	7,925	10,127	8,179	13,586	**30,600**
1985	11,899	25,953	31,066	15,120	15,590	10,410	6,846	7,291	5,113	4,835	2,248	3,175	**8,406**
1986	3,366	6,890	9,430	15,209	205,414	169,447	46,539	15,810	9,223	7,293	5,054	10,726	**29,647**
1987	10,608	7,732	8,986	10,818	16,859	22,916	6,212	4,845	3,382	3,724	2,772	1,737	**6,047**
1988	3,761	4,291	9,454	19,591	3,039	4,481	11,417	4,659	3,082	3,732	2,305	2,251	**4,377**
1989	3,142	6,619	7,231	3,604	6,379	38,928	11,687	7,379	6,156	6,163	4,469	6,446	**6,554**
1990	4,887	5,478	4,399	9,886	6,788	3,813	5,923	7,700	4,846	3,966	4,461	2,450	**3,895**
1991	3,405	4,495	6,383	3,973	7,361	24,579	3,701	3,862	4,002	3,318	2,558	3,761	**4,315**
1992	3,909	3,909	7,623	6,413	28,759	13,283	6,258	3,255	3,426	2,983	2,824	3,366	**5,141**
1993	4,350	4,126	11,603	57,886	55,022	63,969	44,296	25,188	27,078	9,450	9,422	5,306	**19,047**
1994	5,118	7,381	12,361	10,787	20,557	10,595	8,150	7,941	3,782	4,495	3,335	5,506	**5,978**

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (taf)
1995	3,217	5,356	9,629	107,487	72,836	200,645	90,837	98,047	46,754	26,789	10,876	19,629	**41,801**
1996	11,371	8,383	27,709	32,144	126,912	89,148	42,032	46,021	15,270	9,156	9,592	7,293	**25,486**
1997	4,742	10,035	84,538	262,325	118,694	33,699	14,142	12,257	8,199	9,286	8,639	3,914	**34,299**
1998	4,826	10,153	15,351	71,545	230,854	104,441	88,395	67,612	71,736	30,856	19,893	20,060	**43,487**
1999	12,280	20,636	47,241	38,021	98,804	69,106	35,509	22,138	13,664	10,463	5,930	4,784	**22,542**
2000	4,258	6,803	10,467	21,541	94,092	87,828	27,233	22,057	8,823	9,123	6,024	4,622	**18,156**
2001	5,724	4,742	5,996	15,211	19,567	23,404	12,158	9,612	7,404	4,645	3,153	4,123	**6,944**
2002	4,259	8,205	24,733	38,734	12,029	16,964	11,892	13,483	7,374	5,662	3,768	4,108	**9,164**
2003	4,184	7,331	28,885	51,440	29,622	15,761	22,029	41,877	11,719	9,631	6,874	3,447	**14,050**
2004	4,288	6,626	23,820	32,104	68,091	56,256	21,948	12,354	5,651	7,317	5,204	4,676	**14,922**
2005	8,508	6,708	12,449	33,589	24,922	38,546	29,876	50,929	27,838	9,378	5,586	6,897	**15,404**
2006	4,764	5,249	47,943	156,265	55,278	124,121	183,031	82,004	37,105	12,044	8,914	8,610	**43,806**
2007	3,948	5,182	9,238	8,316	21,337	14,039	11,235	9,313	7,793	5,354	3,724	4,616	**6,216**
Minimum	2,046	3,643	4,213	3,604	3,039	3,007	2,977	3,255	2,383	2,983	2,248	1,737	**2,477**
Average	8,803	14,598	29,815	56,029	62,589	58,486	36,125	25,370	15,336	9,201	7,006	9,157	**19,952**
Maximum	32,283	74,137	154,587	262,325	230,854	266,623	183,031	98,659	71,736	43,759	24,484	31,442	**64,266**

Table 5.1-5. Relationship between Delta Outflow and Salinity (EC) at the Downstream (Fleet) and Upstream (Collinsville) Ends of Suisun Marsh

Effective Delta Outflow (cfs)	EC at Fleet (μS/cm)	EC at Collinsville (μS/cm)	Location of X2 (km from GG)
3,000	25,000	12,000	90.7
4,000	23,000	9,500	87.3
5,000	21,000	7,500	84.7
6,000	19,500	6,000	82.6
7,000	18,000	5,000	80.8
8,000	16,500	4,000	79.2
9,000	15,000	3,000	77.8
10,000	13,500	2,250	76.6
11,000	12,000	1,750	75.5
12,000	11,000	1,500	74.5

μS/cm = microSiemens per centimeter.
cfs = cubic feet per second.
GG = Golden Gate Bridge.
km = kilometers.

Salinity, controlled by Delta outflow, is also important for aquatic habitat conditions that influence the distribution and abundance of fish species and other aquatic organisms. These potential impacts will be discussed in Section 5.2, Water Quality, and Section 6.1, Fish.

Historical Central Valley Project and State Water Project Exports

Table 5.1-6 gives the monthly historical CVP exports during 1968–2007. This period corresponds to the historical record when Marsh salinity and Delta water management have been considered linked. These historical CVP exports include the period prior to the SWP exports and San Luis Reservoir operations, which began in 1969. Before the San Luis Reservoir was completed, the CVP exports were used directly for water deliveries along the Delta-Mendota Canal. The CVP exports have been less seasonal since San Luis Reservoir operations began. The CVP pumping plant has a maximum diversion of about 4,600 cfs, and has been regulated by D-1485 objectives from 1978 to 1994, and by D-1641 objectives from 1995 to 2007.

Table 5.1-7 gives the monthly historical SWP exports during 1968–2007. This period corresponds to the historical record when Marsh salinity and Delta water management have been considered linked. The SWP exports generally increased with higher water demands through the 1970s and 1980s. Water demands have been relatively constant and SWP exports have varied with water availability since 1995. The SWP pumping plant had a maximum capacity of about 6,000 cfs until 1988, when four pumps were added to provide a maximum pumping capacity of 10,300 cfs, but the pumping is limited to 6,680 cfs by existing regulatory requirements. The SWP exports were regulated by D-1485 objectives from 1978 to 1994, and by D-1641 objectives from 1995 to 2007.

The historical exports indicate the magnitude of Delta water management that is controlled by CVP and SWP operations. Although the Delta outflow requirements may limit Delta exports, these outflow requirements are conditions on the water rights permits to protect salinity for other beneficial uses.

Table 5.1-6. Historical Monthly Average Central Valley Project Exports (cfs) for Water Years 1968–2007 (Source: DWR DAYFLOW database)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (taf)
1968	1,586	964	428	638	1,721	3,282	3,771	4,165	4,200	4,738	3,902	3,597	**1,997**
1969	3,785	2,298	1,105	2,883	2,998	2,206	1,886	2,187	1,890	2,703	4,366	2,244	**1,844**
1970	1,629	366	0	412	1,481	1,757	3,644	3,562	4,230	4,447	3,559	2,281	**1,653**
1971	2,046	470	8	24	2,312	3,805	3,339	3,609	4,440	4,563	4,372	2,779	**1,918**
1972	2,858	2,322	1,943	1,034	3,253	3,904	3,527	4,065	3,319	4,228	4,391	3,937	**2,346**
1973	3,368	0	0	1,472	631	641	2,473	4,477	4,591	4,640	4,489	3,806	**1,855**
1974	3,342	2,993	1,551	1,235	3,474	4,237	2,564	4,380	4,396	4,498	4,520	3,320	**2,444**
1975	3,440	0	10	2,687	4,189	3,760	4,213	3,949	3,996	4,612	4,490	3,637	**2,349**
1976	3,604	3,833	3,881	4,055	4,584	4,563	4,399	4,540	3,735	3,459	4,564	4,539	**3,008**
1977	3,170	2,518	1,569	3,630	2,250	2,028	1,002	1,657	310	354	1,094	1,641	**1,281**
1978	488	1,638	2,168	3,871	4,065	3,985	2,741	2,066	4,133	4,505	4,166	3,781	**2,264**
1979	2,952	3,206	3,178	2,699	1,227	1,986	3,182	2,991	2,987	4,549	4,558	4,382	**2,296**
1980	3,910	1,031	0	0	2,754	3,236	3,837	2,915	2,863	4,569	4,541	3,509	**2,006**
1981	3,566	3,852	3,788	4,083	3,656	1,942	3,684	3,136	3,458	4,351	4,110	3,314	**2,590**
1982	2,111	1,435	785	1,804	3,788	4,123	3,452	2,984	2,935	2,911	4,349	2,065	**1,971**
1983	2,239	3,337	3,139	3,864	3,947	3,934	3,662	2,823	2,975	3,971	4,266	3,345	**2,502**
1984	2,081	954	1,604	1,373	3,811	4,283	3,961	2,990	2,985	4,676	4,378	3,118	**2,190**
1985	3,614	3,893	3,956	3,859	4,039	3,949	3,900	2,991	3,000	4,573	4,376	4,096	**2,790**
1986	3,927	3,719	3,871	3,881	3,940	2,435	2,783	2,998	2,993	4,450	4,385	4,010	**2,618**
1987	4,000	3,693	4,010	4,004	4,030	2,379	4,339	2,998	2,998	4,435	4,565	4,284	**2,758**
1988	3,998	3,931	4,034	4,063	4,098	4,083	4,083	2,971	2,993	4,479	4,531	4,592	**2,895**
1989	3,547	3,602	4,166	4,183	4,097	4,112	3,987	2,999	2,996	4,739	4,704	4,422	**2,870**
1990	4,217	4,165	4,113	4,137	4,095	4,109	4,253	2,770	2,987	3,661	3,033	3,195	**2,697**
1991	1,107	1,588	2,277	1,883	2,606	3,722	2,882	1,277	894	1,633	1,659	1,852	**1,408**
1992	1,730	2,009	1,855	3,196	2,463	4,094	1,718	846	790	897	989	1,594	**1,342**
1993	967	1,278	1,219	4,006	4,026	4,082	2,882	1,524	1,990	4,303	4,362	4,379	**2,108**

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	**Annual (taf)**
1994	4,311	4,240	4,144	2,277	3,870	2,268	1,562	1,123	1,328	2,512	2,440	3,541	**2,023**
1995	2,480	2,488	3,534	4,141	4,218	2,372	3,326	2,985	4,067	4,463	4,386	4,387	**2,581**
1996	4,334	4,223	4,273	4,272	3,589	739	2,395	2,074	4,416	4,449	4,379	4,295	**2,626**
1997	4,196	4,123	4,083	2,022	557	4,344	2,719	1,744	4,439	4,396	4,429	4,322	**2,510**
1998	4,281	4,201	4,075	3,952	2,956	2,062	1,446	2,320	2,862	4,060	4,371	4,357	**2,474**
1999	4,162	2,136	33	2,978	4,317	4,108	1,710	1,703	3,336	4,426	4,391	4,279	**2,262**
2000	4,249	4,195	2,544	3,205	4,108	3,380	2,207	1,263	3,045	4,319	4,386	4,250	**2,487**
2001	4,208	4,061	3,910	2,737	3,519	1,883	2,177	857	2,997	4,135	4,130	4,081	**2,332**
2002	3,625	3,756	3,677	4,145	3,604	4,182	2,145	857	2,535	4,355	4,337	4,279	**2,505**
2003	4,088	3,671	3,333	4,262	4,274	4,355	1,899	1,465	4,413	4,200	4,308	4,267	**2,685**
2004	4,303	4,324	4,150	4,358	3,968	4,141	1,956	961	3,632	4,374	4,430	4,393	**2,722**
2005	4,350	4,293	3,794	4,217	3,889	3,377	2,121	1,071	4,167	4,374	4,408	4,362	**2,679**
2006	4,342	4,287	4,275	3,918	4,321	3,262	816	1,803	3,363	4,406	4,401	4,378	**2,628**
2007	4,316	4,034	4,140	4,353	4,368	4,023	2,728	843	2,478	4,390	4,429	4,334	**2,679**
Minimum	488	0	0	0	557	641	816	843	310	354	989	1,594	**1,281**
Average	3,263	2,828	2,616	2,995	3,377	3,278	2,884	2,473	3,154	3,995	4,049	3,681	**2,330**
Maximum	4,350	4,324	4,275	4,358	4,584	4,563	4,399	4,540	4,591	4,739	4,704	4,592	**3,008**

Table 5.1-7. Historical Monthly Average State Water Project Exports (cfs) for Water Years 1968–2007 (Source: DWR DAYFLOW database)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (taf)
1968	138	76	167	439	47	1,153	1,479	1,287	284	206	772	1,820	**476**
1969	2,314	2,631	2,572	2,805	1,648	1,143	1,253	975	491	526	556	177	**1,032**
1970	273	628	727	655	385	436	880	283	570	568	834	647	**416**
1971	423	1,482	1,844	1,780	777	846	1,023	843	1,186	1,781	2,148	1,000	**917**
1972	836	640	401	515	407	2,634	2,668	2,216	1,802	665	2,364	2,879	**1,091**
1973	2,915	3,472	3,383	1,428	483	575	795	1,833	2,570	2,820	3,067	1,794	**1,526**
1974	2,479	1,825	1,732	682	1,923	1,972	1,561	2,635	4,545	5,994	4,761	1,620	**1,921**
1975	1,057	1,877	2,744	2,717	2,445	2,245	1,993	1,521	357	398	4,326	4,024	**1,550**
1976	3,870	4,116	3,896	4,139	3,067	3,713	570	869	335	574	2,176	3,689	**1,878**
1977	1,313	1,564	1,090	3,300	1,971	1,722	280	1,310	385	510	425	167	**847**
1978	168	890	3,552	5,937	6,209	1,823	574	1,017	3,491	3,511	4,194	3,657	**2,100**
1979	2,105	2,278	2,785	1,339	1,659	2,294	2,611	3,098	3,166	4,687	5,713	4,795	**2,211**
1980	3,690	4,715	5,894	6,310	3,376	1,069	1,492	1,688	3,012	2,252	4,605	4,092	**2,555**
1981	3,010	2,487	2,901	4,095	3,509	2,813	4,304	1,131	336	2,457	5,002	3,311	**2,132**
1982	3,680	3,197	4,343	3,355	5,614	6,247	6,108	2,970	955	1,057	3,673	3,166	**2,668**
1983	2,973	2,667	5,229	6,175	6,208	1,352	112	404	1,974	1,174	2,833	764	**1,912**
1984	344	732	484	302	1,889	2,586	3,675	2,860	3,078	4,653	4,981	2,258	**1,685**
1985	1,859	4,000	4,452	1,898	3,478	4,561	3,361	3,094	3,402	4,734	5,584	4,485	**2,710**
1986	3,604	3,485	5,881	5,044	2,061	706	1,863	3,183	3,061	4,019	5,423	6,338	**2,705**
1987	3,451	3,020	3,102	2,127	2,707	3,089	2,578	2,184	2,055	4,377	5,075	4,615	**2,319**
1988	1,756	1,377	4,827	6,227	5,802	4,234	4,362	3,184	2,785	3,370	4,123	3,385	**2,747**
1989	1,924	2,339	2,871	5,875	3,968	6,024	6,408	3,121	2,153	4,634	6,452	6,171	**3,136**
1990	6,149	6,060	6,184	6,347	6,315	6,363	5,289	500	385	2,434	3,502	2,577	**3,138**
1991	2,295	2,122	2,780	2,884	1,794	5,933	4,560	1,368	985	870	2,081	2,287	**1,812**
1992	3,447	1,036	1,190	3,088	3,530	6,269	1,246	815	1,107	533	1,580	2,793	**1,612**
1993	765	1,050	2,742	7,564	5,205	1,864	2,745	1,777	2,124	4,305	6,313	6,452	**2,583**

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	**Annual (taf)**
1994	6,455	2,595	6,288	3,496	1,912	1,921	336	707	499	1,721	3,523	3,695	**2,013**
1995	2,779	3,586	3,903	7,508	4,573	533	147	1,279	3,428	5,976	4,823	2,887	**2,500**
1996	2,947	1,235	113	5,707	2,976	2,735	1,801	2,617	5,118	6,085	6,255	5,870	**2,633**
1997	5,514	5,834	3,576	629	1,706	2,577	1,809	1,357	2,688	5,320	4,466	5,797	**2,496**
1998	4,323	4,916	6,838	3,195	234	0	17	909	2,189	3,575	4,431	4,476	**2,134**
1999	4,824	2,191	2,072	1,426	938	2,948	3,105	1,640	1,124	6,277	6,686	6,956	**2,439**
2000	4,986	5,185	3,778	6,454	7,391	5,554	3,048	1,713	4,382	5,852	6,287	6,504	**3,692**
2001	5,050	5,316	4,791	3,929	4,734	5,880	1,724	594	269	3,688	4,077	3,606	**2,635**
2002	983	3,246	6,119	6,466	4,976	3,896	2,114	677	2,265	6,241	6,844	4,199	**2,900**
2003	1,754	3,139	4,165	5,771	6,385	6,216	2,578	983	5,965	6,705	7,004	6,783	**3,458**
2004	2,862	3,828	4,278	6,830	6,408	6,888	2,143	753	1,697	6,342	6,651	5,015	**3,251**
2005	2,843	3,825	4,226	7,801	4,938	3,616	3,868	1,914	5,600	7,162	7,147	7,149	**3,625**
2006	6,303	5,277	6,559	3,184	4,901	2,662	2,713	2,061	3,663	6,862	7,133	7,126	**3,527**
2007	6,024	5,382	6,586	3,454	2,474	3,022	2,088	534	457	6,589	6,765	5,341	**2,954**
Minimum	138	76	113	302	47	0	17	283	269	206	425	167	**416**
Average	2,862	2,883	3,527	3,822	3,276	3,053	2,282	1,598	2,149	3,538	4,366	3,859	**2,248**
Maximum	6,455	6,060	6,838	7,801	7,391	6,888	6,408	3,184	5,965	7,162	7,147	7,149	**3,692**

Managed Wetlands Water Supply

The water supply for the managed wetlands within the Marsh is through riparian and appropriative water rights. Water supply is for waterfowl habitat flooding operations and soil leaching for vegetation management. The majority of diversions occur in October and November at the beginning of the waterfowl habitat flooding period.

The SRCD estimates that the total flooded wetland acreage is about 40,000 acres, and the flooded depth averages about 1 foot. Therefore, the total diversions in October are likely about 40,000 acre-feet. This water is circulated throughout the managed wetlands and then drained back into the slough channels. The water used for soil leaching for salt control and evapotranspiration of the drained wetlands/vegetation in the summer is harder to estimate, but will not exceed seasonal evaporation (about 2 feet). Some of this water is supplied by rainfall, so the total water diversions are likely between 100,000 and 150,000 acre-feet. More details of the managed wetlands water management are provided in the Conceptual Model for Managed Wetlands in Suisun Marsh (California Department of Fish and Game 2007).

Environmental Consequences

Assessment Methods

Timing of availability of the water supply for the managed wetlands in the Marsh is directly related to tidal hydraulics because most water is diverted by gravity to the managed wetlands. These flooding operations rely on adequate tidal water elevations to divert water from the channels. The RMA hydrodynamic model has been used as the primary tool for identifying and evaluating potential tidal hydraulic changes from the SMP alternatives. The tidal hydraulic changes have been evaluated with comparative simulations of tidal hydraulics in 2002 and 2003, which were selected as the evaluation period for RMA modeling because these were recent years with relatively low Delta outflow, so the salinity conditions in the Marsh were relatively high (typical of low-outflow years). An alternative may change tidal flows and tidal elevations in the Marsh by increasing the amount of tidal wetlands that exchange water with the channels of Suisun Marsh during the tidal cycle. Changes in tidal elevations and tidal flows, both upstream and downstream of connections with new tidal wetlands, are somewhat difficult to anticipate; mathematical modeling is the most accurate method for simulating these effects. Two possible distributions of new tidal wetlands within the Marsh have been simulated to estimate the likely general effects from substantial new tidal wetlands (about 7,500 acres in each representative simulation). These simulations assumed all the tidal wetland restoration occurred at one time and looked at the immediate effect on tidal elevations of the total restoration. The simulations did not consider how sea level rise may interact with the tidal restoration actions when predicting tidal elevation changes. The simulations also did not look at tidal elevation changes from tidal restoration actions after the change to determine if the potential tidal elevation changes would continue over any part of the SMP planning horizon.

Based on the variables in the simulation, tidal restoration of existing managed wetlands would increase the tidal flow in the Marsh channels between Suisun Bay and the breached levee connections to the tidal wetlands. Tidal flows upstream from the new levee breaches would not be reduced if the tidal channel is large enough to convey the increased tidal flows. Table 5.1-3 shows the increased tidal areas and tidal volumes that would be added to the existing Marsh channels and tidal wetlands if about 2,000 acres of managed wetlands ("Zone 1" example in the southwest corner of Suisun Slough and Suisun Bay) were restored to tidal action with levee breaches. The additional subtidal volume would be about 2,350 af, and the additional tidal volume between MLLW and MHHW (about 5 feet difference) would be about 9,000 af. A slightly larger restoration of about 3,350 acres ("Zone 4" example in the northeast corner on Montezuma Slough) would add a subtidal volume of about 6,000 af and increase the tidal volume by about 16,000 af between MLLW and MHHW. Therefore, about 25% of the example tidal restoration volumes would be subtidal (below MLLW) and about 75% would be intertidal (i.e., above MLLW). The estimated channel volumes from the DSM2 tidal hydraulic model geometry are similar to those of the revised geometry used in the RMA model. The existing RMA model geometry has about 20% more volume at MLLW and MHHW. The RMA model geometry is assumed to be more accurate. More discussion of the effects of simulated tidal restoration on the Marsh channel tidal hydraulics and water quality (salinity) can be found in Appendix A, "Numerical Modeling in Support of Suisun Marsh EIR/EIS."

Changes in tidal hydraulics in Suisun Marsh also can influence the tidal flows and velocities upstream in the Delta channels. This change in tidal exchange can influence salinity intrusion (i.e., tidal mixing) upstream in the Delta and at the water supply diversions and export pumping locations. These salinity effects will be described and evaluated in the Section 5.2, Water Quality.

Potential effects of Delta water management (CVP and SWP operations) on the salinity of Suisun Marsh water diversions are adequately protected under existing conditions by the Delta outflow constraints and water quality objectives included in the water rights decisions (D-1485 and D-1641) that regulate the CVP and SWP exports and other permitted diversions from the Delta. These established standards in conjunction with the Revised SMPA and the PAI Fund are assumed to offset or prevent any potential salinity impacts on the water supply used for beneficial use of fish and wildlife in the managed wetlands within the Marsh. Likewise, because of the protection provided by established water quality objectives, potential impacts of tidal restoration on salinity that would limit the availability or impair the beneficial uses of upstream municipal water supplies are assumed to be negligible.

The nearest municipal water supply diversions are the City of Antioch and the CCWD intake at Mallard Slough, across from Chipps Island. However, because these water diversions are operated only when salinity is below specific thresholds during periods of high Delta outflows, no impacts on these diversions from Suisun Marsh water management or restoration programs are anticipated.

Significance Criteria

Significance criteria have been developed for one possible impact from new tidal wetland restoration in the Marsh related to water supply.

The possible impact is a reduction in the water availability for the water supply of the managed wetlands. The primary water supply for managed wetlands comes from riparian diversions. A reduction in the amount of water available for riparian diversion as the water supply to the managed wetlands caused by tidal wetlands restoration is considered significant.

The primary issues with water availability for the water supply to managed wetlands are amount of water and timing of water available. The restoration of tidal wetlands is not a consumptive use of water and therefore does not have a significant impact on the amount of water available. The restoration of tidal wetlands could affect the timing of available water related to the riparian water supply by alteration of tidal elevations or velocities.

The normal tidal range within the Marsh is about 5 feet. The RMA tidal hydraulic modeling (Appendix A) indicates that reductions in the MHHW elevations and increases in the MLLW elevations are possible at locations adjacent to substantial acreage of tidal wetlands restoration. These possible changes in tidal elevation range (difference between MHHW and MLLW) would result from additional tidal flows and volumes moving into and out of the restored wetlands. The operation of the managed wetland water supply depends on filling the wetlands during high tides. Changes to tidal elevations could affect the timing of water availability for riparian water diversion to managed wetlands.

Increases in the maximum channel tidal velocities could also affect the timing of water availability for riparian water diversion to managed wetlands. Tidal velocities in the Marsh channels and sloughs are generally moderate, with maximum velocities of between 1 fps and 2 fps, depending on the size of the channel cross section and the upstream tidal volume (upstream area). An increase in average channel velocity to more than 2 fps or an increase of more than 1 fps in an existing channel could affect the timing water availability for diversion.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, some restoration of tidal marsh and natural levee breaching would occur. Changes in tidal hydraulic conditions of water elevation fluctuations or velocity fluctuations in the Suisun Marsh channels may occur, depending on the location of the restoration and natural breaching. Changes in tidal conditions upstream in the Delta channels would not be anticipated. The risk of levee failure would remain at existing levels or increase as maintenance of exterior levees continues to be deferred. Following a levee breach, the tidal flows would be changed both upstream and downstream of the breach. After the levee breach is repaired, the tidal conditions would return to the baseline tidal flows and velocities. The likelihood of levee failure under existing conditions is generally known from the historical frequency of levee breaches, and is expected to increase under the No Action Alternative as a result of deferred maintenance and the effects of sea level rise. The primary change in water supply in the Marsh under the No Action Alternatives would result from a regulatory constraint on operations of managed wetlands as a result of limited restoration. Absent the SMP, it is anticipated that NMFS and FWS BOs for the operations of the managed wetlands would not allow continued operations of the same magnitude as current conditions. This could limit the available water supply through restrictions on flood and drain practices. However, Delta water management would continue under D-1641 outflow requirements, export limits, water quality objectives, and other restrictions related to the CVP/SWP Long Term Operations BOs.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Proposed tidal restoration of 5,000 to 7,000 acres throughout the Marsh over the 30-year period may cause tidal hydraulic changes in some of the existing channels. As part of the site-specific assessment, the initial tidal restoration design would be compared to the existing conditions with modeling studies to determine the extent of any hydraulic effects. Reduction of impacts generally will involve tidal restoration design changes (i.e., number of breaches, locations, lengths, and depths) or modifications in the existing channels (e.g., placement of riprap or local dredging). After restoration to tidal wetlands, the existing channels may experience some hydraulic adjustments (i.e., widening in response to higher tidal flows and velocities). However, the hydraulic modeling of the Marsh used fixed channel geometry and therefore represents the first year of tidal marsh restoration, without any substantial hydraulic adjustments.

Restoration Impacts

Impact WTR-1: Reduction in Water Availability for Riparian Water Diversions to Managed Wetlands Upstream or Downstream of Restoration Areas

The impact would be due to a change in timing of water availability for water supply to the managed wetlands due to changes in tidal elevations. Tidal flows into restored tidal wetlands may affect the tidal range in the sloughs adjacent to the restored tidal wetlands. The reduction in tidal range upstream would be caused by the diversion of the flood-tide channel flow into the tidal wetlands, and the drainage from the tidal wetlands during ebb-tide would reduce the drainage of the slough upstream from the restored wetlands. The diversion of a portion of the tidal flows would cause a greater dissipation of the tidal energy through the breach and within the new tidal wetlands area. A similar reduction in the tidal range downstream from the tidal wetlands breach could be caused by increased drainage from the slough and restored wetlands at low tide. Modeling results (see Appendix A, "Numerical Modeling in Support of Suisun Marsh EIR/EIS") and field measurements in sloughs with temporary breaches in managed wetlands levees have demonstrated this effect.

The changes in tidal elevation could affect the timing of water available to the riparian diversions. While the total amount of water available for diversion would not change, changes in tidal elevation would have a small effect on the timing of water availability due to the intertidal location of most manage wetlands in the Marsh. For one season or a portion of one season, the timing of water availability may experience a small change on a diurnal basis due to reduced tidal elevation differences. This change of timing would not significantly affect the beneficial use of the water for fish and wildlife in the managed wetlands and would not affect the amount of water supply available during the diversion periods.

The current operations of some of the managed wetlands could be effected for limited periods of time by reduced tidal elevation differences due to infrastructure limitations, but the amount of water available in tidal sloughs to divert would not be changed.

As described in Chapter 2, breaches will be designed to ensure that tidal flows remain below about 2 fps to prevent tidal muting (i.e., reduced tidal range) that is caused by the increased water surface gradient during peak tidal flows in channels with relatively high velocities.

Conclusion: Less than significant No mitigation required.

Impact WTR-2: Increased Tidal Velocities from Breaching of Managed Wetlands Levees

Tidal velocities in the Marsh channels and sloughs are generally moderate, with maximum velocities of between 1 fps and 2 fps, depending on the size of the channel cross section and the upstream tidal volume (upstream area). These maximum tidal velocities occur regularly (four times each day). An increase in average channel velocity to more than 2 fps or an increase of more than 1 fps in an existing channel is considered a significant change in tidal velocities and may result in local sediment scour or vegetation disruption. As described in Chapter 2, restoration designs will incorporate breach locations to minimize upstream tidal muting, tidal elevation changes, channel scour, and hydraulic changes. This can be accomplished by locating breaches on larger channels or allowing more openings to reduce the effects of the increased tidal flows on tidal elevations and velocities.

Breaches will be designed to ensure that tidal flows remain below 3 fps to prevent tidal muting or scouring that is caused by the increased water surface gradient during peak tidal flows in channels with relatively high velocities.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities

Impact WTR-3: Improved Water Supply as a Result of Improved Flooding and Draining of Managed Wetlands

The increased frequency of managed wetland activities has the potential to improve the ability to flood and drain managed wetlands. Activities that involve improving diversion such as installation and replacement of water control structures, and DWR/Reclamation activities such as maintenance of RRDS, would improve managed wetland water supply for those managed wetlands that implemented these activities. This would be a beneficial water supply impact for individual managed wetlands.

Conclusion: Beneficial.

Impact WTR-4: Increased Tidal Flows and Improved Water Supply as a Result of Dredging

Dredging is proposed to obtain source materials for levee maintenance throughout the Marsh. This includes dredging around water control structures and fish screens. Therefore, dredging would improve the ability of managed wetlands to obtain water supplies for flooding operations. Additional water management facilities and improved maintenance procedures would benefit the water management operations within the Marsh. Dredging channels for levee maintenance materials also would have an indirect effect of improving tidal circulation in dredged channels by increasing the total channel volume.

Conclusion: Beneficial.

Alternative B: Restore 2,000–4,000 Acres

Impacts for Alternative B would be similar to those described for Alternative A. Alternative B involves less tidal restoration, so any minor changes in timing of water availability for water supply would be of less magnitude and would occur in fewer areas of the Marsh.

Alternative C: Restore 7,000–9,000 Acres

Impacts for Alternative C would be similar to those described for Alternative A. Alternative C involves more tidal restoration, and therefore localized changes in timing of water available for diversions may occur more frequently throughout the Marsh, however any impacts to water supply from these minor timing changes would be less than significant.

Section 5.2
Water Quality

Introduction

This section describes the existing environmental conditions and possible beneficial and deleterious impacts on water quality that may result from implementing SMP alternatives.

The Affected Environment subsection below establishes the existing environmental context against which potential impacts may be considered. The Impact Analysis subsection specifically identifies potential impacts, their causes and estimated extents, and mitigation measures to reduce impacts to less-than-significant levels, where appropriate.

Salinity is the best understood and most managed water quality parameter in the Marsh. Delta water management for agriculture and water supply diversions and exports and the salinity of water diverted for waterfowl habitat in the managed wetlands of the Marsh became linked in the State Water Board's 1978 *Water Quality Control Plan for the Sacramento–San Joaquin Delta and Suisun Marsh* (1978 WQCP) and D-1485 Suisun Marsh salinity standards (objectives). The State Water Board required a plan of protection for Marsh water quality conditions. Initial facilities, including an improved RRDS to better supply approximately 5,000 acres on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly Islands with lower salinity water from Montezuma Slough and the MIDS and Goodyear Slough outfall to improve water supply for the southwestern Marsh, were constructed in 1979 and 1980. The Plan of Protection for Suisun Marsh was approved in 1984.

Delta outflow is the primary factor governing salinity in the Marsh. Sloughs in the Marsh are used to flood and drain managed wetlands in support of habitat for resident and migratory wildlife and waterfowl hunting. Increased salinity in water used in managed wetlands inhibits wetland diversity and food-plant productivity intended to attract waterfowl species. Therefore, in addition to other critical water quality parameters, this section explores existing salinity conditions and the possible changes to salinity within the Marsh that may result from the SMP or its alternatives. In addition to salinity in the Marsh, the SMP and alternatives have the potential to affect salinity as distant as the south Delta CVP and SWP export facilities. Modeling of salinity impacts is described in great detail in Appendix A. Overall, minimal salinity effects are expected to occur.

The majority of impacts on water quality can be grouped as conventional pollutants or chemical contaminants. Besides potential adverse changes in salinity levels, other conventional water quality pollutants include low dissolved oxygen (DO), elevated water temperature, and increased levels of suspended sediment (SS). Chemical contamination includes elevated levels of mercury, especially in fish and other aquatic species. (Impacts on fish are discussed in Section 6.1.) In the context of the SMP, the primary anticipated sources of water quality pollution are annual discharges from existing managed wetlands and temporary construction activities during tidal wetlands restoration. However, this analysis assesses only the change in restoration and managed wetland activities associated with the SMP alternatives.

Summary of Impacts

Table 5.2-1 summarizes water quality impacts from implementing SMP alternatives. There are currently chronic significant, albeit temporary and localized, impacts on water quality from annual discharges of poor-quality (e.g., low-DO, high sulfur compound–containing) water from some managed wetlands. These impacts are expected to be reduced under the No Action Alternative and with implementation of the three project alternatives. No significant impacts on water quality solely from implementing any of the SMP action alternatives are anticipated.

Table 5.2-1. Summary of Water Quality Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
WQ-1: Increased Salinity in Suisun Marsh Channels from Increased Tidal Flows from Suisun Bay (Grizzly Bay) as a Result of Restoration	A, B, C	Less than significant	None required	–
WQ-2: Changes to Salinity of Water Available for Managed Wetlands from October to May	A, B, C	Less than significant	None required	–
WQ-3: Increased Salinity at Delta Diversions and Exports	A, B, C	Less than significant	None required	–
WQ-4: Possible Changes to Methylmercury Production and Export as a Result of Tidal Restoration	A, B, C	Less than significant	None required	–
WQ-5: Improved Dissolved Oxygen Concentrations in Tidal Channels from Reduced Drainage of High Sulfide Water from Managed Wetlands	A, B, C	Beneficial	None required	–
WQ-6: Temporary Changes in Water Quality during Construction Activities	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Managed Wetland Activities Impacts				
WQ-7: Temporary Degradation of Water Quality during Implementation of Managed Wetland Activities	A, B, C	Less than significant	None required	–
WQ-8: Temporary Degradation of Water Quality during Dredging, Including Possible Increases in Mercury Concentrations	A, B, C	Less than significant	None required	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section:

- California Department of Water Resources. 1998. Suisun Marsh Preservation Agreement Amendment Three Actions as a means to provide equivalent or better protection than channel water salinity standards at Suisun Marsh Stations S-35 and S-97. Suisun Marsh Branch, Environmental Services Office.
- California Department of Water Resources. 2000. *Comprehensive Review of Suisun Marsh Monitoring Data 1985–1995*.
- California Department of Water Resources. 2001. *Final Report of the Suisun Marsh Ecological Workgroup Chapter 6 Hydrology and Water Quality Sub-Committee*. Prepared for the State Water Board.
- DWR and Reclamation electrical conductivity (EC) monitoring records. Available from IEP and CDEC.
- NMFS Biological Opinion and Essential Fish Habitat Consultation for the 2006 Regional General Permit 3 Extension (National Marine Fisheries Service 2006).
- Resource Management Associates (RMA) (2008) Bay-Delta and Suisun Marsh 2-D Model Calibration and Comparison of Tidal Marsh Restoration (Appendix A).
- San Francisco Bay RWQCB 2010. Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan).
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- Wesley A. Heim, Dr. Kenneth Coale, and Mark Stephenson. 2003. *Methyl and Total Mercury Spatial and Temporal Trends in Surficial Sediments of the San Francisco Bay-Delta, CALFED Bay-Delta Mercury Project Final Report*. October. Moss Landing Marine Lab.
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Regulatory Setting

Implementation of Federal Water Quality Law

The Clean Water Act is the Nation's water quality law, administered by the EPA, with regulatory assistance from the Corps. It generally applies to all navigable waters of the United States. As intended, many day-to-day administrative and regulatory requirements of this act are administered by local, state, and Indian Tribe organizations—for example, in California by the State Water Board and RWQCBs.

The nine RWQCBs designate official beneficial uses of water (e.g., various uses of water to maintain aquatic and wildlife habitats) for all California water bodies, establish water quality objectives (allowable limits) on pollutants intended to protect designated beneficial uses, and develop effective implementation and enforcement plans. The region-specific planning information necessary to manage the State's water quality is contained in regional Water Quality Control Plans (Basin Plans), developed and revised periodically by the RWQCBs. Additional plans and policies are prepared as necessary. In particular, the RWQCBs are required by the Clean Water Act to identify impaired water body segments, those waters chronically failing to meet water quality objectives, and to develop total maximum daily loads (TMDLs) (the amounts of pollution that can be safely tolerated while still achieving objectives) for every pollutant-impaired water body segment combination identified.

Three of the state water quality agencies have direct jurisdiction over parts of the Delta: the State Water Board, the San Francisco Bay RWQCB, and the Central Valley RWQCB. The San Francisco Bay RWQCB, through its regional Basin Plan, has general water quality jurisdiction over the Marsh, Suisun Bay, and, of course, the San Francisco Bay estuary. Beneficial uses for the Suisun Marsh and associated sloughs include estuarine, spawning, and migrating habitat uses for fish species, recreational uses (contact and non-contact) and wildlife habitat uses. Mercury, specifically methylmercury (MeHg), in Suisun Bay is one example of a pollutant–water body combination that has an EPA-approved TMDL requiring regulatory action by the San Francisco Bay RWQCB. Meanwhile, because of the complex, sensitive, and multi-jurisdictional issues involved in one of California's most important watershed areas, the State Water Board Division of Water Rights Bay-Delta Program has for many years developed specific water quality standards for the Delta, including the Suisun Bay area, through various water rights decisions and regional water quality control plans.

State Water Quality Objectives

Salinity

The State Water Board established salinity standards for the protection of Suisun Marsh fish and wildlife starting with its 1978 regional water quality plan (1978 WQCP) and accompanying water rights decision (D-1485). The interim salinity standard was a maximum EC of 12.5 milliSiemens per centimeter (mS/cm) from October to May of all water-year types and locations. These interim salinity standards were to remain in place for 5 years until the Suisun Marsh Plan of Protection was developed, some initial facilities were constructed, and salinity monitoring stations were established.

At the end of the 5-year period, the D-1485 salinity objectives were implemented at eight locations (shown in Figure 1-6) for all water-year types. Maximum salinity (as EC) levels varied from 8 to 19 mS/cm depending on month (October to March) and Delta outflow (19 mS/cm in October, 15.5 mS/cm in November and December, 12.5 mS/cm in January, 8 mS/cm in February and March, and 11 mS/cm in April and May). The State Water Board also required a minimum Delta outflow of 10,000 cfs from February to May in wet-water years. Flow requirements were included in the standards, in part, to help meet salinity requirements. Objectives were not established for summer months because only limited use of water for pond circulation and irrigation of some wetland vegetation occurs from June to September in any particular year.

The revised 1995 WQCP retained the D-1485 monthly standards for Marsh monitoring sites. Salinity objectives at monitoring sites S-35 (Goodyear Slough) and S-97 (Cordelia Slough) had not been implemented because the State Water Board extended the effective date of compliance at these locations by specific orders (October 30, 1997; August 14, 1998; April 30, 1999; and November 1, 1999). Monthly salinity objectives were implemented at three eastern Marsh locations: Collinsville, Montezuma Slough at National Steel, and Montezuma Slough near Belden’s Landing. The Revised SMPA includes the same salinity objectives, and the State Water Board will continue to waive requirements at S-35 and S-97 if equivalent or better protection of the Marsh can be shown through the implementation of the Revised SMPA and the PAI Fund. Instead of numeric standards, a narrative standard was applied. There was disagreement among the many parties with interests in the Marsh as to the efficacy of a narrative standard. The USFWS testimony differed from that of the SMPA agencies. The USFWS expressed concern over the proposed operations of the SMSCG and the efficacy of the D-1641 narrative standard.

In May 1995, the State Water Board asked DWR to convene the Suisun Ecological Workgroup (SEW), with the primary purpose of determining the appropriate measures and objectives to protect and maintain the beneficial uses of the Suisun Marsh to address the need for a salinity standard for the Marsh based on the varied resources existing there. This process required the review of the numeric and narrative salinity standards for the Marsh. The SEW individual workgroups came up with disparate recommendations based on the resources they were examining; namely, brackish marsh vegetation, aquatic habitat, wildlife, and waterfowl. These subgroups were unable to reconcile their differences, and their final report went forward to the State Water Board with a chapter devoted to each resource group and resource-specific recommendations.

The narrative standard calls for maintaining healthy tidal marsh within Suisun Marsh. If the narrative standard is retained, the question of the health of these areas can be answered by the triennial vegetative survey conducted by DWR in cooperation with DFG as part of the SMPA Suisun Monitoring Agreement, which is a “companion” agreement to the SMPA. The survey is designed to detect changes in the vegetative makeup of the Marsh and can distinguish between wetland types. The brackish tidal wetlands are included in that survey, and it therefore can serve as a measure of compliance with the narrative standard. In addition, one of the SMP goals is to increase the amount of tidal marsh while concurrently enhancing existing managed marsh. Therefore, tidal marsh restoration and programs to enhance endangered plant species habitat will provide additional protection and contribute to the recovery of these species.

The 1995 WQCP included a new salinity objective in Suisun Bay known as X2, which allowed the State Water Board to help regulate salinity by controlling flow. X2 is the 2 parts per thousand isohaline point, defined as the location of the 2 parts per thousand salinity contour (isohaline), 1 meter off the bottom of the estuary, as measured in kilometers (km) upstream from the Golden Gate. (The 1995 WQCP used an EC value of 2.64 mS/cm to represent the X2 point.) Biologists determined that regulating the location of X2 in the months of February to June downstream of Collinsville in Honker Bay or Suisun Bay proved beneficial to fish species there, and this may benefit fish in Marsh channels, as well. Figure 5.2-1 shows the location of all water quality compliance and monitoring stations established in the 1995 WQCP and subsequently in D-1641).

Dissolved Oxygen

The minute-by-minute concentration of DO throughout the water column is critical for the immediate survival and long-term viability of fish and other aquatic species. The San Francisco Bay RWQCB Basin Plan DO objective for the Suisun Marsh is 7 milligrams per liter of water (mg/l) or more of DO (or at least 80% of maximum saturation within the water column of DO). Deleterious effects on aquatic organisms may occur at low DO concentrations below 5 mg/l. Therefore, as required by water quality law, the DO objective includes a buffer to ensure that oxygen concentrations stay at acceptable levels for the most vulnerable beneficial uses of water (e.g., maintenance of aquatic habitat for the most sensitive aquatic species). Because the oxygen saturation concentration is temperature-dependent, this minimum DO objective is intended to be particularly protective during warm water temperatures. The warmer water becomes, the less DO it can retain. The oxygen saturation point is about 9.2 mg/l in 20 degrees Celsius (°C) (68 degrees Fahrenheit [°F]) water but only about 8.4 mg/l in 25°C (77°F) water. As a result, temperature-sensitive species, such as salmon, become oxygen-deprived more easily in higher water temperatures.

DO levels increase in water through gradual gas exchange with the atmosphere at the surface of a body of water; turbulent action (e.g., spray and foaming); the release of oxygen throughout the water column by aquatic plants, particularly algae (during daylight hours); and other chemical and physical pathways. Oxygen is removed from water by those same aquatic plants (at night) and by aerobic bacteria, common to most water bodies, at any time. Excessive aquatic bacterial activity (i.e., mass digestion of over-ample food supplies resulting in too-rapid bacteria population increases)—as can occur when water bodies receive excessive amounts of dead organic material—often can result in sudden, catastrophic declines in DO levels. Fish kills can occur in waterways lacking significant flows and, as a result, adequate flushing and mixture.

The analytical process for quantifying the uptake of DO by biological organisms in water is called biochemical oxygen demand (BOD). It involves monitoring DO concentrations in water samples over a set period of time in strictly controlled laboratory conditions (e.g., at a particular temperature). Like DO, BOD is measured in milligrams of oxygen per liter of water. The higher the BOD, the greater the bacterial demand for oxygen and the greater the potential impact on multi-cellular, water-breathing aquatic organisms (e.g., fish, insects, amphibians). Relatively high BOD is required to reduce oxygen concentrations below 5 mg/l. However, this easily can occur under the right conditions in artificially impounded water bodies subject to high organic loads (e.g., from dead or decaying vegetation, the influx of animals wastes, contamination by fertilizers and other organic materials). Moderate BOD commonly reduces DO levels to as low as 7 mg/l.

Another factor related to BOD and DO can be an excess of algae or other aquatic plants. Plants both increase (through photosynthesis in daylight) and decrease (from respiration at night) DO concentrations. Under healthy environmental conditions, the results of these two activities are balanced and DO levels remain adequate both day and night. But under adverse conditions (e.g., long periods of sunlight, warm water temperatures, together with high nutrient loads), algae and other aquatic (often nonnative) plants can proliferate, reach excessive levels, and seriously deplete DO levels. Nighttime demands on oxygen in water from algae blooms can rapidly reduce DO concentrations to near zero, killing water-breathing organisms before oxygen levels have time to recover during daylight hours. And when weather conditions change rapidly (e.g., cloudiness increases, temperatures fall significantly) or herbicides (or herbicidal pollutants) are discharged, large-scale algae die-offs in impounded, slow-moving water bodies can fuel excessive BOD, again seriously reducing DO levels.

The factors discussed above are pertinent to considerations of Suisun Marsh because under certain conditions, managed wetlands contribute to the problems discussed; less so for tidally influenced wetland, where on the average regular flushing generally helps ensure adequate oxygen levels and fewer incidences of algal blooms or excessive BOD.

Temperature

The temperature quality objectives, developed by the State Water Board for estuaries, are (a) any increase in surface water temperature must be less than 4°F (outside a mixing zone) and (b) a change in 25% of the cross section of a river must be less than 1°F. These limits were intended to help control major thermal power-plant cooling discharges. No monthly temperature standards apply.

Suspended Sediment

The San Francisco Bay RWQCB Basin Plan includes objectives for turbidity and SS concentrations. Generally a discharge or dredging activity should not increase the turbidity by more than 10% in water where natural turbidity is greater than 50 nephelometric turbidity units (NTUs).

Mercury

Current Pertinent Mercury Regulatory Guidelines

Both the San Francisco Bay and the Central Valley RWQCB staffs have prepared or are preparing TMDL plans for better control of total mercury and methylmercury in San Francisco Bay and Delta waters. The current (as of October 2010) draft Central Valley RWQCB Delta TMDL recommends a maximum of 0.24 part of methylmercury per one million parts of fish tissue (ppm) in 350 millimeter (mm) (14-inch) largemouth bass, to protect humans who may consume these sports fish. For its draft TMDL effort, Central Valley RWQCB staff has estimated methylmercury values in both water and fish tissue that should be protective of human consumers, as well as fish and wildlife.

The San Francisco Bay TMDL for mercury has a median goal for total mercury in SS of 0.2 ppm, about half the current median level. Discussed in the San Francisco Bay mercury TMDL documents are control measures to reduce mercury input to the bay from upstream (e.g., the Delta, Suisun Bay) and from wastewater treatment facilities. However, because of the large remnant load of existing mercury already present in bay sediments (a legacy of historical mining upstream), these control measures probably will not significantly lower total mercury levels in suspended bay sediment. The bay mercury TMDL also set target criteria of 0.03 ppm methylmercury in small prey fish (<75 mm) that may be eaten by waterfowl and shore birds, and 0.2 ppm methylmercury in large sport fish. Methylmercury levels in about half the fish sampled as part of the San Francisco Bay Regional Water Quality Monitoring Plan (RMP) (conducted by the San Francisco Estuary Institute) are currently above, and therefore violate, these criteria.

The San Francisco Bay RWQCB is currently developing a TMDL to address multiple pollutants, including mercury, in the Suisun Marsh.

Other Water Quality Parameters

The San Francisco Bay RWQCB Basin Plan includes other water quality objectives intended to protect fish and wildlife, recreation and drinking water beneficial uses against various chemical pollutants. One compound of potential concern is ammonia.

Ammonia, a nitrogen-containing compound, commonly exists in water in two forms—the more toxic un-ionized (un-dissociated) "free ammonia" (NH_3), and the much less toxic, ionized (charged) ammonium compound (NH_4^+). The ratio in water of free ammonia to ammonium ions (which together compose total ammonia) increases with increased pH and temperature—i.e., proportionally more toxic NH_3 makes up total ammonia under warmer and more alkaline conditions.

As stated, free or un-ionized ammonia is the form most hazardous to fish and other aquatic organisms. The LC_{50}—the lethal concentration at which 50% of test animals die within a standard length of time (e.g., 96 hours)—of un-ionized ammonia for salmonids species in fresh water can range from 0.2 to 0.7 milligrams of ammonia per liter. Free ammonia therefore is categorized as *highly* toxic by the EPA, and the RWQCB Basin Plan establishes a region-wide water quality objective of 0.025 mg/l as N (annual median).

Ammonia compounds often exist naturally in wetlands as part of a complex nitrogen cycle of physical, chemical, and biological activities. Their production may be related to the natural breakdown of dead vegetation, waste excretions from resident fish and animals, atmospheric deposition of nitrogen, and waste treatment and other discharges. Fortunately, free ammonia is rapidly diluted and degrades to less toxic forms readily in the aquatic environment. Nonetheless, nitrogen-containing materials, including the byproducts of ammonia, from natural and artificial fertilizers and from sewage are often a major biostimulatory (though not necessarily toxic) factor in many California watersheds, fueling the excessive growth of algae and other aquatic plants. Ammonia therefore could be of hypothetical localized concern in the Marsh during temporary dredging operations or more permanently in the vicinity of the treated wastewater discharge into Boynton Slough.

For this document, the assessment of potential impacts from ammonia relies on a qualitative evaluation of likely effects of the alternatives. Experience shows (e.g., DFG Napa–Sonoma Marsh restoration project) that the transformation of previously ponded wetlands into healthy salt marsh habitat should reduce, and certainly not increase, conditions that encourage free ammonia production. Denser populations of salt marsh plants would help remove nitrogen compounds from the water column and sediments. Also, daily tidal flows would help dilute, degrade, and transport away ammonia compounds and by-products. Therefore, any impact from ammonia from restoration activities is expected to be minimal at most and most likely insignificant.

Local

Solano County and local municipalities do not specifically regulate water quality in the managed or tidal wetland areas in Suisun Marsh. The Fairfield-Suisun Sewer District has a National Pollutant Discharge Elimination System (NPDES) permit (a Clean Water Act-based point source pollution permit issued by the RWQCB) which controls its discharge of treated wastewater to the Marsh. The District discharges about 20 cfs of effluent to Boynton Slough. Depending on or despite the level of treatment, such discharges can, over time or during emergency overflow events, be sources of nutrients and other pollutants, including mercury.

Relationship between Delta Outflow and X2 (Salinity Gradient)

Table 5.1-5 shows the basic relationships between effective Delta outflow and the EC values at Fleet and at Collinsville, as well as the estimated X2 locations. The historic Delta outflow values were used to calculate the end of month X2 locations for 1968 to 2007. Over the 40-year period, X2 values averaged 74 km upstream of the Golden Gate, ranging from a minimum 41 to a maximum 98 km. For comparison, Martinez is located at about 54 km, both the downstream (mouth) of Suisun Slough and Port Chicago at about 64 km, and the upstream end of Montezuma Slough at Collinsville at about 81 kilometers upstream from the Golden Gate, the mouth of the San Francisco Bay Estuary.

As discussed above, the X2 isohaline objective currently corresponds to an average electrical conductivity value of 2.64 mS/cm. This objective helps maintain the X2 point downstream of Collinsville from February through June in all years (except in May and June of years where the Sacramento River Index is less than 8.1 maf). This suggests that salinity at the upstream end of the Marsh near Collinsville would be relatively low. The X2 location is, by design, required to be downstream of Chipps Island (now Mallard Slough) at kilometer 75 for several days each month, depending on the previous month's runoff. This generally provides fairly low salinity (less than 5 mS/cm) at the downstream end of Montezuma Slough and Suisun Slough. The X2 salinity objective is intended to provide protection for managed brackish-water wetlands from excessive Suisun Bay salinity in winter and spring months, when water is pumped from Marsh sloughs to help leach salts from soils in managed wetlands.

Calculations using an X2 regression equation (San Francisco Estuary Project 1993) show that an outflow of about 7,000 cfs would maintain average salinity (as EC) at about the 2.64 mS/cm standard near Collinsville, at the upstream entrance to the Marsh and at the upstream end of Montezuma Slough. Such salinity would generally be satisfactory for those Grizzly Island diversions near the SMSCG.

Relationship between Delta Outflow and Suisun Marsh Salinity

The outflow of fresh water from the upstream Delta controls the Suisun Bay salinity gradient and corresponding Suisun Marsh channel salinity conditions. Salinity levels at both the mouth of Suisun Slough and the mouth of Montezuma Slough are very similar to salinity measured in Suisun Bay at Port Chicago (opposite Roe Island). Similarly, salinity in the upstream portion of Montezuma Slough is similar to salinity at Collinsville. The SMSCG reduce salinity in Montezuma Slough, with the most noticeable effects seen at the National Steel and Belden's Landing stations. The impacts on salinity of the SMSCG are less at Hunter Cut and smaller still in Suisun Slough and the tributary sloughs. Minimal impacts from the SMSCG occur in western areas of the Marsh (Cordelia Slough and Goodyear Slough).

Local runoff from Green Valley Creek and Suisun Creek potentially could lower salinity in Cordelia Slough and Suisun Slough after storm events. However, the greatest local runoff often accompanies large flows from the Delta, so salinity-lowering impacts from local runoff in general may be relatively unimportant as salinity throughout the Marsh will already be relatively low when local runoff stands to make the greatest contribution. The 20 cfs discharge of treated wastewater effluent from the Fairfield-Suisun wastewater treatment plant to Boynton Slough provides an additional source of relatively non-salty water year-round that slightly reduces salinity in the upstream end of Suisun Slough.

One source of quantitative data is daily estimates of Delta outflow calculated using the DWR DAYFLOW database. Calculations were based on measured inflows, measured exports, and estimated channel depletions (diversions for agriculture minus drainage and runoff pumped from the Delta islands). Although daily variations in Delta outflow can be large, the average salinity at any particular station in the Estuary responds slowly, with a definite time-lag response. CCWD staff (Denton and Sullivan 1993) calculated the effective outflow based on the sequence of daily Delta outflow values. The equation used is similar to the X2 equation and results in a "moving average" of outflow. CCWD staff also found that salinity (measured as EC or concentration of chloride) at each Estuary station could be estimated from the effective outflow with a negative exponential equation. Based on these calculations, the daily average salinity (as EC) at Martinez, Port Chicago, and Collinsville can be estimated accurately from the daily effective outflow, providing a descriptive procedure for evaluating the range of seasonal salinity in the Marsh as a function of the seasonal Delta outflow conditions.

Measured Suisun Marsh Salinity (Electrical Conductivity)

Figure 5.2-2 illustrates daily Delta outflow, estimated effective outflow, and salinity (as EC) for Suisun Bay stations in 2002 and 2003. The salinity gradient in Suisun Bay can be identified from these data. During periods of high outflow, Suisun Bay salinity is reduced and the salinity gradient is smaller. During periods of low Delta outflow, the salinity (as EC) at Martinez increases to about 30 mS/cm, and the salinity upstream increases proportionally.

Modeled Delta outflow estimates are lower than daily (sampled) Delta outflow measurements when actual Delta outflow is increasing, and effective outflow estimates are higher than daily outflow readings when Delta outflow is decreasing. The effective Delta outflow model is similar to a 14-day moving average of Delta outflow. The minimum effective outflow was less than 5,000 cfs in the fall of both 2002 and 2003. The SMSCG were operated during the October–December period in both years. Delta outflow increased sufficiently in December 2002 to reduce the Marsh channel salinity to meet the salinity objective from January through May 2003, so the SMSCG were not operated after December 2002. As the effective outflow increases, the salinity at all Suisun Bay stations and in the Marsh decreases. As the effective outflow declines, the salinity at all Suisun Bay stations and in the Marsh increases.

Figure 5.2-3 compares estimated salinity against actual measured salinity (as EC) for various Suisun Bay locations. Salinity data from Martinez (generally the highest) and Collinsville (the lowest) define the full range of salinity values in the Suisun Bay area. The top chart portrays measured (actual) salinity during 2002 and 2003 at Collinsville, the SMSCG, and Martinez, and estimated salinity (using CCWD equations) for Collinsville and Martinez. Delta outflow is also portrayed (blue line). As shown, estimated and actual salinity values coincide reasonably well.

The bottom chart plots actual and estimated salinity (as EC) at each Suisun Bay station against effective (modeled) Delta outflow. Collinsville salinity (as EC) declines rapidly as effective outflow increases. This model suggests that Delta outflow is a major factor controlling salinity in Suisun Bay and adjacent Suisun Marsh channels.

The top graph in Figure 5.2-4 compares actual salinity (as EC) measured at several locations along Montezuma Slough in 2002 and 2003. Note a roughly inverse relationship between measured salinity and modeled outflow for all sites (except, naturally, at the SMSCG).The bottom chart illustrates data for the same parameters and time period at Suisun Slough sample sites (fleet data are provided for comparison in both the upper and lower chart). Once again, salinity and flow appear to be inversely related. This suggests that flow is a key impact on salinity levels throughout the Marsh.

Hill Slough salinity was probably lower than the other Suisun Slough stations because of the 25 cfs of low salinity treated wastewater from the Fairfield-Suisun treatment plant discharged into Boynton Slough near the upstream end of Suisun Slough. Tidal mixing distributes this non-saline water throughout the upper end of Suisun Slough (including Peytonia, Boynton, and Hill Sloughs).

Based on current measurements and modeling, Delta outflow is postulated to be the major factor controlling salinity in the Marsh. Dilution of the western sloughs (e.g., Cordelia and Chadbourne Sloughs) occurs after major local storm runoff events. Salinity at the upper end of Suisun Slough is diluted by the Fairfield-Suisun treated wastewater of about 25 cfs. Each year’s data reveals a different seasonal salinity regime, controlled by the seasonal pattern of effective outflow.

Suisun Marsh Salinity Control Gates

The SMSCG near Collinsville began operating in October 1988. The gates control salinity by allowing tidal flow from the Sacramento River into Montezuma Slough during ebb (outgoing) tides but restricting the tidal flow from Montezuma Slough during flood (incoming) tides. The SMSCG cause a net inflow (about 2,500 cfs) of low-salinity Sacramento River water into Montezuma Slough. Operation of the SMSCG lowers salinity in some Marsh channels, primarily those in the eastern Marsh, and results in a net movement of water from east to west. The SMSCG generally are operated from October through May to meet the Suisun Marsh salinity standards (objectives). They generally are not operated when salinity becomes lower than the monthly salinity objectives because of high Delta outflow. The operation of the SMSCG may increase the salinity in Honker Bay and the Delta slightly because the forced diversion into Montezuma Slough reduces the net outflow past Chipps Island and may allow slightly higher seawater intrusion from tidal mixing.

The SMSCG normally are operated from October through May by DWR to help meet D-1641 Suisun Marsh salinity standards for that critical period. The SMSCG have been operated in September occasionally to help reduce Marsh channel salinity prior to initial flooding of managed wetlands in October. Flooding managed wetlands with low-salinity water in late September or early October helps prevent the buildup of salt in flooded (and later dried) temporary pond sediments and improves food plant production for preferred waterfowl species during non-flooded periods later in the year.

Restrictions on unscreened diversions to managed wetlands are intended for the protection of delta smelt and winter-run Chinook salmon, but make it more difficult to manage soil leaching cycles efficiently. It therefore is important to managed wetlands that the intake of salt be reduced to the extent possible during the initial flooding.

Figure 5.2-4 suggests that the SMSCG operation in October of 2002 and 2003 reduced Montezuma Slough salinity somewhat in both years. Hunter Cut, Belden's Landing, and National Steel salinity levels dropped noticeably following SMSCG operations. The Collinsville salinity readings remained relatively constant during the period of SMSCG operations, probably because the effective Delta outflow remained relatively low during that period. Higher Delta outflow in December summarily reduced the Collinsville salinity as well as salinity at the other Suisun Bay stations.

The total number of days the SMSCG are operated varies from year to year. From 1988 to 2004 the SMSCG were operated between 60 and 120 days from October to December. With time and operational experience, achieving salinity standards requires fewer days of SMSCG operation. In 2006 and 2007, the SMSCG were operated periodically between 10 and 20 days annually. This level of operation should continue in the future, except perhaps during the most extreme hydrologic conditions.

Dissolved Oxygen and Temperature

As described above, oxygen concentrations in water and water temperature are somewhat related. Higher water temperatures generally result in lower DO concentrations because the maximum amount of oxygen that can be held dissolved in water (the saturation level) decreases with increased water temperature. This is one reason that unusually warm water temperatures negatively affect some aquatic animals. In Suisun Marsh, low DO levels and warm water conditions may result when discharges of long-impounded water from managed wetlands temporarily overwhelm receiving water in the tidal sloughs. This can occur throughout the Marsh but has been associated most with small dead-end sloughs in Region 1. In compliance with the previous ESA/Essential Fish Habitat (EFH) consultation terms and conditions, managed wetland managers have implemented the following actions:

- eliminate as much drainage discharge to Boynton and Peytonia Sloughs as deemed possible and relocate drainage to Suisun Slough;
- discourage growth of and mow broad-leaved vegetation prior to flood-up to reduce BOD while ponds are inundated;
- increase circulation in managed wetlands to reduce BOD and total organic levels in drainage water (i.e., help prevent incidences of "black water"); and
- implement rapid flooding and drainage to increase water aeration.

These measures are only partially effective in controlling DO and in some cases they could exacerbate the impacts if all the discharges from landowners occur over the same short period of time.

SRCD monitored Peytonia, Boynton, Suisun, Cordelia, Chadbourne, and Goodyear Sloughs in 2006 and 2007 for temperature and DO conditions (Suisun Resource Conservation District and California Department of Fish and Game 2009). DO concentrations in discharge water were consistently less than 5 mg/l, whereas DO levels in receiving (slough channel) waters were generally higher than that level. (Boynton Slough DO concentrations were generally lower than measurements at other ambient stations. The Fairfield-Suisun wastewater discharge may be a factor in the low Boynton Slough DO measurements, although the discharge satisfies the ambient monitoring DO requirements specified by the San Francisco Bay RWQCB. UC Davis researchers also have monitored selected areas in the Marsh. Preliminary results suggest that DO levels have improved in many small tidal sloughs with previous problems.

Suspended Sediment and Contaminants

SS concentrations have been measured at several locations throughout Suisun Marsh. Ruhl and Schoellhamer (2004) measured SS concentrations at a shallow-water site (Honker Bay) and a deep-water channel (Mallard Island) from December 1996 through July 1997. They found similar temporal trends caused by tidal velocities and storm events at both the shallow-water and deep-channel sites. In December, SS was relatively low (25–50 mg/l) at both sites but increased following the first-flush winter storm event to 100–150 mg/l in Honker Bay and 50–100 mg/l at Mallard Island.

The Blacklock Restoration Project is located on Nurse Slough adjacent to Little Honker Bay and provides an example of background SS levels. DWR measured SS concentrations at two locations in Nurse Slough from December 2004 to April 2006 as part of background monitoring for the restoration plan (see Figure 5.2-5). Average SS concentration was about 100 mg/l. Concentrations were lowest (about 50 mg/l) in fall 2005. It appears that Suisun Bay and the Marsh channels have a reasonably high and relatively constant SS concentration of about 50–100 mg/l.

SS binds metals and other potentially toxic chemicals and pollutants, including mercury. However, as discussed elsewhere in this section, clear, predictable relationships among the various forms of mercury, appearing in different media (e.g., water, sediment, living tissue), often are lacking or at least are not well understood. At present, there are no firm grounds to assume that temporary changes to SS levels during habitat restoration will result in higher (or lower) levels of organic mercury, the form of most concern, in resident fish and other species.

Mercury and Methylmercury

The concentration of total mercury in sediments at various levels sampled throughout San Francisco Bay averages about 0.4 ppm (Conaway et al. 2007). However, total mercury levels in deeper bay sediments (which are probably more representative of older, pre-mining and pre-industrial, natural background conditions) average only about 0.05 ppm (almost 10 times less). The higher total mercury levels in shallow, more recent bay sediment layers probably originated with upstream mining (i.e., historical use of elemental mercury in gold processing) and from industrial activities surrounding the Bay-Delta. In comparison, Sacramento River sediment averages about 0.1 ppm in total mercury (one-fourth that of the Bay concentration). The gradual influx of this relatively cleaner sediment into the Bay-Delta therefore may contribute to a long-term overall reduction in the average total mercury load in San Francisco Bay estuary sediments.

As previously discussed, methylmercury concentrations in sediment normally are not correlated with total sediment mercury levels, being linked instead to amounts of sulfate and organic materials in sediment. For example, methylmercury sediment concentrations are generally less than 1% of total mercury levels, but were found as high as 5% in wetlands sediment with relatively high organic peat content near Franks Tract (Choe et al. 2004).

The concentration of SS in Suisun Bay and the Marsh channels is often relatively high (e.g., 50–100 mg/l), and similar concentrations have been measured in Little Honker Bay near the Blacklock tidal wetlands restoration. Mercury is strongly adsorbed onto sediment particles, so inorganic mercury historically entered Suisun Marsh channels from Suisun Bay through tidal transport, creating legacy total mercury sediment concentrations similar in magnitude to those in upper-level San Francisco Bay sediments (i.e., 0.4 ppm).[1]

[1] Slotten et al. (2002) sampled surficial sediments (top 1 cm) throughout Suisun Marsh and the Delta and analyzed the samples for total mercury. Mercury concentrations in Suisun Marsh generally ranged from 0.20 to 0.33 ppm (dry weight). Heim et al. (2003) collected sediment from Suisun Bay and Grizzly Bay and found total mercury concentrations averaging 0.3 ppm (dry wt) with some sites above 0.5 ppm (dry wt). Hornberger et al. (1999) found that the mercury concentration in surficial sediment from Grizzly Bay was about 0.3 ppm. However, the concentration increased to 0.95 ppm at a depth of 30 cm. The mercury-enriched zone persisted to about 80 cm before declining to a background concentration of 0.05 to 0.08 ppm. The higher mercury concentrations in sediments 30–80 cm deep were attributed to hydraulic mining debris.

Slotten et al. (2002) found that flooded tracts characterized by dense submergent and/or emergent aquatic vegetation and highly organic sediments had greater levels of methylmercury in sediment than adjacent non-wetland control sites. These sites generated all of the most elevated sediment methylmercury samples, with vegetated wetlands tracts exhibiting up to 10 times greater methylmercury concentrations than adjacent control sediments. In Suisun Bay, sediment samples were collected from the Ryer Island tidal marsh and the adjacent Grizzly Bay. Methylmercury concentrations on Ryer Island were 2.15 nanograms of methylmercury per gram of sediment (ng/g) compared to 0.30 ng/g in the adjacent channel. (A nanogram is 1/1000 of a microgram [µg].) 2 nanograms are equivalent to about 2 parts of methylmercury per 1 billion parts of sediment, or about 0.5% of the total mercury content of 0.4 ppm. Methylmercury concentrations are generally less than 1% of total mercury in Bay-Delta sediment. The local production of methylmercury by sulfate-reducing bacteria, which may be controlled by the organic content of the sediment, is likely the most important factor for methylmercury concentration. The methylmercury moves into the pore water and is transported to the water column. Benthos (invertebrates, clams) may ingest mercury from the sediments. Phytoplankton and zooplankton incorporate mercury from the water. Fish are exposed to water (very low concentrations) and to the phytoplankton and zooplankton and benthos that they eat.

Mercury concentrations[2] in bivalve organisms (e.g., mussels, clams) range from about 0.5 to 2.5 ppm (dry weight). This is somewhat higher than mercury concentrations found in game fish tissue in the estuary. The national human health criterion for mercury in fish tissue is 0.3 ppm, as established by the EPA (U.S. Environmental Protection Agency 2001). The San Francisco Bay RWQCB mercury TMDL has established a fish tissue methylmercury objective of 0.2 ppm for game fish. The mercury objective for small fish used as prey (forage) by waterfowl, shore birds, and other wildlife is 0.03 ppm. Many of the small fish in the Bay-Delta have average mercury concentration of about 0.025 to 0.075 ppm (Greenfield et al. 2006).

Environmental Consequences

Assessment Methods

Dissolved Oxygen

Changes in levels of DO in Marsh channels are related primarily to annual discharges of poor-quality water from adjacent managed wetlands. Hunting club management procedures create yearly low DO conditions in impounded seasonal waterfowl ponds. When these waters are discharged into sloughs with minimal tidal flushing, the quality of water in the sloughs can decrease significantly, at

[2] Tissue samples are frequently measured in the laboratory for total mercury, as most mercury in animal tissue is methylmercury.

least temporarily. Discharges into the Marsh from adjacent developed and agricultural areas likely contribute to the problem. Tidal restoration of portions of the Marsh would result in fewer poor-quality (e.g., low-DO) conditions. Because the level of improvement to DO concentration levels in Marsh sloughs from tidal restoration cannot be quantified precisely, impacts are described qualitatively.

Total Organic Carbon

There is no evidence to suggest that tidal wetlands will produce larger volumes of vegetation and export more total organic carbon (TOC) than managed seasonal wetlands. There are few measurements of TOC export from managed wetlands, and the contribution of TOC from tidal wetlands has not been measured reliably. Therefore, these impacts are evaluated qualitatively.

Suspended Sediment

The level of SS in Suisun Bay and Marsh sloughs is closely related to measurements of turbidity. Many contaminants are found to be strongly adsorbed (i.e., bound) to sediment particles. The San Francisco Bay Basin Plan SS objectives (turbidity) require the effects of discharge or dredging to be no more than a 10% increase in background levels. Evaluating turbidity in a hydraulically complicated, tidally influenced bay-marsh system is difficult, at best. Impacts of upstream flow, storm and wind events, and existing narrow channels can be difficult to separate from any short-term restoration/construction activities. As there are no measurements of SS or turbidity concentrations in the yearly managed-wetland discharges, the effects of tidal restoration and dredging will be discussed qualitatively.

Methylmercury

The possibility of either increasing or decreasing the amount of methylmercury exported into the bay by restoring tidal wetlands (as compared to maintaining existing managed wetlands) is possible but not yet scientifically proven. Most area experts suspect that low-lying, continuously wet tidal wetlands generally produce and export smaller quantities of methylmercury than do managed wetlands. However, there are no comprehensive studies comparing methylmercury production and export between tidal and seasonal wetlands.

Salinity

Salinity is an important water quality parameter for Suisun Marsh because the presence of salt negatively affects the ability of wetland managers to encourage the growth of vegetation that supports preferred waterfowl species. Salinity in the Marsh is controlled primarily by salinity in Suisun Bay. The salinity of water applied annually to managed wetlands, as well as yearly management (e.g., drainage, leaching) practices, controls the cumulative buildup of salt in managed wetlands soils, which in turn affects vegetation for preferred duck and waterfowl species.

An RMA hydrodynamic and water quality model of San Francisco Bay and the Delta was manipulated to identify and evaluate potential salinity impacts from SMP alternatives. The model evaluated 2 restoration scenarios (Set 1 and Set 2) as shown in Figure 5.2-6, which were intended to capture the range of salinity effects based on different restoration configurations. Details are provided in Appendix A.

The model was used to test the hypothesis that introduced tidal flow to Marsh areas bordering the bay might increase salinity in the Delta and Marsh channels used as a source for seasonal-pond flood-up and at water supply diversion locations. Likely changes to salinity as the result of tidal restoration are described in Appendix A. The RMA model was used to simulate tidal conditions and salinity in the Marsh and Delta for 2002 and 2003 because actual outflow in those years was generally low and those years therefore represent a worst-case (i.e., relatively high fall salinity) scenario.

Using the 2002–2003 low-flow period, comparisons of simulated salinity levels and actual measured salinity values at 14 key monitoring sites suggest that salinity levels in the western portion of Suisun Marsh will not be significantly affected by any of the tidal restoration scenarios (see Appendix A).

Significance Criteria for Water Quality Assessment

Dissolved Oxygen

The San Francisco Bay RWQCB Basin Plan water quality objectives for DO are 7 mg/l for Estuary waters above the Carquinez Bridge, and a 3-month median level of at least 80% of the DO saturation point. A significant deleterious impact on some sensitive species may occur when oxygen concentrations fall below that number (<7 mg/l), or from any reduction in DO levels of more than 20% below the oxygen saturation level. DO levels below the legal water quality objective (7 mg/l) have been observed in virtually all sloughs of the Marsh including Grizzly Bay.

Turbidity

The RWQCB Basin Plan turbidity objectives prohibit more than a 10% increase in turbidity attributable to waste discharge in waters where natural turbidity is above 50 NTU. Turbidity is often directly related to the level of SS. An increase in SS (turbidity) from dredging or tidal restoration of more than 10% of the average background concentration is considered significant. A 10% increase may be difficult to detect because the measured turbidity variations in Suisun Bay and Marsh channels are relatively large during the daily tidal cycles and within the monthly spring-neap tidal cycle.

Mercury

Accurate determination of quantitative significance thresholds for judging potential impacts from methylmercury production and export is difficult because of the complicated nature of mercury chemistry in the environment and indefinite relationships among mercury levels in various media (sediment, water, and animal tissue). Water quality objectives (San Francisco Bay RWQCB Basin Plan) for mercury in Suisun Bay and Marsh saline and brackish waters are in units of total, not methyl-, mercury per water volume: 2.1 μg/l (1-hour average). (For fresh water [salinity <1,000 ppm], the 1-hour average is 2.4 μg/l.) As stated elsewhere, the statistical relationships between total mercury in water and methylmercury in water and living animals are often poor and non-predictive. Yet any impact on natural resources is related to the level of methylmercury in resident animals. Nonetheless, these total mercury objectives, developed by the EPA, are intended to be conservatively protective against bioaccumulation of methylmercury in the food chain and apparently are the only mercury-related water quality objectives that apply to the Suisun area.

No methylmercury water quality objectives and no methylmercury TMDL as yet applies specifically to Suisun Bay or Marsh waters. A methylmercury TMDL for the upstream, primarily freshwater Delta adopted in April 2010 by the Central Valley RWQCB includes target numbers of 0.03 mg/kg (<5 cm), 0.08 (trophic level 3), and 0.24 mg/kg (trophic level 4) for fish tissue, and a corresponding concentration of 0.06 ng/l for ambient fresh waters, all intended to protect human health and wildlife.

For downstream waters a San Francisco Bay mercury TMDL includes target values for protection of (a) human health of 0.2 mg/kg (wet weight) in sport fish and (b) wildlife of 0.03 mg/kg (wet weight) in fish 3 to 5 cm in length (i.e., prey items for many larger fish and for birds). That same TMDL includes target numbers for total mercury in SS (0.2 ppm, dry weight). Again, total mercury levels in sediments do not necessarily accurately predict methylmercury levels in resident animals.

As there are no applicable methylmercury water quality objectives for the Suisun Bay area, determinations of mercury-related significance must be predominantly qualitative. Impacts were considered significant if an alternative would:

- violate any applicable water quality standards or waste discharge requirements,
- degrade surface water and/or groundwater quality, or

- discharge contaminants into the waters of the United States.

Salinity

Any increase in salinity exceeding State Water Board Delta salinity standards is a significant impact. For purposes of this analysis, however, those increases that do not exceed objectives, but are nonetheless greater than 10% of the applicable monthly salinity objective, are also considered significant.[3] Salinity changes that are less than 10% of the maximum monthly criteria are similar to natural variability and are not likely to cause significant harm to natural habitat or species.

For Suisun Marsh objectives, the lowest salinity (as EC) objective is 8 mS/cm in February and March, so the most restrictive guideline would be an increase of more than 0.8 mS/cm in February or March. For the upper Delta water supply intakes, the salinity objective is 1 mS/cm, so the 10% guideline would be a change in salinity of more than 0.1 mS/cm. This guideline is intended to protect the water quality for managed wetland habitat, as well as the salinity at Delta drinking water intakes and agricultural diversions.

Environmental Impacts

No Action Alternative

The existing management of salinity conditions with the operation of the SMSCG would continue as it has since 1988 to lower salinity during the fall and winter period when water is applied to the managed wetlands. Actual operations of the SMSCG would depend on environmental conditions and regulatory constraints by BOs for the Continued Operation of the CVP and SWP (U.S. Fish and Wildlife Service 2008; National Marine Fisheries Service 2009) and other application permits. Uncontrolled levee breaches could occur and, if not repaired, could result in small changes in salinity regimes in the Marsh and, potentially, the Delta. The extent of this change would be based on the size and location of the breaches and whether they are repaired. However, without adequate supplies of levee materials to maintain levees at current standards as well as address sea level rise, the potential for levee failure and resultant changes in water quality will increase over time.

[3] A 10% change in the baseline salinity value would not be considered significant in an estuarine tidal slough or channel unless the baseline salinity was approaching the maximum monthly objective. A 10% (or 5% or 20%) change in baseline salinity has been considered significant in some previous salinity impact analyses. However, if the baseline monthly salinity is relatively low, the significance criteria will be relatively small. A small change in salinity is not likely to cause concern. On the other hand, salinity that increases by a substantial fraction of the monthly salinity objective is potentially harmful.

The No Action Alternative also assumes that absent the SMP, it would be difficult for managed wetland operations to continue as a result of an inability to secure the necessary environmental permits. As such, it is expected that most, if not all, managed wetland flood and drain activities would cease, and the current water quality degradation from managed wetland operations likewise would be reduced. This would result in an improvement in many water quality parameters, including DO, BOD, sulfide, and methylmercury.

Cattle grazing, common on grasslands in Potrero Hills and other surrounding uplands, contributes to (a) increased sediment in adjacent sloughs, (b) degradation or elimination of riparian habitat, (c) trampling of tidal wetland vegetation along sloughs, and (d) introduction of excessive nutrients. Agricultural drainwater from the northwestern and northeastern Marsh contaminates creeks and sloughs in the northwestern and northeastern Marsh with pesticides, herbicides, and fertilizers. Permitted discharges of stormwater and treated wastewater, plus the occasional pollutant spill, also would continue to contribute proportionately and seasonally to Marsh water degradation.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact WQ-1: Increased Salinity in Suisun Marsh Channels from Increased Tidal Flows from Suisun Bay (Grizzly Bay) as a Result of Restoration

Increased tidal flows in Marsh channels from restoration would not significantly increase salinity in channels connecting Suisun Bay with restored tidal wetlands. Seasonal magnitude of salinity in the Marsh would continue to be governed primarily by Delta outflow and operation of the SMSCG. Therefore, changes to salinity are expected to be insignificant.

Additional tidal wetland within the Marsh would increase the tidal flows throughout the Marsh channels and could increase the salinity in the channels between Suisun Bay and the new tidal wetlands. The magnitude of the salinity effects would depend on the location (and breach connection) of the new tidal wetlands and the size (acreage) of the new tidal wetlands. Restoration with tidal connection to Suisun Bay or Honker Bay may have the largest salinity effects. The effects would be greatest during period of low Delta outflow when the Suisun Bay salinity is highest and the salinity gradients within Suisun Bay and along Montezuma Slough are strongest. However, the seasonal magnitude of the salinity in the Marsh would continue to be governed by Delta outflow and operation of the SMSCG.

Modeling by RMA suggests that maximum changes in monthly average salinity in the Marsh would be less than 10% (Appendix A). Figures 5.2-7 to 5.2-13 show simulated salinity in selected Marsh channels for baseline conditions and for simulated tidal restoration conditions (with about 7,500 acres of new tidal restoration) for years 2002 and 2003. Salinity changes in the Marsh sloughs would depend on the additional tidal restoration upstream and downstream from the stations, as well as the location within the Marsh. For example, Goodyear Slough and Cordelia Slough salinity probably would not change with additional tidal wetland restoration in the Marsh because salinity in the western Marsh is strongly controlled by Delta outflow and the corresponding Suisun Bay salinity. The results from this modeling generally indicated the following changes in salinity:

- Mouth of Suisun Slough—No change.
- Montezuma Slough at Hunter's Cut—The simulated restoration cases did not change the EC at Hunter's Cut by more than 1 mS/cm (Figure 5.2-7). No significant change.
- Montezuma Slough at Belden's Landing—The simulated restoration cases did not change the EC at Belden's Landing by more than 1 mS/cm (Figure 5.2-8). No significant change.
- Montezuma Slough at National Steel—Estimated reduction in salinity by about 1 mS/cm (Figure 5.2-9). No significant change.
- Suisun Slough at Volanti—Estimated increase in salinity by about 1 mS/cm (Figure 5.2-10). No significant change.
- Hill Slough—Estimated increase in salinity by about 1 mS/cm (Figure 5.2-11). No significant change.
- Cordelia Slough—The simulated restoration cases had little effect on the simulated EC in Cordelia Slough (Figure 5.2-12). No significant change.
- Goodyear Slough at Morrow—The simulated restoration cases had little effect on the simulated EC in Goodyear Slough (Figure 5.2-13). No significant change.

Models suggest that monthly salinity changes would likely be less than about 5 to 10% of the baseline monthly salinity value, and hence would be less than the significance criteria (10% of salinity objective from October to May). For maximum seasonal salinity values in October (about 15–20 mS/cm) any increase in salinity caused by tidal wetland restoration above the maximum monthly objective (19 mS/cm) would be significant. Any change of more than 10% (1.9 mS/cm) also would be considered significant. Simulated changes in the Marsh locations are much less than these values. Salinity changes in the Marsh channels therefore would be less than significant.

Conclusion: Less than significant. No mitigation required.

Impact WQ-2: Changes to Salinity of Water Available for Managed Wetlands from October to May

As described under Impact WQ-1, models predict that salinity changes at Suisun Marsh monitoring locations, including the eastern channels, would be much less than the maximum allowed by monthly objectives. Also, any change in salinity would be substantially less than 10% of the objectives at those locations. Additionally, the seasonal salinity pattern (determined primarily by Delta outflow) would remain similar, and any potential change to salinity should not reduce the value of Marsh channel water for managed wetlands flood and drain operations.

Conclusion: Less than significant. No mitigation required.

Impact WQ-3: Increased Salinity at Delta Diversions and Exports

Models indicate that any increases in salinity in channels and sloughs upstream can be eliminated by physically connecting tidal wetlands to existing Marsh channels, rather than directly to Suisun Bay. Using this design, any upstream salinity impacts from tidal restoration would be less than significant. Figures 5.2-14 and 5.2-15 indicate that even the largest increase in upstream salinity would be much less than 10% of the average baseline salinity, with no month increasing by more than 10% of any pertinent salinity objective.

Conclusion: Less than significant. No mitigation required.

Impact WQ-4: Possible Changes to Methylmercury Production and Export as a Result of Tidal Restoration

Many, if not most, northern California environmental mercury experts suspect that tidal wetland habitat produces and exports less methylmercury than managed wetlands. Unfortunately, authoritative studies comparing methylmercury production and export among the tidal and non-tidal wetlands are lacking. There is no evidence to conclude that tidal restoration in the Marsh would lead to increased problems with methylmercury for fish and wildlife (and consumers). One preliminary, unpublished account focusing on water entering and leaving the newly tidal Blacklock area suggests an overall reduction in the export of methylmercury in water. This result must also remain preliminary and unsubstantiated. However, ultimately it is not the amount of inorganic or even organic mercury in sediment or in water that is most critical, but the amount of organic mercury that appears in representative, resident organisms and that enters the food chain. As yet there are insufficient data to conclude that those amounts would increase with tidal restoration.

It is reasonable to assume that tidal wetland restoration in Suisun Marsh will not result in increased methylmercury compared to the baseline export of mercury (total or methyl-) in sediment or soils from managed wetlands to tidal sloughs during flood and drain activities. In cooperation with regional monitoring and research efforts, sediment and fish monitoring will be conducted at several restoration sites. Ongoing information can be used adaptively to correct long-term construction and management plans and activities associated with restoration.

Some experts suspect an actual benefit of less methylmercury being exported by tidal marshes than from existing habitat may occur.

Conclusion: Less than Significant. No mitigation required.

Impact WQ-5: Improved Dissolved Oxygen Concentrations in Tidal Channels from Reduced Drainage of High Sulfide Water from Managed Wetlands

As a result of the conversion of managed wetland to tidal wetland, there is the potential of increasing DO and reducing sulfide concentrations in Marsh channels, thereby improving overall water quality conditions. The extent to which this happens depends on the location of restoration sites. Sites with little or no previous DO problems probably would not see a noticeable benefit. Managed wetlands with low-DO events that are restored to tidal influence should see the greatest improvement in water quality. Tidal restoration therefore is expected to have a beneficial impact on water quality because it would increase levels of DO and improve overall water quality in Marsh channels.

Conclusion: Beneficial.

Impact WQ-6: Temporary Changes in Water Quality during Construction Activities

Remobilization of sediments into the water column caused by restoration activities such as levee breaching can lead to temporary, localized increases in SS and DO. However, construction activities would be spread throughout the Marsh and over the 30-year implementation period.

Additionally, as described in Chapter 2 in the Environmental Commitment section, Erosion and Sediment Control Plan and Stormwater Pollution Prevention Plan, SS will be minimized during project activities. Because of the short duration, limited extent of local construction activities, implementation of the appropriate best management practices, and environmental commitments to minimize and control erosion, these temporary water quality impacts would be less than significant.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact WQ-7: Temporary Degradation of Water Quality during Implementation of Managed Wetland Activities

Increased frequency of managed wetland activities and new activities occurring on the waterside of levees could result in temporary and localized impacts on water quality. These activities would occur in small, distinct, localized areas throughout the Marsh and be minimized through the implementation of standard BMPs, as described in Chapter 2.

Conclusion: Less than significant. No mitigation required.

Impact WQ-8: Temporary Degradation of Water Quality during Dredging, Including Possible Increases in Mercury Concentrations

Project dredging would result in a temporary degradation of water quality as a result of disturbing channel-bottom sediments. Water quality parameters that might be affected would include levels of SS, ammonia, and possibly mercury (in SS). But the form of mercury in the SS probably would be predominantly inorganic, with minor or no additional impacts on aquatic life expected. Temporary changes in turbidity would be minimal and localized, and because the minimum SS concentrations in the Marsh are relatively high, the effects of dredging in Marsh channels would not likely change the already relatively turbid conditions. The localized and temporary impacts would be similar to increased levels of SS caused by spring tides and major runoff events. These effects on SS concentrations in the tidal channels of the Marsh are expected to be less than 10% of the background (e.g., about 50 mg/l).

While levels of inorganic mercury may increase temporarily, there currently exists no reasonable evidence to assume a significant increase in methylmercury concentrations in Marsh or Bay organisms as a result of these temporary dredging activities.

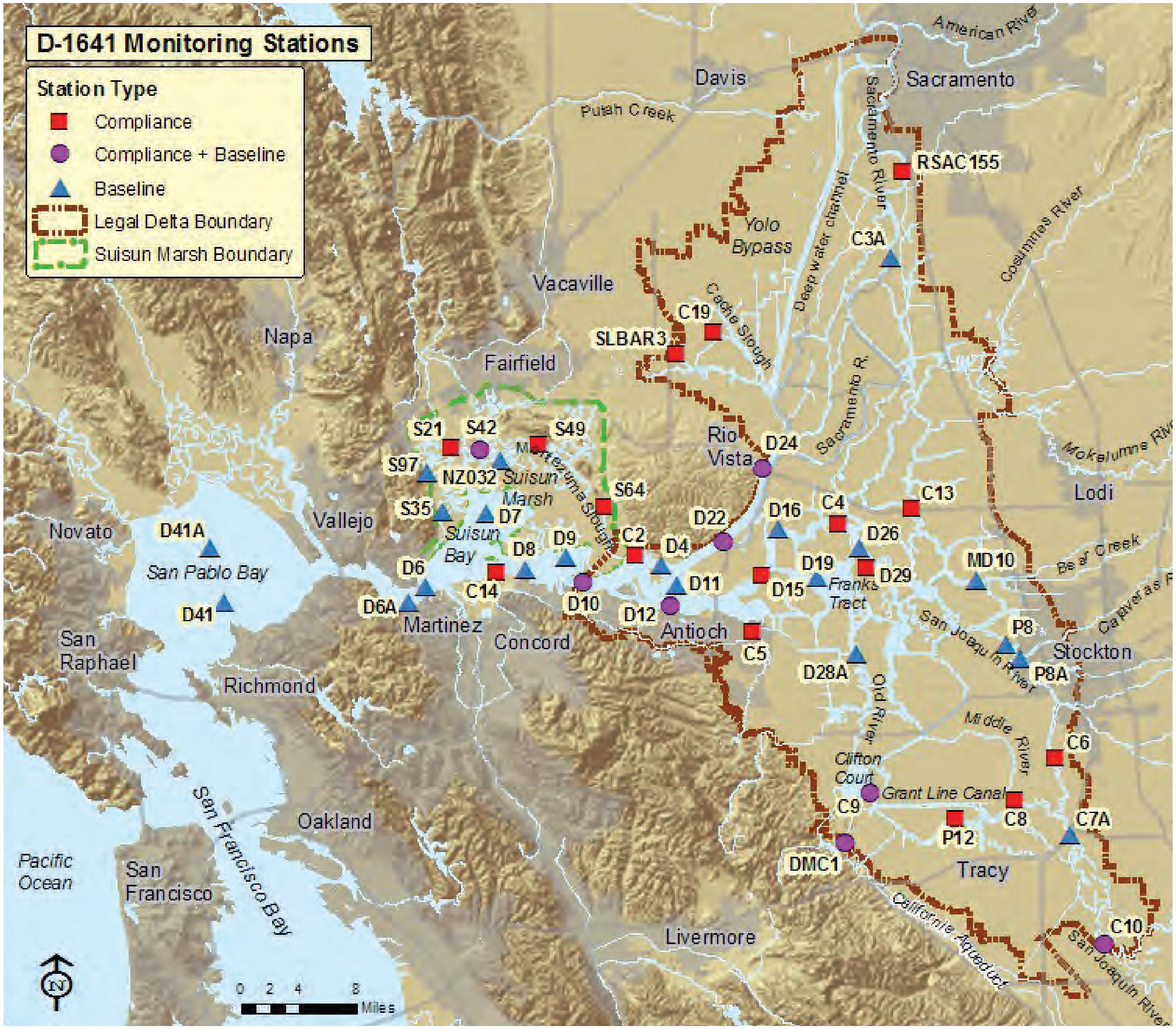
Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Impacts of Alternative B are similar to those described for Alternative A. Under Alternative B, less tidal restoration would occur, so the magnitude of any adverse or beneficial impacts described for restoration under Alternative A would be less for Alternative B, and the impacts of managed wetland activities would increase compared to Alternative A. The significance of adverse impacts would be the same as under Alternative A.

Alternative C: Restore 7,000–9,000 Acres

Impacts for Alternative C are similar to those described for Alternative A. Under Alternative C, more tidal restoration would occur, so the magnitude of any adverse and beneficial impacts described for restoration under Alternative A would increase under Alternative C, and impacts related to managed wetland activities would decrease compared to Alternative A. The significance of adverse impacts would be the same as under Alternative A.

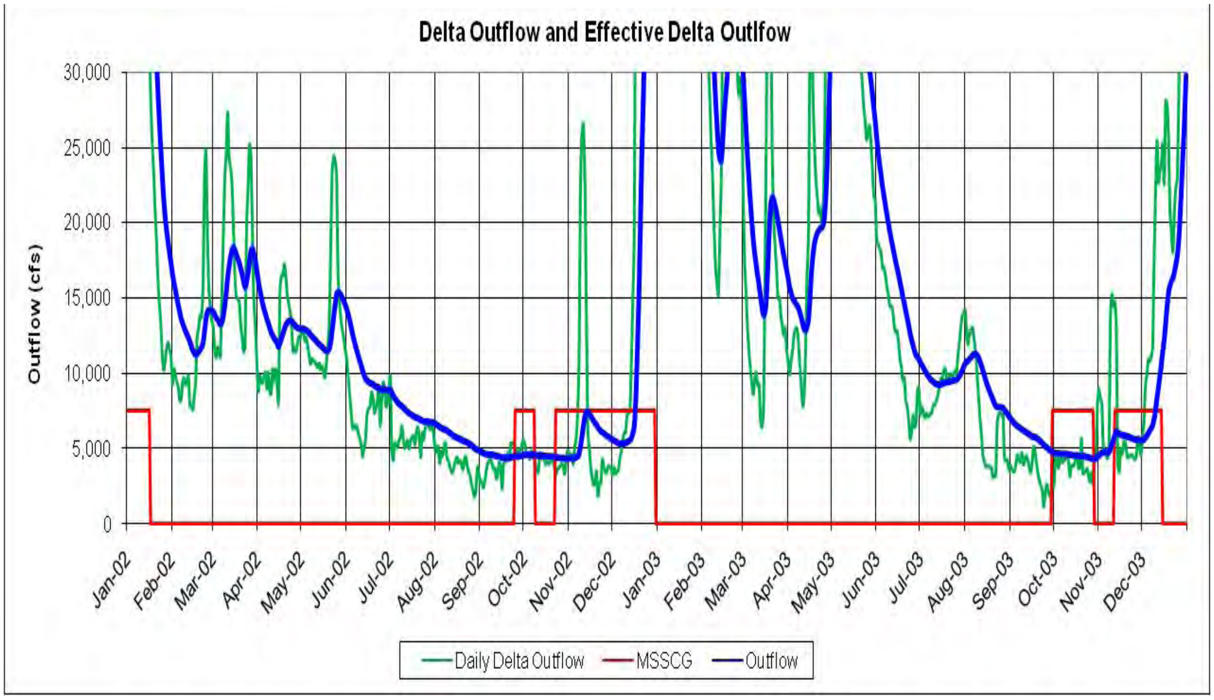


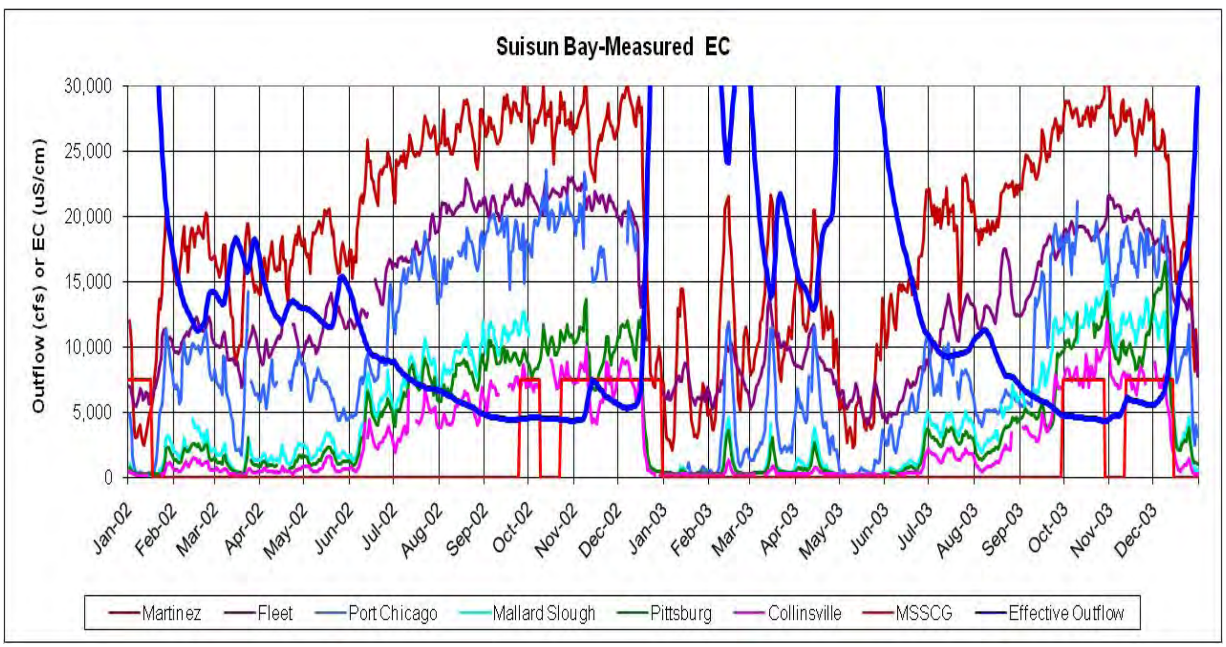
Location	Station
Martinez	D6
Port Chicago	C14
Chipps Island	D10
Collinsville	C2
Jersey Point	D15
Clifton Court Forebay (SWPExports)	C9
Delta Mendota Canal (CVP Exports)	DMC1

Source: Source: Department of Water Resources, Bay Delta and Tributaries (BDAT) website.

Graphics/Projects/project number/document (date) SS

Figure 5.2-1
Map of Water Right Decision1641 Monitoring Stations

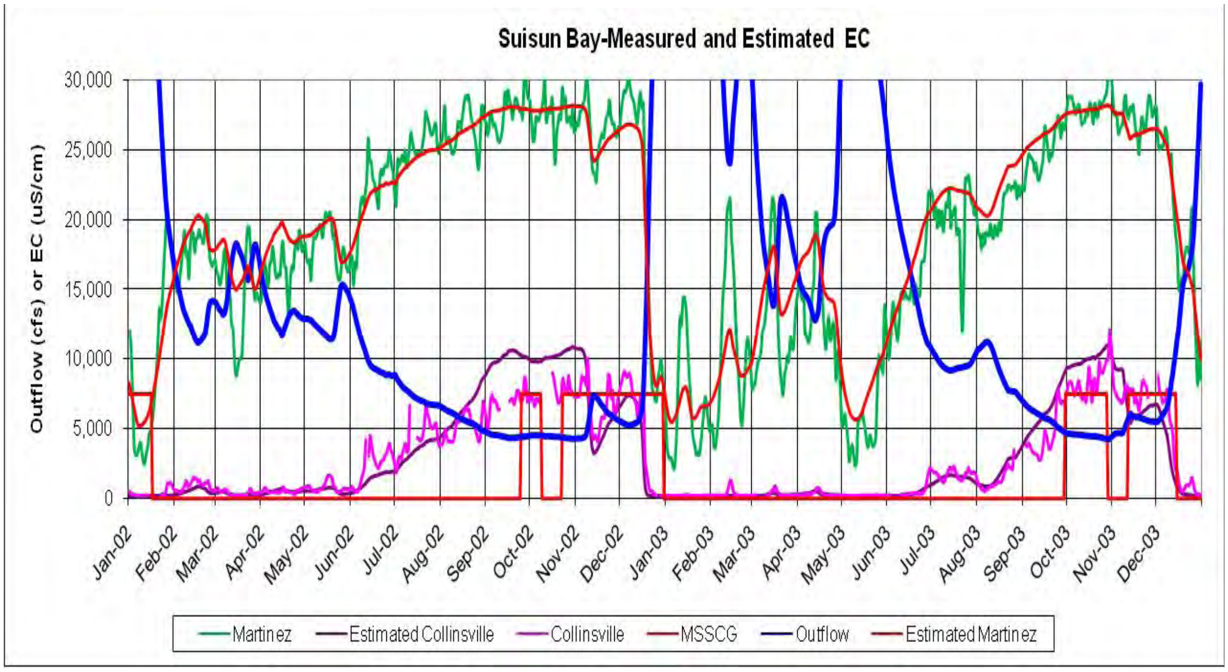


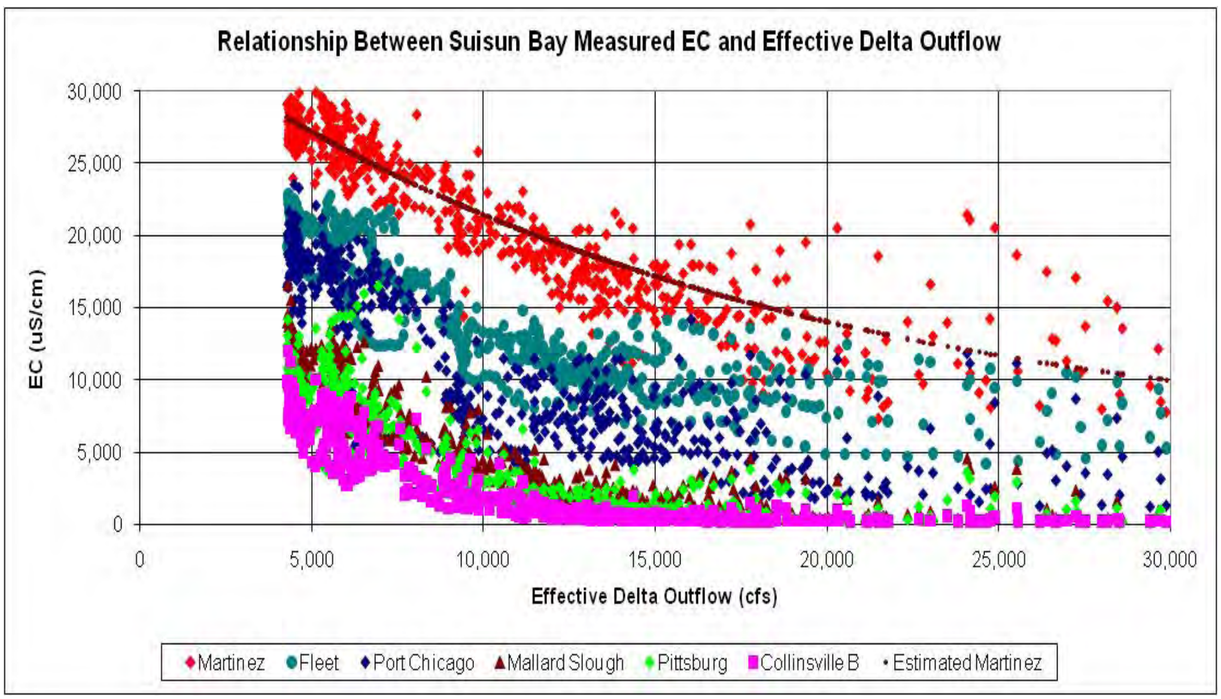


Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

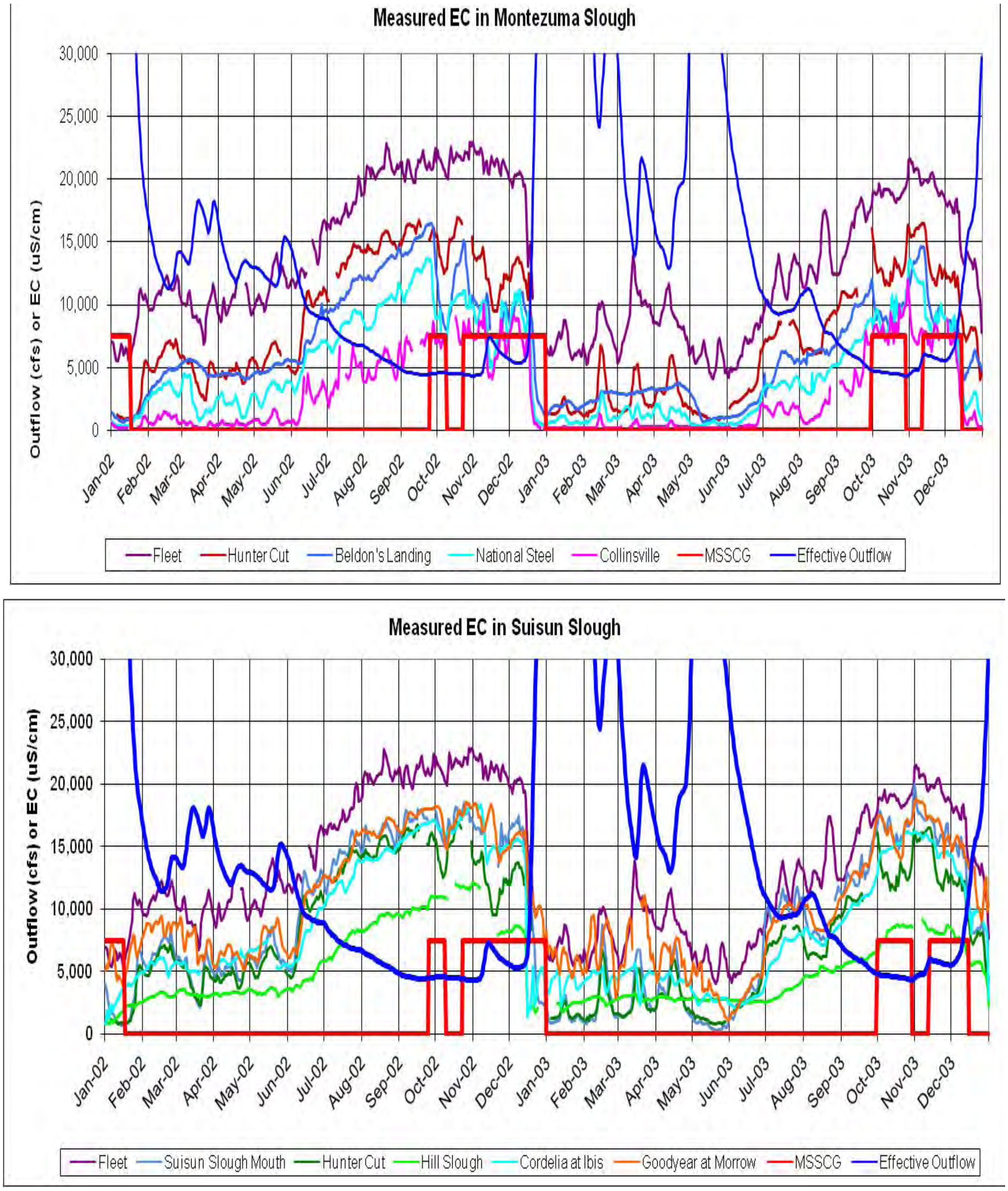
Figure 5.2-2
Daily Delta Outflow, Effective (G-model) Delta Outflow,MSSCG Operations and Measured Daily Average EC in Suisun Bay for 2002 and 2003





Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

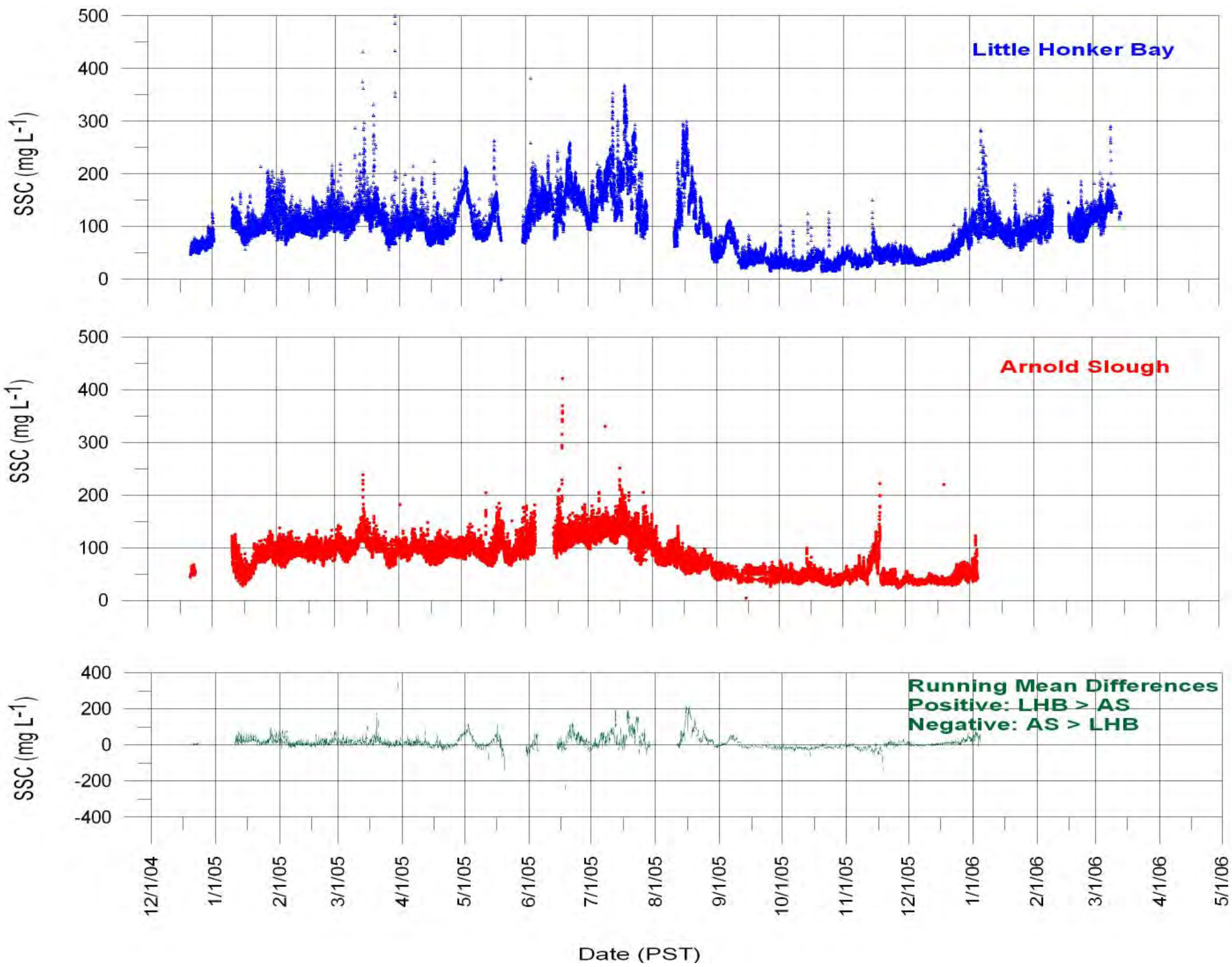
Figure 5.2-3
Measured EC at Martinez and Collinsville with Relationship between Suisun Bay EC and Effective (G-model) Delta Outflow in 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

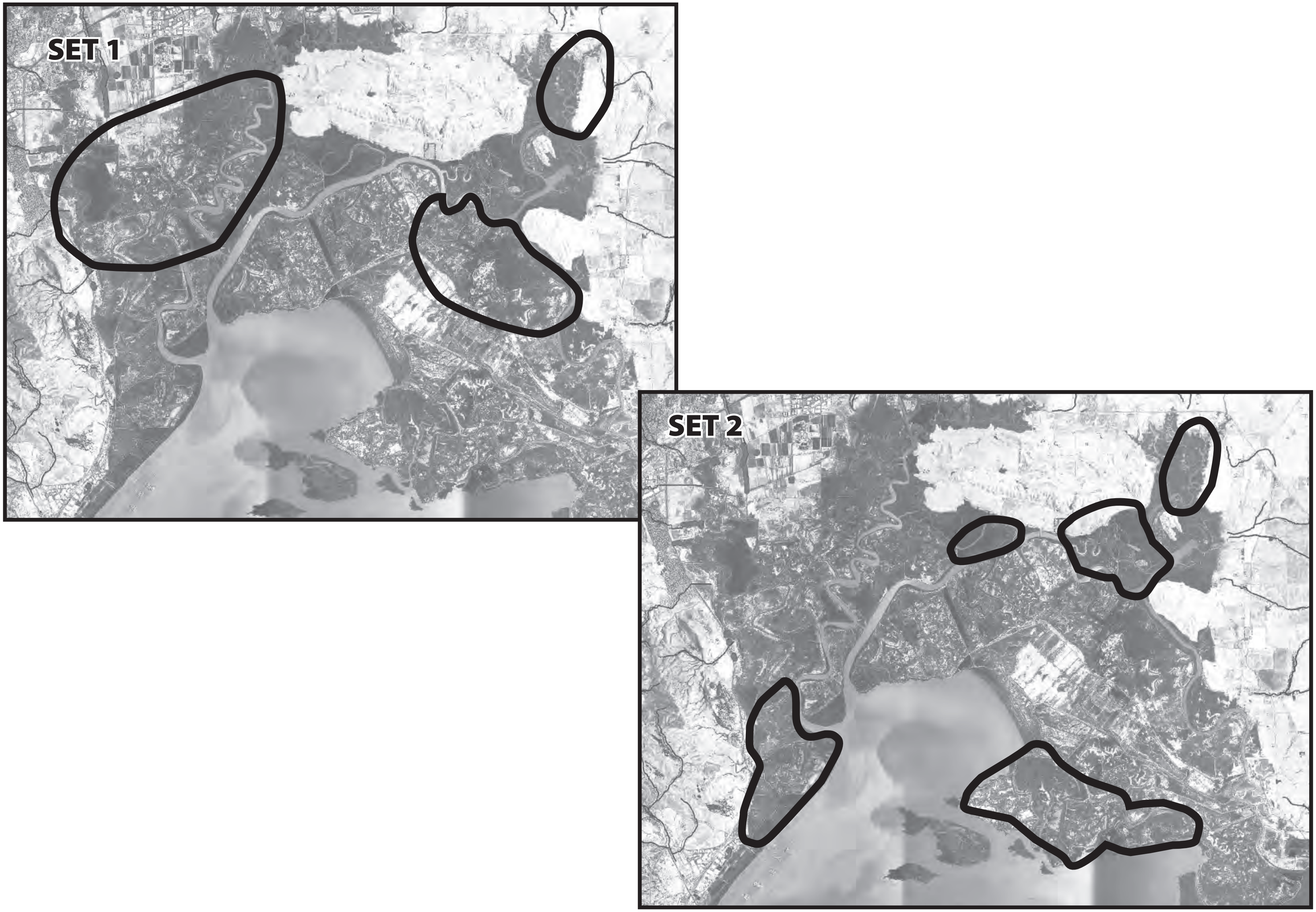
Figure 5.2-4
Measured EC at Montezuma Slough and Suisun Slough Stations in 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

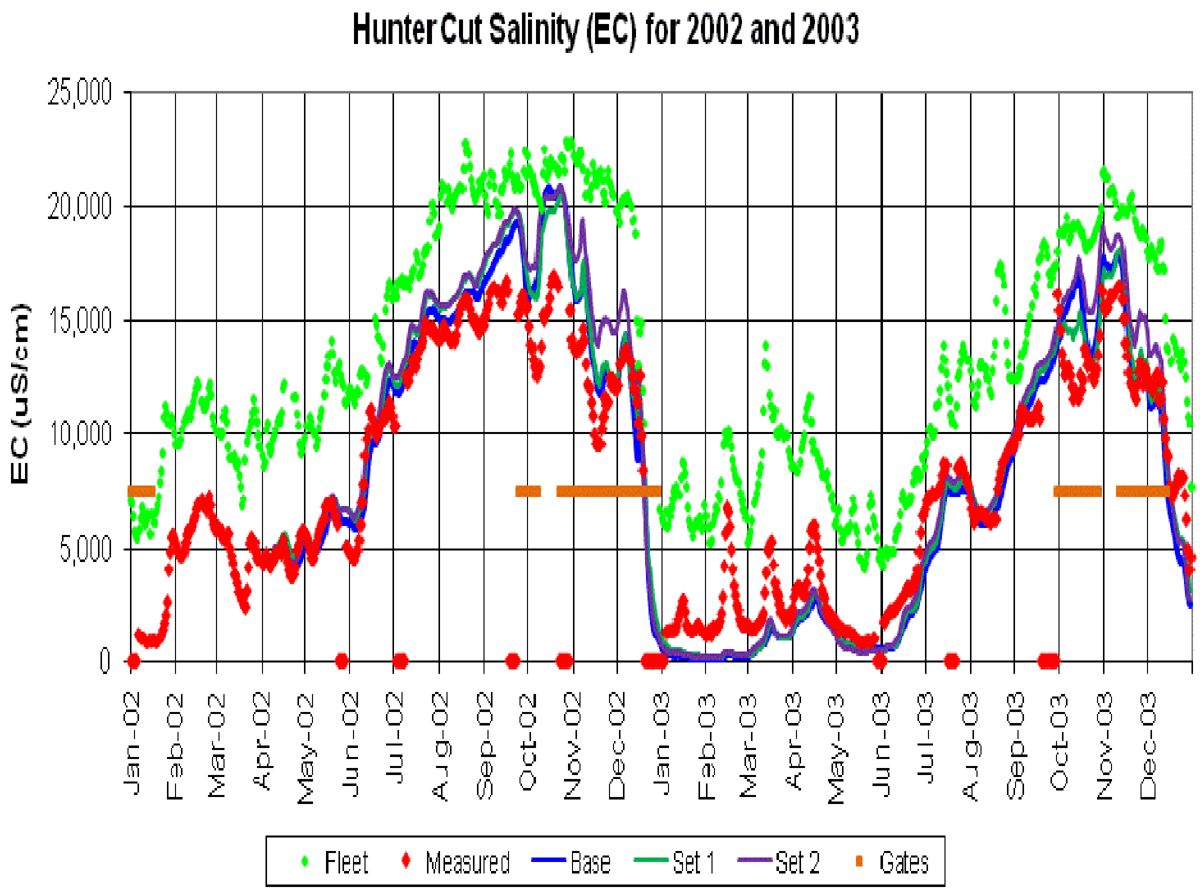
Figure 5.2-5
Measured Suspended Sediment Concentration (SSC) in Little Honker Bay and Arnold Slough Adjacent to the Blacklock Tidal Restoration Site for 2005



Graphics/Projects/project number/document (date) SS

ICF INTERNATIONAL

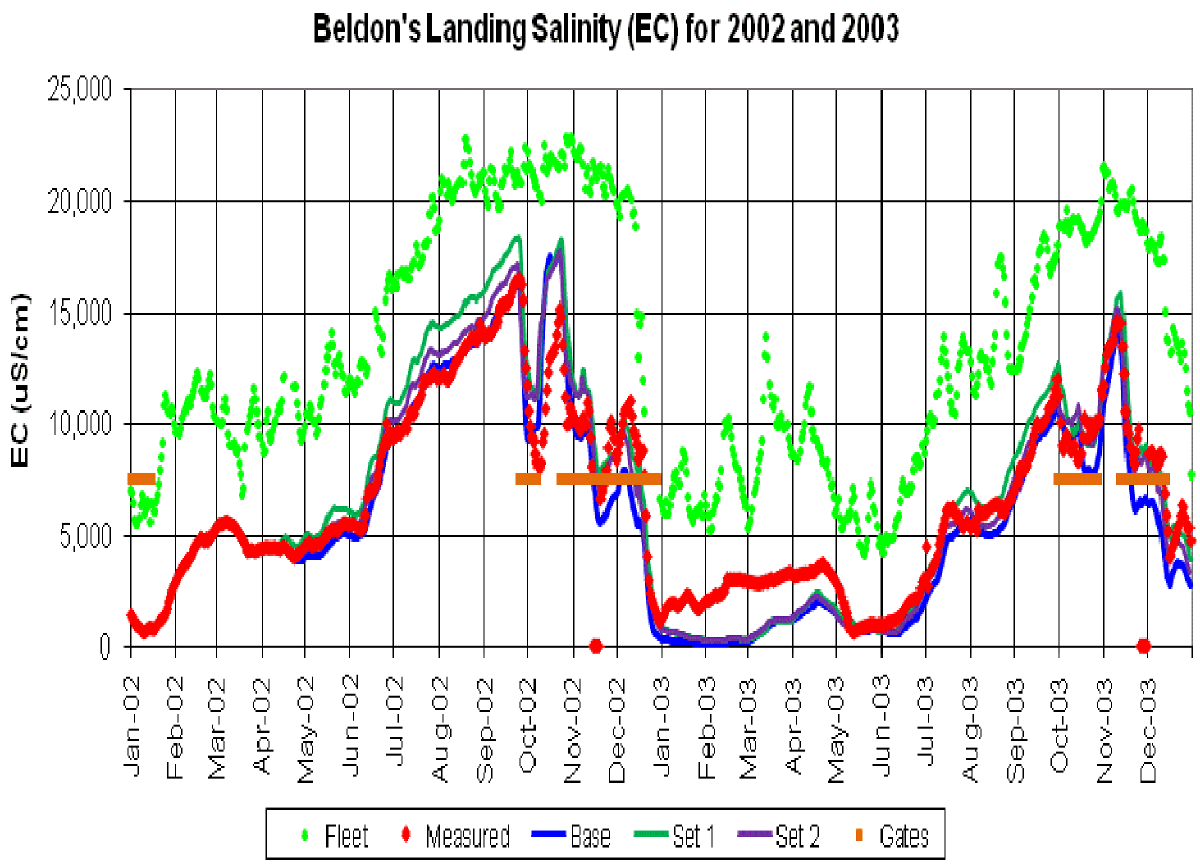
Figure 5.2-6
Approximate Congurations of Modeled Restoration Areas



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

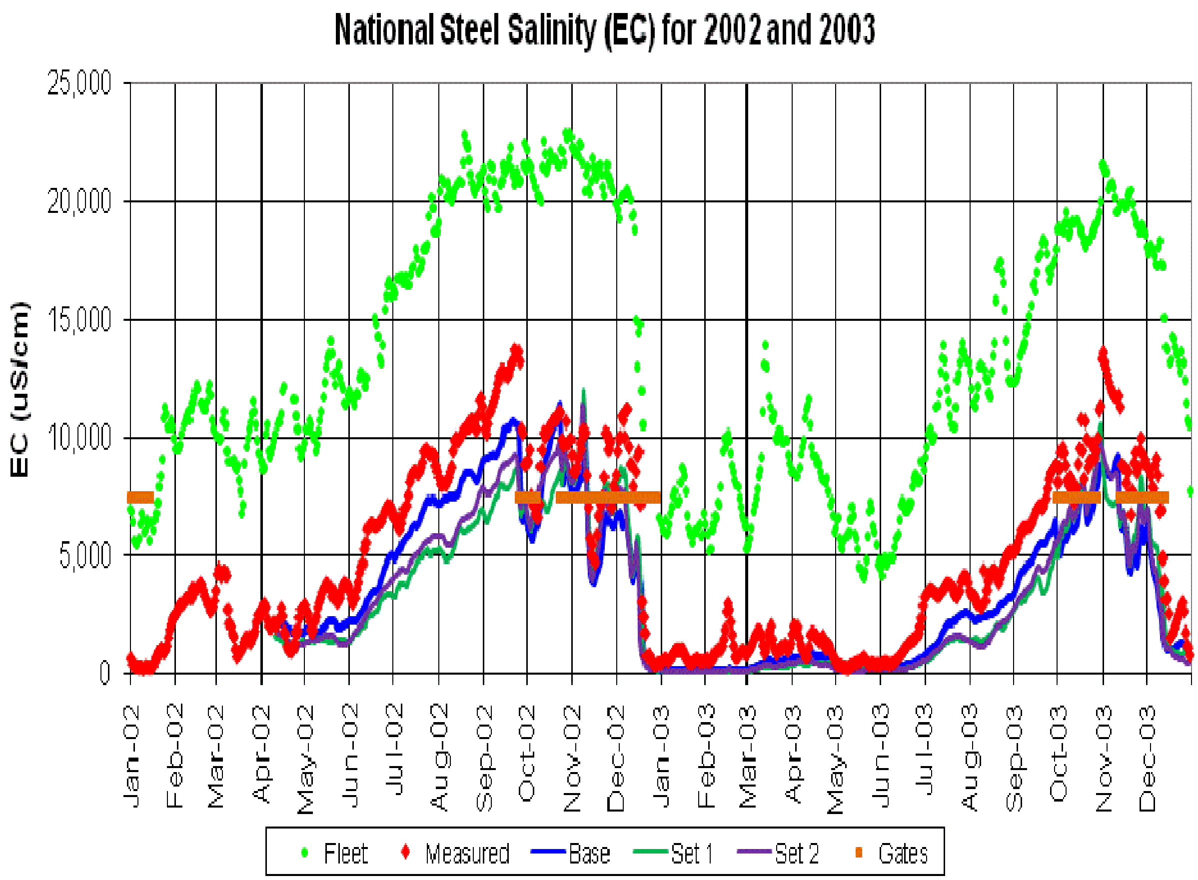
Figure 5.2-7
Measured EC and Simulated EC in Montezuma Slough at Hunter Cut (2 Miles Upstream from the Mouth) for 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

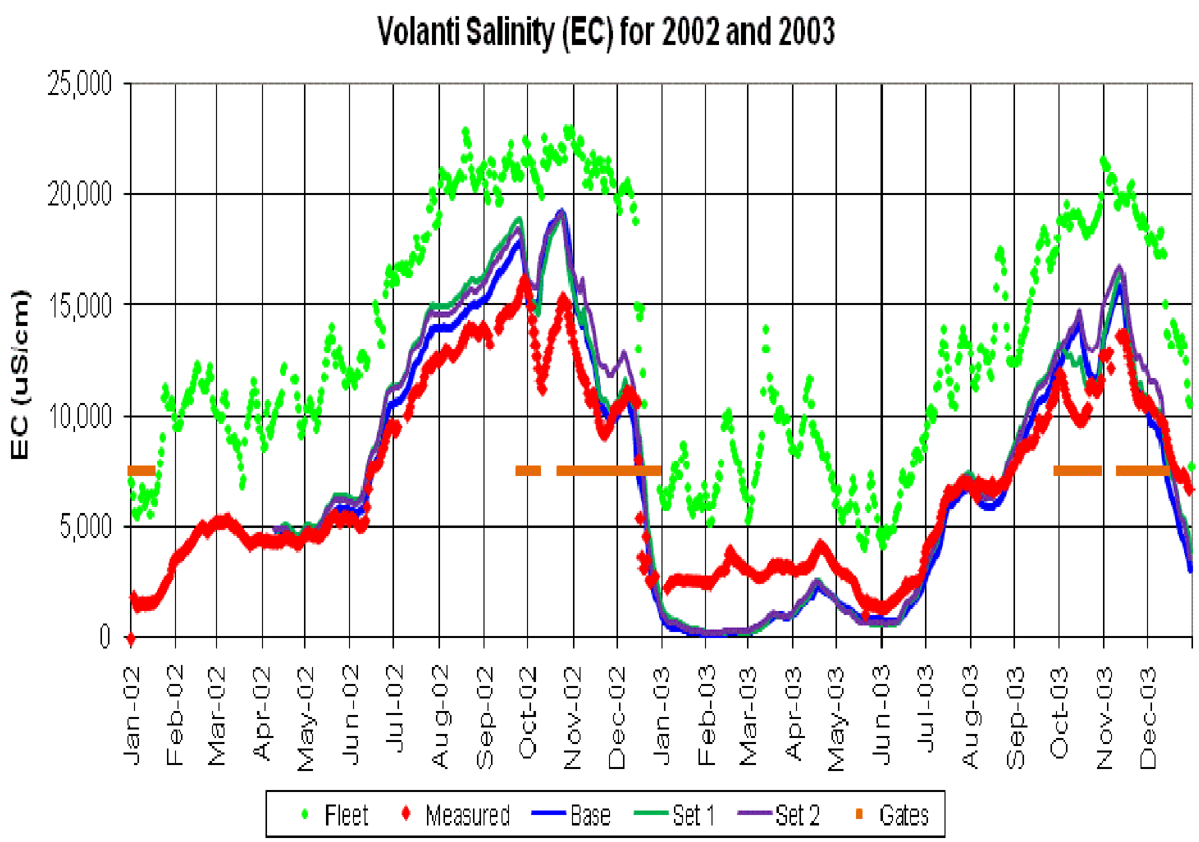
Figure 5.2-8
Measured EC and Simulated EC in Montezuma Slough at Beldon's Landing for 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

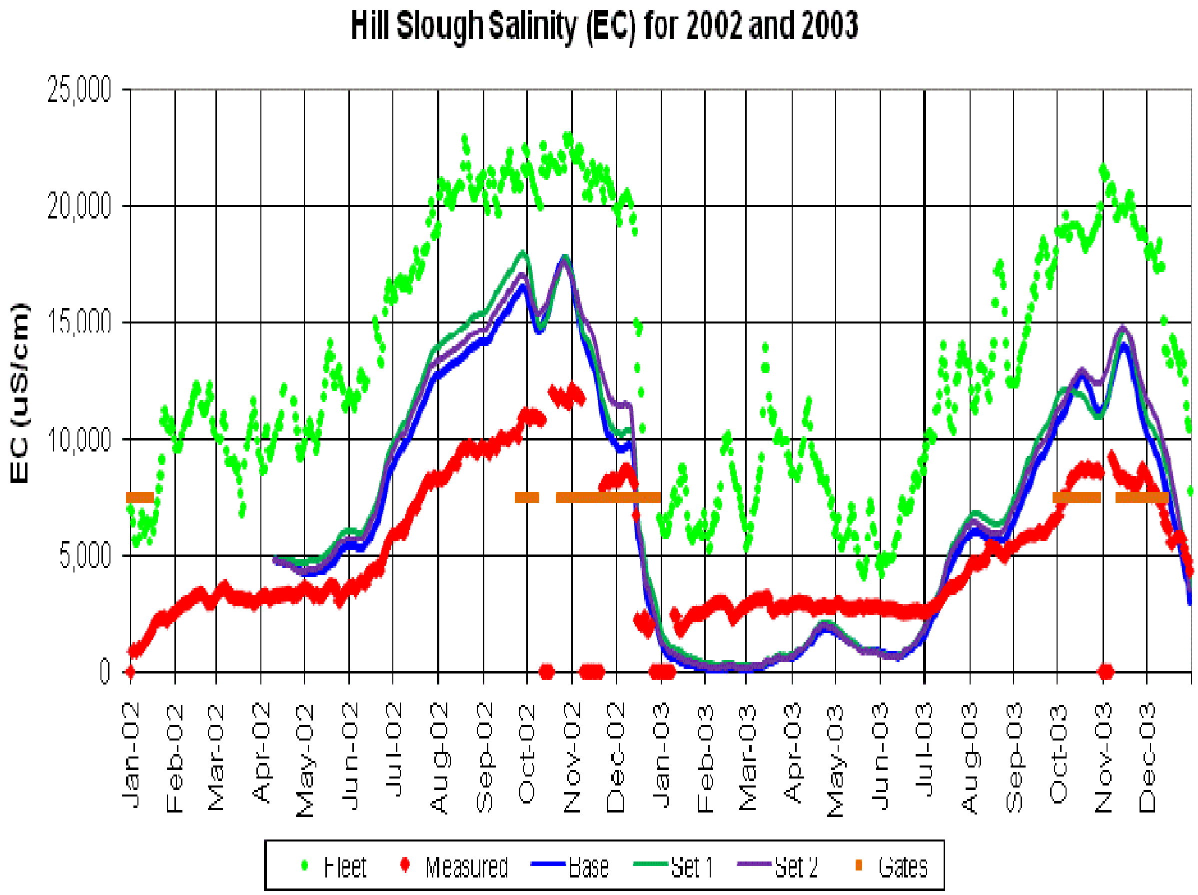
ICF INTERNATIONAL

Figure 5.2-9
Measured EC and Simulated EC in Montezuma Slough at National Steel for 2002 and 2003



ICF INTERNATIONAL

Figure 5.2-10
Measured EC and Simulated EC in Suisun Slough at Volanti for 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

Figure 5.2-11
Measured EC and Simulated EC in Hill Slough for 2002 and 2003

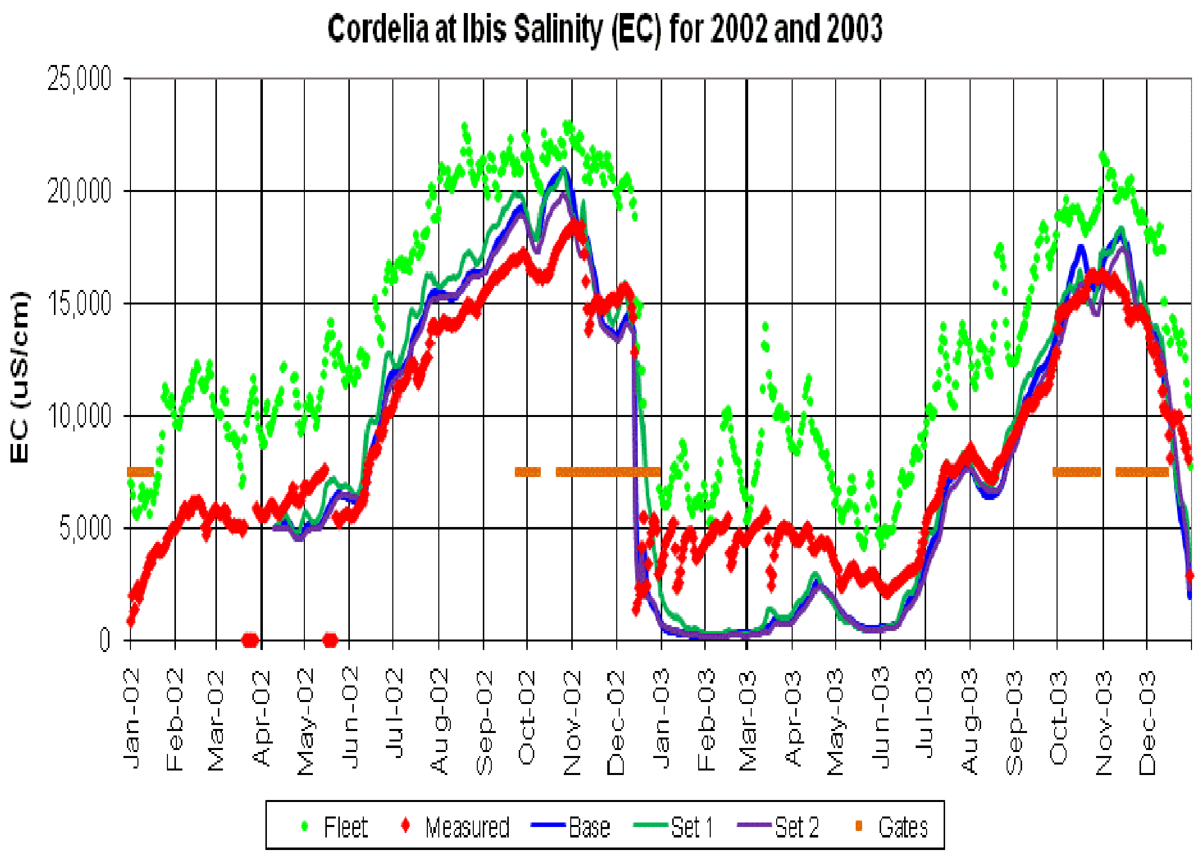
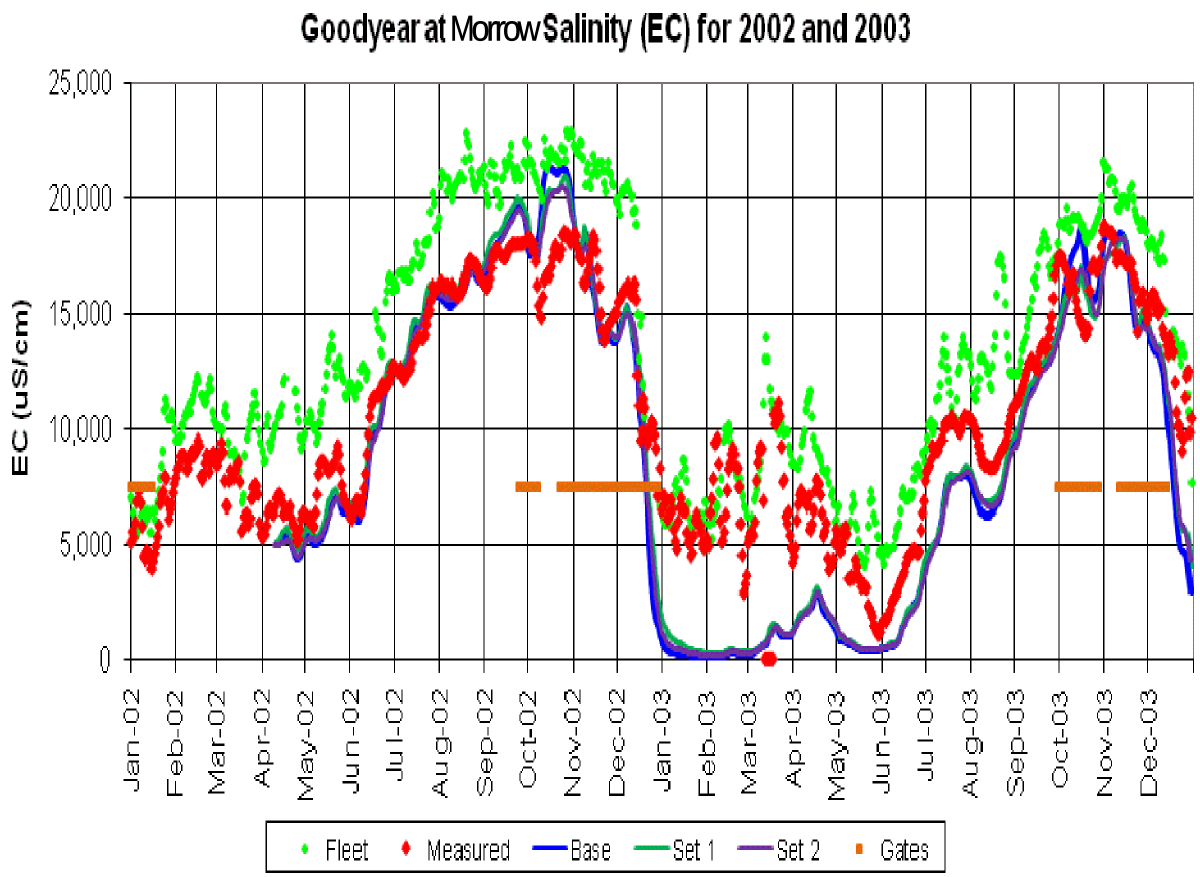
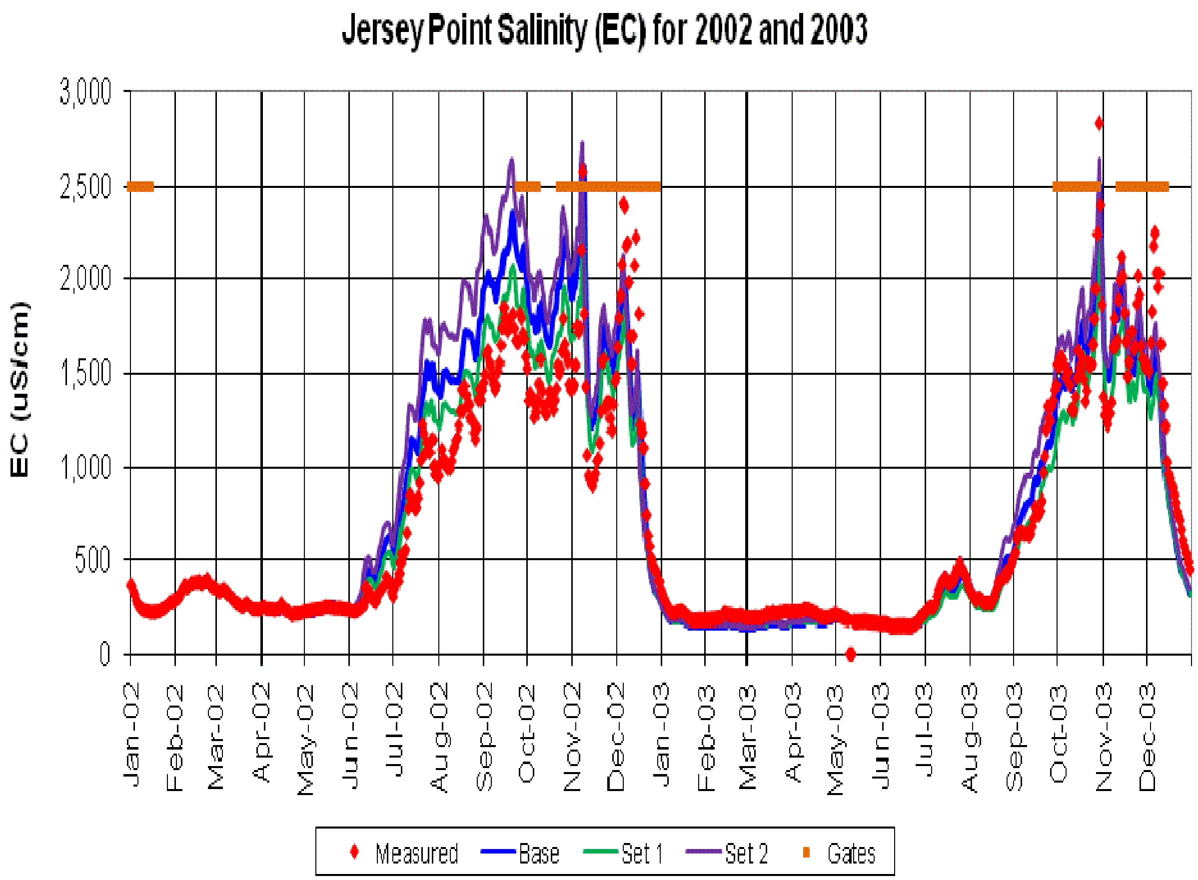


Figure 5.2-12
Measured EC and Simulated EC in Cordelia Slough at Ibis for 2002 and 2003



ICF INTERNATIONAL

Figure 5.2-13
Measured EC and Simulated EC in Goodyear Slough at Morrow for 2002 and 2003



Graphics/Projects/0688.06 Suisun Marsh EIR/EIS (07-10) SS

ICF INTERNATIONAL

Figure 5.2-14
Measured EC and Simulated EC at Jersey Point for 2002 and 2003

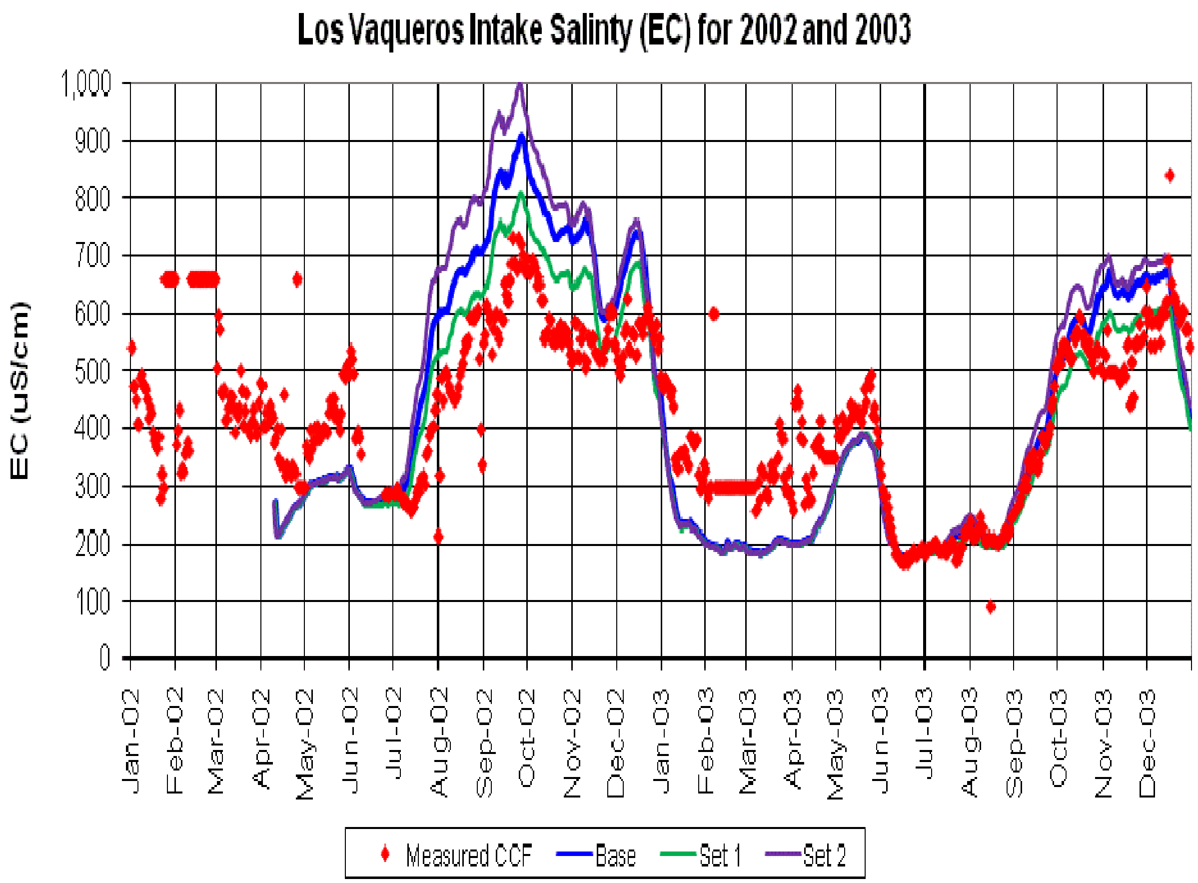


Figure 5.2-15
Measured EC (at CCF) and Simulated EC in Old River at CCWD Los Vaqueros Reservoir Intake for 2002 and 2003

Section 5.3
Geology and Groundwater

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on geology and groundwater resources.

The Affected Environment discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts. The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 5.3-1 summarizes impacts on geology, seismicity, soils, mineral resources, and groundwater from implementing the SMP alternatives. There would be no significant impacts on geology, seismicity, soils, mineral resources, and groundwater from implementing the SMP alternatives.

Table 5.3-1. Summary of Impacts on Geology, Seismicity, Soils, Mineral Resources, and Groundwater

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
GEO-1: Potential to Create Unstable Cut or Fill Slopes	A, B, C	Less than significant	None required	–
GEO-2: Potential for Accelerated Soil Erosion	A, B, C	Beneficial or Less than significant	None required	–
GEO-3: Potential Loss of Topsoil Resources	A, B, C	Less than significant	None required	–
GEO-4: Reduction in Availability of Non-Fuel Mineral Resources	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
GEO-5: Reduction in Availability of Natural Gas Resources	A, B, C	Less than significant	None required	–
GW-6: Potential for Altered Salinity in Shallow Suisun Marsh Groundwater	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
GEO-1: Potential to Create Unstable Cut or Fill Slopes	A, B, C	Less than significant	None required	–
GEO-2: Potential for Accelerated Soil Erosion	A, B, C	Less than significant	None required	–
GEO-5: Reduction in Availability of Natural Gas Resources	A, B, C	No impact	–	–
GEO-7: Potential for Damage to Structures as a Result of Surface Fault Rupture, Groundshaking and/or Seismically Induced Ground Failure (Liquefaction)	A, B, C	Less than significant	None required	–
GEO-8: Potential for Damage to Structures as a Result of Landslides, Including Seismically Induced Landslides	A, B, C	Less than significant	None required	–

Affected Environment

Sources of Information

Background information in this section was derived from sources in the published geologic literature. No new fieldwork or other research was conducted for the preparation of this EIS/EIR. Specific reference information is given in the text. Key sources used in compiling this section include:

- maps and reports published by the U.S. Geological Survey (USGS) and California Geological Survey (CGS);
- soil surveys by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) (formerly U.S. Soil Conservation Service);
- the Solano County General Plan (Solano County 2008) and background reports prepared for the recent General Plan update (EDAW/AECOM 2006a, 2006b);
- publications of the California Department of Conservation's Division of Oil, Gas, and Geothermal Energy;
- California Department of Water Resources' Bulletin 118 (*California's Groundwater*) (California Department of Water Resources 2003);

- the San Francisco Bay Conservation and Development Commission's *Suisun Marsh Protection Plan* (San Francisco Bay Conservation and Development Commission 1976);and
- the Solano County Water Agency's *Integrated Regional Water Management Plan and Strategic Plan* (Solano County Water Agency 2005).

Existing Conditions

Regional Geologic Setting

The plan area is located near the east flank of the Coast Ranges, in the east-central portion of California's Coast Ranges geomorphic province (e.g., Norris and Webb 1990).

The Coast Ranges province is characterized by echelon northwest-trending mountain ranges formed over the past 10 million years or less by active uplift related to complex tectonics of the San Andreas fault/plate boundary system (e.g., Norris and Webb 1990, Buising and Walker 1995, Atwater and Stock 1998). The Coast Ranges Province extends westward to the coastline and beyond, including the Farallon Islands offshore; on the east, it abuts the Great (Central) Valley province (Norris and Webb 1990). The eastern rangefront is defined by faults that have been interpreted as contractile features associated with shortening along an axis approximately normal to the rangefront (e.g., Sowers et al. 1992, Unruh et al. 1995; see also Jennings 1977 for regional mapping) but may also locally accommodate a right-lateral component of motion (e.g., Richesin 1996).

The eastern Coast Ranges are broadly antiformal. At the general latitude of the project area, they consist of a central "core" of Mesozoic units—including mafic and ultramafic rock allied with the Coast Range ophiolite, and lithologically diverse units of the Franciscan complex—flanked on the west by extensive exposures of Miocene volcanic rocks (Sonoma Volcanics) and on the east by an upward-younging sequence of marine and terrestrial sedimentary units that ranges in age from Cretaceous (Great Valley Group) to Neogene (Monterey Group, San Pablo Group, Sonoma Volcanics, and Huichica Formation). The area's larger drainages preserve several generations of alluvial fan and stream deposits ranging in age from Pleistocene to Holocene (Wagner and Bortugno 1982; Graymer et al. 2002).

Topography and Geology of Project Site

Suisun Bay occupies a topographic depression in the easternmost portion of the Coast Ranges. This low area is defined on its west side by uplift along the active Green Valley and Concord fault trends (Wagner and Bortugno 1982; Wagner et al. 1990; Hart and Bryant 1997; Graymer et al. 2002) and on the east by the

Pittsburg−Kirby Hills fault zone, which is likely allied to the Mt. Diablo thrust system to the south and may also be active, as discussed in more detail below (Unruh and Hector 1999). West of Suisun Bay the Coast Ranges rise steeply; east of Suisun Bay are the rolling Montezuma Hills, which consist of uplifted sedimentary strata of early Pleistocene age, with active (Holocene) alluvium in stream drainages that dissect the uplift. Low-lying flat areas of current and former marshland that border the Bay proper are underlain by Bay Mud deposits of Holocene age. To the north of Suisun Bay, the Potrero Hills, which form the topographically higher central portion of Grizzly Island, consist primarily of tightly folded and faulted marine sedimentary rocks of Eocene age, flanked by an apron of late Pleistocene alluvial fan deposits (Graymer et al. 2002).

Geologic Hazards

Primary Seismic Hazards—Surface Fault Rupture[1] and Groundshaking

The only faults known to be active in the immediate project vicinity are the Concord and Green Valley faults, which cross the project area at the westernmost end of Suisun Bay. Both of these structures are zoned by the State of California pursuant to the Alquist-Priolo Act and are recognized as Type B seismic sources by the Uniform and California Building Codes (International Conference of Building Officials 1997, 2001). The western edge of the project area, along the mapped traces of the Concord and Green Valley faults, is thus at some risk of surface fault rupture.

To date, the potential for Holocene activity on the Pittsburg−Kirby Hills fault zone has not been studied extensively, and this system is not zoned by the State of California or recognized by the Uniform Building Code. However, recent work suggests that it may be active. Peat layers of Holocene age thicken markedly toward the fault's surface trace, indicating active valley floor subsidence along this trend during Holocene time (Williams and Gabet 1997). A north-northwest trending alignment of earthquake foci along the west margin of the Montezuma Hills likely is associated with the Pittsburg−Kirby Hills system, and physical features suggestive of Holocene activity—such as well developed topographic lineaments and aligned drainages—coincide with the zone's mapped fault traces (Unruh and Hector 1999). In addition, the Pittsburg−Kirby Hills fault may be related to the Mt. Diablo Thrust system to the south (Unruh and Hector 2007), which is also increasingly thought to be Holocene-active (e.g., Sawyer 1999). With this in mind, there also may be some risk for surface fault rupture along the eastern margin of the project area, where the Pittsburg−Kirby Hills fault zone marks the edge of the Montezuma Hills uplift.

In addition to some level of localized surface fault rupture hazard, the entire project area is likely to experience strong groundshaking during the lifespan of

[1] *Surface fault rupture* is a rupture at the ground surface along an active fault, caused by earthquake or creep activity.

the project. Recent USGS studies estimate a 62% probability of at least one earthquake with a magnitude of 6.7 or greater occurring on one of the faults of the greater San Francisco Bay Area in the next 30 years, and a 10% probability of a magnitude 7.0 or greater event during the same timeframe (U.S. Geological Survey Working Group on California Earthquake Probabilities 2003). Table 5.3-2 summarizes current information on earthquake recurrence intervals and maximum credible earthquake (MCE) for key structures in and near the project area.

Table 5.3-2. Maximum Credible Earthquake and 30-Year Earthquake Probabilities for Principal Active Faults in Project Vicinity

Fault	Magnitude of MCE	30-Year Probability[a]
San Andreas	6.9–7.9[a]	All ruptures: 0.24 Magnitude≥6.7: 0.24 Magnitude≥7.0: 0.18 Magnitude≥7.5: 0.09
Hayward−Rodgers Creek	6.5–7.3[a]	All ruptures: 0.40 Magnitude≥6.7: 0.27 Magnitude≥7.0: 0.11 Magnitude≥7.5: 0.00
Green Valley−Concord	6.0–6.7[a]	All ruptures: 0.26 Magnitude≥6.7: 0.04 Magnitude≥7.0: 0.00 Magnitude≥7.5: 0.00
Calaveras	5.8–6.9[a]	All ruptures: 0.59 Magnitude≥6.7: 0.11 Magnitude≥7.0: 0.02 Magnitude≥7.5: 0.00
Greenville	6.2–6.9[a]	All ruptures: 0.08 Magnitude≥6.7: 0.03 Magnitude≥7.0: 0.01 Magnitude≥7.5: 0.00
Macaama (South)	6.9[b]	Not Provided
West Napa	6.5[b]	Not Provided
Pittsburg−Kirby Hills	>6[d]	Unknown
Cordelia	>6[c]	Unknown

Sources:

[a] U.S. Geological Survey Working Group on California Earthquake Probabilities 2003.

[b] International Conference of Building Officials 1997.

[c] Information compiled from multiple published sources, in Jones & Stokes (2005)

[d] Unruh and Hector 1999.

Secondary Seismic Hazards—Liquefaction and Ground Failure

The State of California maps areas subject to secondary seismic hazards pursuant to the Seismic Hazards Mapping Act of 1990. To date, this effort has focused on the Los Angeles Basin–Orange County region and the San Francisco Bay area, where dense populations are concentrated along active faults. State seismic hazards maps have not been issued for the Suisun Bay area, and no such mapping is planned in the immediate future (California Geological Survey 2004).

In general, however, liquefaction risks are greatest where the shallow substrate consists of loose or unconsolidated sands or silts that are saturated by groundwater; areas of Holocene Bay Mud substrate surrounding Suisun Bay are thus at high risk of liquefaction (Figure 5.3-1) (EDAW/AECOM 2006a, 2006b). Liquefaction risks are low in alluvial fan areas adjacent to the Montezuma and Potrero Hills and very low in the consolidated deposits interior to these uplifts (EDAW/AECOM 2006a, 2006b).

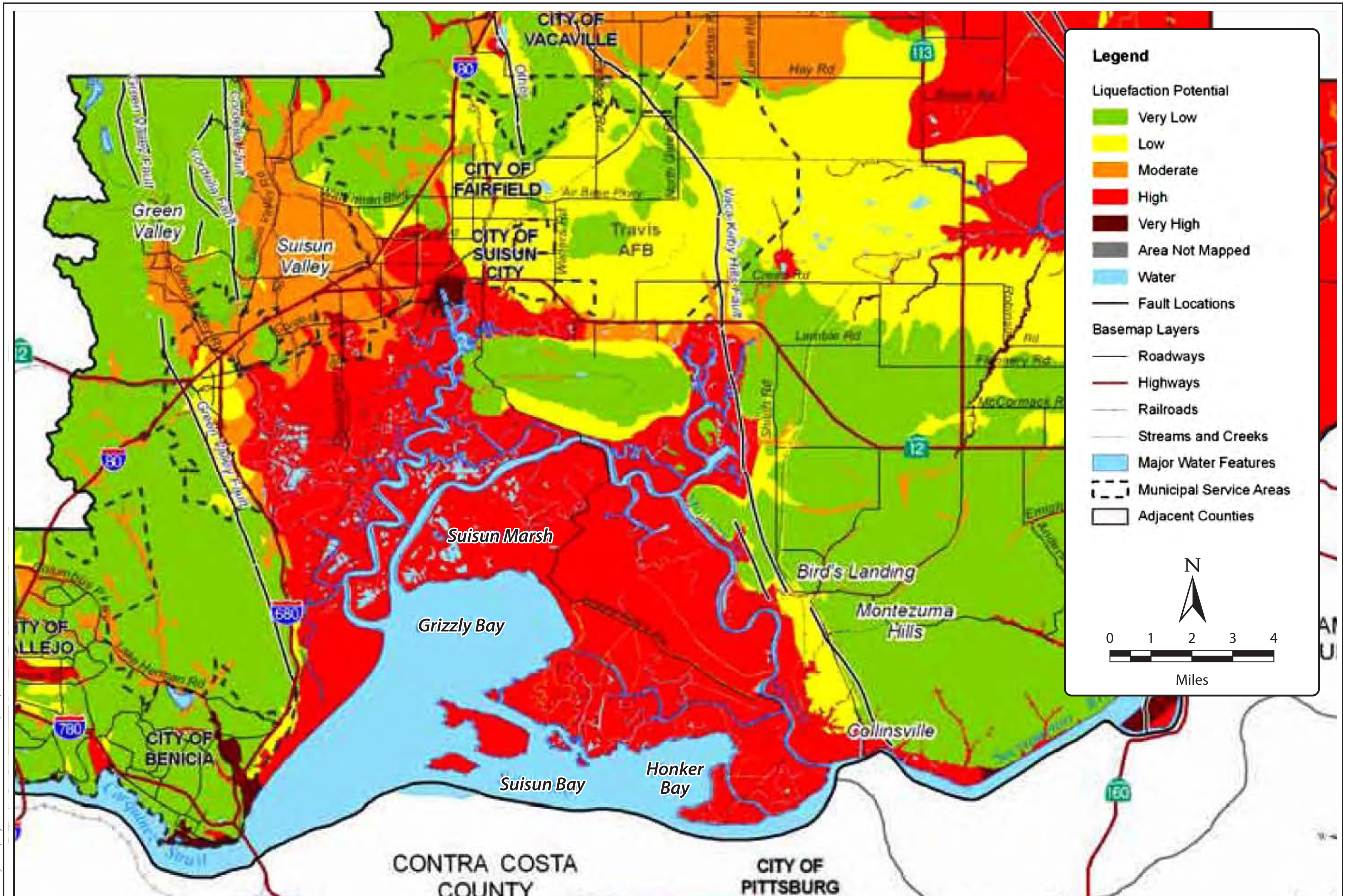
Landslides

The project area is located in flat marshland topography, and as such the majority of the project area is not subject to landslide hazard. However, U.S. Geological Survey landslide mapping, and landslide susceptibility maps in baseline reports prepared for the County's recent General Plan update, identify substantial landslide potential in some of Solano County's hillslope areas (Wentworth et al. 1997; EDAW/AECOM 2006b). Portions of the project area at the base of steep, landslide-prone uplifts are in potential landslide runout areas and subject to corollary risks. These portions include the strip along I-680 at the west edge of Suisun Marsh and alluvial/marshlands downslope from the western tip of the Potrero Hills (Figure 5.3-2).

Soils

Soils of Suisun Bay's bayland and marsh areas include the Joice muck, Tamba mucky clay, and Suisun peaty muck, with small enclaves of remaining active tidal marsh substrate. Areas of Reyes silty clay, and Valdez loams (Valdez silty clay loam, clay substratum; Valdez silt loam, drained) are also present (Bates 1977).

The Joice and Suisun series occur in nearly level areas of salt marsh or former salt marsh and are very poorly drained organic soils that formed from the accumulation of hydrophytic plant remains with an input of fine-grained mineral sediment (Bates 1977). A typical profile of the Joice muck consists of black, saline clayey muck to depths of more than 60 inches. Permeability is limited; surface water tends to pond, and erosion hazard is slight (Bates 1977). The



Source: County of Solano 2006, 2008.

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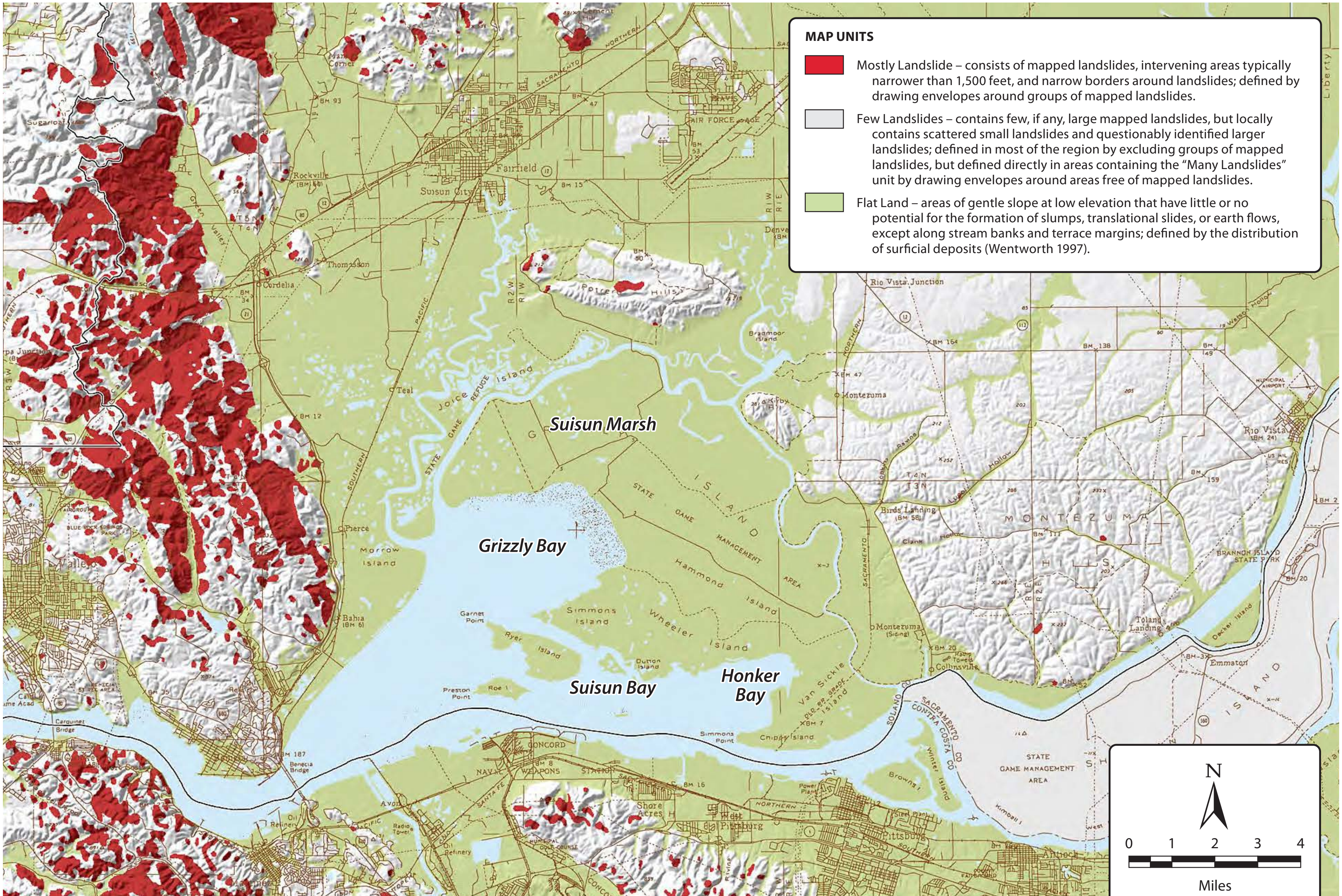
Figure 5.3-1
Liquefaction Susceptibility



Source: Adapted from Wentworth et al. 1997.

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Figure 5.3-2
Summary Distribution of Landslides and Earth Flows

Suisun peaty muck consists of more than 60 inches of dark-colored muck that contains dark reddish-brown plant fibers. Permeability is rapid, but under natural conditions the water table is shallow (10–20 inches below ground surface), so surface water tends to pond. Erosion is not a hazard in the Suisun peaty muck (Bates 1977).

The Tamba series also occurs in nearly level areas of current and former salt marsh and consists of very poorly drained organic-rich soils. Tamba series soils formed in alluvium derived from mixed sources and in hydrophytic plant remains. In a typical profile, the Tamba mucky clay consists of about 10 inches of light brownish-gray, grayish-brown, and yellowish-brown mottled mucky clay overlying about 30 inches of mottled gray and black mucky clay, which in turn overlies a substratum consisting of more than 30 inches of gray mucky clay. Permeability of the subsoil is moderate, and under natural conditions the water table (12–36 inches below ground surface) so surface water tends to pond. Erosion hazard is slight (Bates 1977).

Active tidal marsh is a very poorly drained, strongly saline land type restricted to areas between constructed levees and bodies of water. Tidal marsh substrate ranges from mud flats to a mixture of hydrophytic plant remains and alluvial sediment (Bates 1977).

The Reyes series occurs in nearly level areas of current and former salt marsh and consists of poorly drained soils that are very strongly acid and saline. Reyes soils formed in alluvium derived from mixed sources. A typical Reyes profile, like that of the Reyes silty clay, consists of about 7 inches of light gray, yellowish-red, and grayish-brown mottled silty clay overlying about 35 inches of mottled gray silty clay, which in turn overlies a substratum of gray silty clay. The substratum is moderately alkaline *in situ* but becomes strongly acid when exposed to the air and allowed to dry. The water table is 24–48 inches below ground surface under natural conditions. Permeability is slow, and surface water ponds on Reyes soils. Erosion is a slight hazard (Bates 1977).

The Valdez series consists of poorly drained soils that formed in nearly level areas on alluvial fans. Valdez soils are also present in some areas where dredge spoils have been disposed of. A typical Valdez profile includes about 12 inches of light-colored mottled silty clay loam, overlying about 20 inches of light-colored mottled and stratified silty clay loam and very fine sandy loam, which in turn overlies a subsoil consisting of more than 40 inches of slightly darker colored mottled and stratified silty clay loam, silt loam, and very fine sandy loam. The Valdez silty loam, drained, has a profile similar to this, except that the texture is silt loam throughout, and salinity is lower. Artificial drainage maintains the fluctuating water table at depths of more than 4 feet below ground surface. Permeability is moderately slow, runoff is slow, and erosion hazard is slight in the Valdez silt loam, drained. The Valdez silty clay loam, clay substratum is also similar to the typical Valdez profile but is underlain by a buried clay soil at a depth of 35–50 inches below ground surface. It is a moderately to strongly saline soil. Permeability is slow, runoff is slow, and erosion hazard is slight in the Valdez silty clay loam, clay substratum. The water table is 3–5 feet below ground surface in this unit (Bates 1977).

Land Subsidence

Portions of Suisun Marsh have undergone marked subsidence, although not near as much as the neighboring Delta area. This is believed to be the result of diking and removal from tidal inundation—where formerly saturated peaty soils allowed to dry out, plant material oxidizes, decays, and becomes more compact. Drying also allows the mineral soil matrix to compact, as pore space is no longer filled by water. Agricultural and managed wetland activities such as disking, which accelerates the drying and oxidation processes, likely have contributed to accelerated subsidence. The amount of subsidence in various parts of Suisun Marsh is believed to be controlled by the thickness of the soil column and the abundance and distribution of organic material (Siegel pers. comm.). In other parts of the Bay Area and in parts of the Central Valley, land subsidence has been caused by groundwater overdraft; the contribution of groundwater withdrawal, if any, to Suisun Marsh subsidence has not been evaluated (Siegel pers. comm.). Active tectonics also can result in subsidence but are not thought to have contributed to recent subsidence in Suisun Marsh (Siegel pers. comm.).

Natural Gas Reserves

Natural gas refers to hydrocarbons that occur naturally in a gas or vapor state at ordinary temperatures and pressures. Natural gas consists primarily of methane but also may contain a smaller percentage of ethane, propane, and other gaseous hydrocarbons. Impurities such as nitrogen, carbon dioxide, hydrogen sulfide, and water (brines) also may be present (Jackson 1997). Already an essential energy source for heating, electricity generation, and transportation, natural gas is expected to increase in importance in coming years, because it offers a “cleaner” alternative to other petroleum products and coal. However, world reserves of natural gas are limited and likely will be exhausted within the next 50 years (EDAW/AECOM 2006c).

Known for “dry” or nonassociated gas (i.e., natural gas produced without concurrent production of crude oil), the Sacramento Valley and Delta areas are home to some of California’s most important gas reserves. Figure 5.3-3 shows natural gas fields in Solano County. Although production rates have declined somewhat in recent years and are expected to continue on a downward trend, as of 2005 the county had about 900 active natural gas extraction wells. Most of these wells are located in proven fields, although gas field boundaries are expanding in some areas. (EDAW/AECOM 2006c.)

The Rio Vista field, east of Suisun Bay, has been the largest producer of dry gas in northern California and one of the largest gas producers in California for a number of years (e.g., California Department of Conservation, Division of Oil,

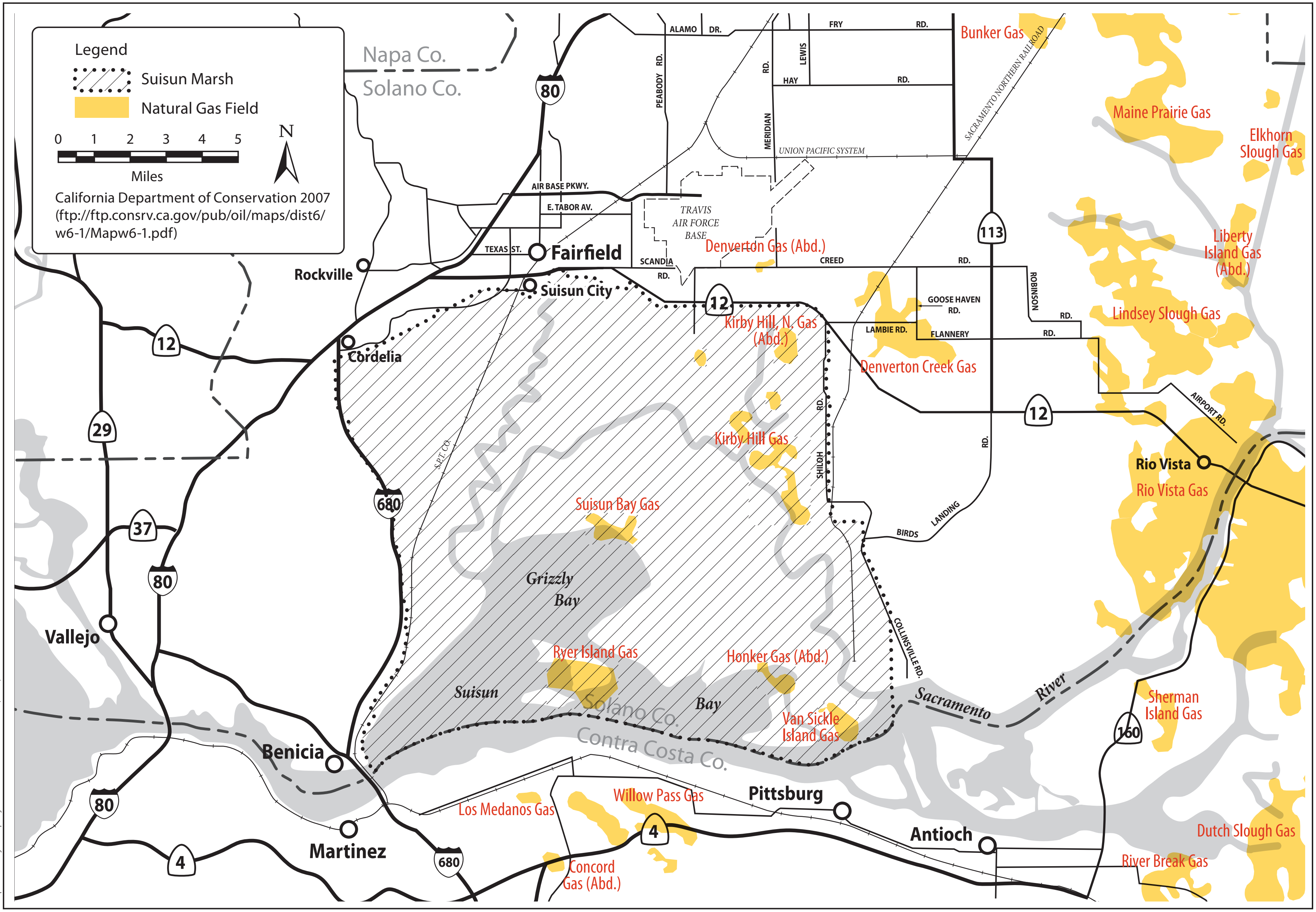

Figure 5.3-3
Natural Gas Fields

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Gas, and Geothermal Resources 2004, 2006). In the immediate project area, active gas fields include Ryer Island and Suisun Bay (California Department of Conservation, Division of Oil, Gas, and Geothermal Resources 2008). Nearby Kirby Hill is an important natural gas storage field (EDAW/AECOM 2006c).

Non-Fuel Mineral Resources

Solano County is rich in non-fuel mineral resources, including mercury, construction sand and gravel, stone products, clay, calcium, and sulfur (EDAW/AECOM 2006a). Figure 5.3-4 shows the location and distribution of known mineral resources in the county.

As shown in Figure 5.3-4, small areas zoned MRZ-2 and MRZ-3 for aggregate resources are located along the edge of the plan area, in and adjacent to the city of Vallejo. Portions of the Potrero Hills also are zoned MRZ-3 for sand and gravel resources. One operating quarry is located on the north flank of the Potrero Hills uplift, and other active sand, gravel, and stone quarries are located in and adjacent to the city of Benicia, along the west side of the plan area. Mercury also has been produced in this portion of the county (EDAW/AECOM 2006a).

Groundwater Resources

The project area overlies the Suisun-Fairfield Valley Groundwater Basin, which is the second-largest groundwater basin in Solano County, with an area of 133,600 acres. The Suisun-Fairfield basin is bounded on the north and west by foothills of the Coast Ranges uplift, on the south by marshlands bordering Suisun Bay, and on the east by the low bedrock ridges that crop out southeast from Vacaville to the Montezuma Hills (Thomasson et al. 1960; Solano County Water Agency 2005).

The Suisun-Fairfield Valley groundwater basin recharges by infiltration on the Suisun Valley floor and along stream channels and drains generally southward into Suisun Marsh, where groundwater provides freshwater mixing and flushing action (San Francisco Bay Conservation and Development Commission 1976). The most important water-bearing formations are the gravel and sand deposits within the older alluvium, which are up to 200 feet thick. These are underlain at depth by a thick sequence of non–water-bearing marine sedimentary deposits of Mesozoic-Paleogene age (Great Valley Complex) and by volcanic rocks associated with the Sonoma Volcanics of Miocene age.

Groundwater supplies municipal, agricultural, and rural residential uses in Solano County (Solano County Water Agency 2005). To date, however, groundwater use has not been accurately quantified, and the SCWA’s Integrated Regional Water Management Plan (IRWMP) identifies the need for better understanding of groundwater supply and demand as a key issue for water management in the county (Solano County Water Agency 2005). Nonetheless, existing data suggest that the Suisun-Fairfield basin is not a significant source of supply because of low yields (average = 200 gallons per minute [gpm], maximum = 500 gpm) and poor water quality (total dissolved solids [TDS] averaging 410 mg/l and ranging as high as 740 mg/l) (Solano County Water Agency 2005; California Department of Water Resources 2003). However, several small communities and individual landowners on the periphery of the Marsh, as wells as a few parcels in the Primary Zone of the Marsh, use groundwater for their domestic water supply.

An existing well in the Grizzly Island Wildlife Area provides brackish water with a high mineral content. With the exception of the few landowners that use groundwater for domestic supplies, well water typically is used for lawn irrigation, and drinking water is imported.

Regulatory Setting

Federal

Geology, Geologic Resources, and Geologic Hazards—Clean Water Act, Section 402(p)

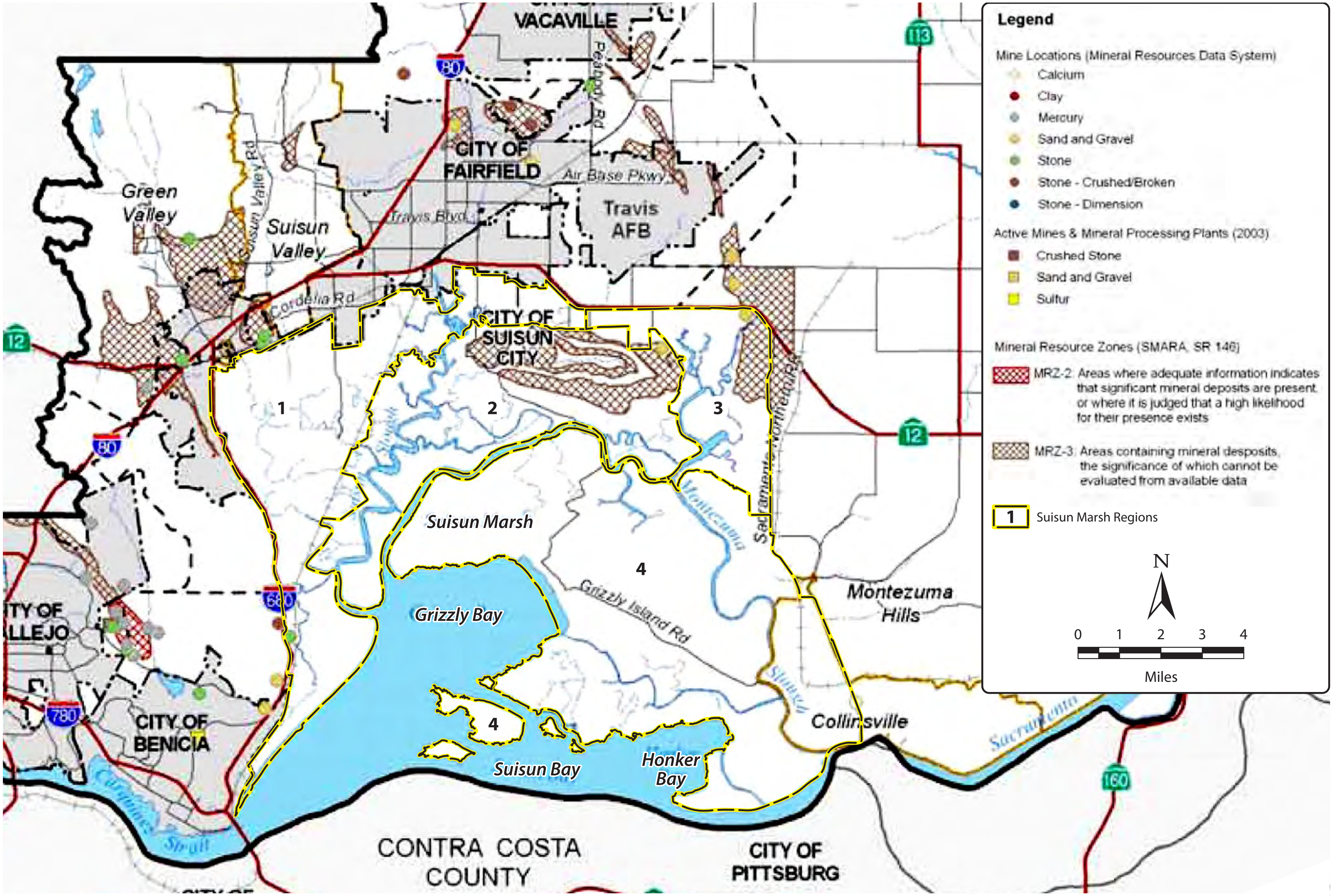
Amendments to the CWA in 1987 added Section 402(p), which created a framework for regulating municipal and industrial stormwater discharges under the NPDES program. In California, the State Water Board is responsible for implementing the NPDES program; pursuant to the state's Porter-Cologne Water Quality Control Act (Porter-Cologne Act) (see discussion in Water Quality section of this EIS/EIR), it delegates implementation responsibility to the state's nine RWQCBs.

Under the NPDES Phase II Rule, any construction project disturbing 1 acre or more must obtain coverage under the state's NPDES General Permit for Stormwater Discharges Associated with Construction Activity (General Construction Permit). The purpose of the Phase II rule is to avoid or mitigate the effects of construction activities, including earthwork, on surface waters. To this end, General Construction Permit applicants are required to file a Notice of Intent to Discharge Stormwater with the RWQCB that has jurisdiction over the construction area and to prepare a stormwater pollution prevention plan (SWPPP) stipulating BMPs that will be in place to avoid adverse effects on water quality.

Additional information on other aspects of the CWA is provided in the Water Quality section of this EIS/EIR.

Groundwater—Clean Water Act, Other Sections

As discussed in more detail in the Hydrology and Water Quality section, the CWA is the primary federal law that protects the quality of the nation's waters.



Source: Solano County General Planning Documents, 2006 and 2008.

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Figure 5.3-4
Mineral Resources

It operates on the principle that all discharges of pollutants into the nation's waters are unlawful unless specifically authorized by a permit; permit review is the CWA's primary regulatory tool.

Groundwater quality is indirectly protected by the permit review under CWA Section 402 (permits for discharge of stormwater from construction sites, discussed briefly in the preceding section), and to some extent by the Section 404 process (permits for discharge of dredged and fill materials to waters of the United States).

Broader protection is provided by Section 401, which stipulates that any project requiring a federal permit must be reviewed for its potential effects on water quality, and Section 303(d); under Section 303(d) and California's Porter-Cologne Act of 1969 (discussed below), the State of California is required to establish beneficial uses of state waters and to adopt water quality standards to protect those beneficial uses.

State

Geology, Geologic Hazards, and Geologic Resources

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code [PRC] Section 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active faults and strictly regulates construction in the corridors along active faults (earthquake fault zones). It also defines criteria for identifying active faults, giving legal weight to terms such as *active*, and establishes a process for reviewing building proposals in and adjacent to earthquake fault zones.

Under the Alquist-Priolo Act, faults are zoned and construction along or across them is strictly regulated if they are "sufficiently active" and "well-defined." A fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as referring to approximately the last 11,000 years). A fault is considered well-defined if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional techniques, criteria, and judgment (Hart and Bryant 1997).

Seismic Hazards Mapping Act

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong groundshaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act: the state is charged with identifying and mapping areas at risk of strong groundshaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped seismic hazard zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within seismic hazard zones until appropriate site-specific geologic and/or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans.

Surface Mining and Reclamation Act

The Surface Mining and Reclamation Act of 1975 (SMARA) (PRC Sections 2710–2719) is the principal legislation addressing mineral resources in California. SMARA was enacted in response to land use conflicts between urban growth and essential mineral production. Its stated purpose is to provide a comprehensive surface mining and reclamation policy that will encourage the production and conservation of mineral resources while ensuring that:

- adverse environmental effects of mining are prevented or minimized;
- mined lands are reclaimed and residual hazards to public health and safety are eliminated; and
- consideration is given to recreation, watershed, wildlife, aesthetic, and other related values.

SMARA governs the use and conservation of a wide variety of mineral resources, although some resources and activities are exempt from its provisions, including excavation and grading conducted for farming, construction, or recovery from flooding or other natural disaster.

SMARA provides for the evaluation of an area’s mineral resources using a system of mineral resource zone (MRZ) classifications that reflect the known or inferred presence and significance of a given mineral resource. The MRZ classifications are based on available geologic information, including geologic mapping and other information on surface exposures, drilling records, and mine data; and socioeconomic factors such as market conditions and urban development patterns. The MRZ classifications are defined as follows.

- **MRZ-1**: Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- **MRZ-2:** Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.
- **MRZ-3:** Areas containing mineral deposits, the significance of which cannot be evaluated from available data.

- **MRZ-4:** Areas where available information is inadequate for assignment into any other MRZ.

The State of California is responsible for mineral resources zoning under SMARA, but SMARA implementation and enforcement authority rests with the local jurisdiction and is carried out through the county or city land use planning process and codes. Solano County's SMARA implementing regulations are contained in Chapter 29 of the County Code.

Marsh Development Permits

In the primary management area of Suisun Marsh, a new project involving grading would require a BCDC marsh development permit. Depending on the size of the project and the amount of work, the project could either require an administrative permit or a major permit (requiring a public hearing). Individual projects will be evaluated based on project activities and project proponents to determine the appropriate permitting mechanism. It is anticipated that restoration activities under the SMP would require a permit.

Groundwater

Porter-Cologne Water Quality Control Act of 1969

The Porter-Cologne Act, passed in 1969, dovetails with the CWA. Both laws are discussed in detail in the Hydrology and Water Quality section of this EIS/EIR. Briefly, the Porter-Cologne Act established the State Water Resources Control Board and divided the state into nine regions, each overseen by an RWQCB. The State Water Board has primary responsibility for the quality of the state's surface and groundwater supplies, but much of its daily implementation authority is delegated to the nine RWQCBs, which are responsible for implementing Sections 401 and 402 of the CWA. They also oversee implementation of CWA Section 303(d). In general, the State Water Board manages water rights and regulates statewide water quality, and the RWQCBs focus on water quality within their respective regions.

The Porter-Cologne Act requires the RWQCBs to develop water quality control plans (Basin Plans) that designate beneficial uses of California's major surface water bodies and groundwater basins and establish specific narrative and numerical water quality objectives for those waters. *Beneficial uses* represent the services and qualities of a water body—i.e., the reasons why the water body is considered valuable. *Water quality objectives* reflect the standards necessary to protect and support those beneficial uses. Basin Plan standards are implemented primarily by using the NPDES permitting system to regulate waste discharges so that water quality objectives are met. Under the Porter-Cologne Act, Basin Plans must be updated every 3 years.

The Suisun Marsh area is within the jurisdiction of the San Francisco Bay RWQCB, headquartered in Oakland.

Groundwater Management Act

California's Groundwater Management Act (California Water Code Sec. 10750–10756) gives existing local agencies expanded authority over the management of groundwater resources in basins recognized by DWR. Its intent is to promote the voluntary development of groundwater management plans in order to ensure stable groundwater supplies for the future. Under the act, a groundwater management plan is defined as providing for "planned use of the groundwater basin yield, storage space, transmission capability, and water in storage."

The act stipulates the technical components of a groundwater management plan as well as procedures for such a plan's adoption, including passage of a formal resolution of intent to adopt a groundwater management plan, and holding a public hearing on the proposed project. The act also requires agencies to adopt rules and regulations to implement an adopted plan and empowers agencies to raise funds to pay for the facilities needed to manage the basin, such as extraction wells, conveyance infrastructure, recharge facilities, and testing and treatment facilities.

Local

Grading

Solano County has adopted the 1997 Uniform Building Code and 2001 California Building Standards Code, including the optional appendices that regulate earthwork. The County's grading codes (also referred to as the Grading, Drainage, Land Leveling and Erosion Control Ordinance) are contained in Chapter 31 of the County Code, and do not apply to federal or state agencies. The County requires grading permits for most earthwork, with the exception of the following.

- Small excavations and fills (those with no more than 8,000 square feet disturbed, an excavated volume less than 150 cubic yards, a finished depth less than 4 feet, and slopes no steeper than 2:1).
- Landscaping of areas smaller than 10,000 square feet.
- Excavation for structures—such as pools, basements, and septic tanks—that are typically covered through other permit processes.
- Permitted land leveling for agricultural purposes.
- Agricultural activities on previously graded or leveled lands.
- Utility trenches, wells, and exploratory excavations by licensed personnel.
- Activities in disposal areas, landfills, quarries, stockpiles, and other operations where a County Use Permit has been granted
- Grading for fire roads and firebreaks.
- Grading by Solano County or Special Districts; grading for projects on state- or federally owned or operated lands.

- Grading within the Suisun Primary Marsh Area.

Mineral and Energy Resources

The Resources Element of the County General Plan (Solano County 2008) recognizes the economic importance of the county's mineral resources and contains policies (Policy RS.P-32) to ensure that

- areas with important mineral resources are zoned and developed in ways that maintain resource availability;
- mineral extraction activities are performed in a manner that is compatible with surrounding land uses;
- adverse environmental effects of extractive activities are avoided; and
- mined sites are properly restored following closure, consistent with SMARA requirements and surrounding land uses.

General Plan policies regarding natural gas resources differ somewhat from those for non-fuel mineral resources. The General Plan recognizes the past and current importance of natural gas in Solano County but also stresses that natural gas has a limited lifespan as an alternative to other fossil fuels. General Plan Policy RS.P-54 identifies the importance of "responsible extraction, storage, and transportation of natural gas resources" to "minimize the impact on the natural environment" (Solano County 2008).

Groundwater

The SCWA was established in 1951 to provide untreated water to water service agencies in Solano County from the federal Solano Project and the North Bay Aqueduct of the SWP. SCWA is responsible for delivering water to water service agencies and monitoring efforts to mitigate stormwater runoff. An IRWMP (Solano County Water Agency 2005) has been developed for the SCWA and its member cities and districts. The IRWMP proposes regionwide policies and projects to meet key strategic issues identified by stakeholder groups, including the management of the county's groundwater resources. The IRWMP identifies lack of knowledge about groundwater resources as a key management concern, limiting understanding of groundwater problems and opportunities in areas where insufficient monitoring has taken place (Solano County Water Agency 2005).

Environmental Consequences

Assessment Methods

Impacts related to geology, seismicity, soils, and mineral and groundwater resources were assessed qualitatively, based on published information and professional judgment, in light of the current standards of care for engineering geology, mineral resources management, and groundwater management. Analysis of geology-related impacts focused on the potential for increased risk of personal injury, loss of life, damage to property or facilities, and reduced availability of important mineral resources. Analysis of groundwater impacts focused on the potential for the project to deplete groundwater resources or degrade water quality in the groundwater basin.

Significance Criteria

Impacts would be significant and would require mitigation if the proposed action were to result in any of the following.

- Exposure of people, structures, or facilities to hazards involving:
  - rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map or based on other substantial evidence of active faulting;
  - strong seismic groundshaking;
  - seismically induced ground failure, including but not limited to liquefaction;
  - landslides, including seismically induced landslides; or
  - expansive soils, as defined in the current California Building Code.
- Creation of unstable cuts or fills.
- Substantial loss of topsoil resources; substantially accelerated soil erosion.
- Loss or substantial reduction in availability of a known mineral resource of regional or statewide value.
- Loss or substantial reduction in availability of a locally important mineral resource recovery site.
- Substantial depletion of groundwater supplies or interference with groundwater recharge.
- Long-term groundwater overdraft; appreciable land subsidence as a result of groundwater overdraft.
- Interference with the normal operation of existing nearby wells or a substantial increase in pumping cost at those wells such that they could not

support existing land uses or planned land uses for which permits have been granted.

- Detectable degradation of groundwater quality.
- Increased seepage losses from sloughs, canals, and streams.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, the SMP would not be implemented, and land use decision making would continue under current plans and practices. Limited marsh restoration and managed wetland enhancement are expected to occur through several separate projects unrelated to the SMP.

As there would be no change from baseline land use, current conditions, practices, and outcomes relative to geology, soils, natural gas, and non-fuel mineral resources would remain unchanged under the No Action alternative. However, the reduction in frequency of managed wetland activities would limit the potential for soil disturbance throughout the Marsh.

Depending on their location and extent, marsh restoration projects under the No Action Alternative might have some potential to affect the salinity of shallow groundwater, especially during dry periods when inland recharge is substantially diminished, but if this occurs, it would represent a return to a more natural hydrologic pattern and would be considered an overall benefit. Aquifer stratigraphy in Suisun Marsh is not well documented, so it is unclear whether shallow infiltration could affect the producing aquifer. However, because wells in Suisun Marsh are not used for potable, municipal, or agricultural supply, even if producing aquifers were affected, there would be little or no effect on the use of well water, particularly in light of the limited extent of restoration anticipated under the No Action Alternative.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact GEO-1: Potential to Create Unstable Cut or Fill Slopes

The proposed action would entail activities requiring fill placement and/or excavation, including but not necessarily limited to placement of locally obtained fill (dredge spoils) to raise levee crest elevations. Excavation associated with restoration would be limited to grading to create desired habitat features and removal of levee portions to inundate the restoration area. Fill would be applied mainly to improve both interior and exterior levees, but may also be used to create islands or other upland transition areas as part of restoration design. Excavation would be limited by both volume and geographic location, thus minimizing risks of soil instability. Additionally riprap and other bank protection would be implemented to protect newly created or modified slopes from excessive instability and erosion. As a result, project activities are not expected to create unstable cut or fill slopes, and would likely benefit slopes in both newly created tidal and existing managed wetlands.

Conclusion: Less than significant. No mitigation required.

Impact GEO-2: Potential for Accelerated Soil Erosion

Soils in Suisun Marsh are clay-rich and are not highly erodible, but ground-disturbing activities—such as earthwork to breach levees and fill placement to expand and maintain the levees that are not removed—nonetheless would have the potential to increase rates and extent of soil erosion. However, as described in Chapter 2, project proponents will implement an erosion and sediment control plan consistent with the current engineering standard of care and also will be required to implement a SWPPP for CWA compliance for activities that disturb an area of more than 1 acre. Additionally, restoration sites will be managed to establish vegetation before breaching, which would limit erosion. With these protective measures in place, impacts related to the potential for accelerated soil erosion would be substantially avoided or minimized, and are expected to be less than significant.

Restoring tidal action to portions of Suisun Marsh would increase the mobility of sediment in reconnected tidal channels and mudflat areas. This would entail some scour and localized sediment deposition. However, the cycle of tidally driven sediment erosion, transport, and redeposition would reflect the restoration of natural processes interrupted by the existing levee and dike system, so it is viewed as a benefit and does not require mitigation. Sediment transport is analyzed in more detail in Section 5.5, Sediment Transport.

Conclusion: Beneficial or less than significant. No mitigation required.

Impact GEO-3: Potential Loss of Topsoil Resources

Topsoil is the fertile, organic-rich upper portion of a soil profile; under natural conditions, it is present only where a soil profile has developed over time. Thus, some portions of the project area—active tidal channels and mudflats, where sediment is regularly remobilized by tidal currents—are unlikely to support topsoil.

Nonetheless, in areas where topsoil is present, construction of new project facilities would require removal of the existing topsoil layer. Other ground-disturbing activities—such as earthwork to breach levees and fill placement to expand and maintain the levees that are not removed—also would have some potential to result in removal and loss of topsoil resources where they are present. Ground disturbance would be confined to the minimum area necessary for project purposes, and, where feasible, topsoil would be sidecast and stockpiled for on-site reuse. The amount of topsoil lost as a result of project activities would be reduced to the extent feasible; in consideration of the comparatively small loss of topsoil and the overall project outcome of restoring, enhancing, and preserving marshland ecology (including an intact soil profile, where originally present) over a large area, impacts are evaluated as less than significant.

Conclusion: Less than significant. No mitigation required.

Impact GEO-4: Reduction in Availability of Non-Fuel Mineral Resources

Small areas zoned MRZ-2 and MRZ-3 for aggregate resources are located along the edge of the project area, in and adjacent to the city of Vallejo. Portions of the Potrero Hills also are zoned MRZ-3 for sand and gravel resources. One operating quarry is located on the north flank of the Potrero Hills uplift, and other active sand, gravel, and stone quarries are located in and adjacent to the city of Benicia, along the west side of the project area. Mercury also has been produced in this portion of the county (EDAW/AECOM 2006a).

To the extent that restored marsh habitat is viewed as incompatible with mineral resource extraction on nearby parcels, the proposed action could lead to long-term shifts in land use planning priorities, rendering extractive activities less feasible in the future. However, because the known mineral resources are not within the project area and are located only in limited areas on the periphery, it is not expected that restoration would result in changes in land uses related to mineral extraction.

Conclusion: Less than significant. No mitigation is required.

Impact GEO-5: Reduction in Availability of Natural Gas Resources

Several proved natural gas fields are located in or near the plan area, as shown in Figure 5.3-3 above. As discussed in the previous impact for non-fuel mineral resources, habitat restoration may be viewed as incompatible with continued, new, or renewed extraction of natural gas. To the extent that restored marsh habitat is viewed as incompatible with natural gas extraction, the proposed action could render natural gas extraction less feasible in the future. Regardless, restoration activities would occur only on lands purchased from willing sellers, and natural gas still would be extracted in other areas in and around the Marsh.

Conclusion: Less than significant. No mitigation required.

Impact GW-6: Potential for Altered Salinity in Shallow Suisun Marsh Groundwater

Restoring tidal connectivity and increasing the acreage of tidal wetland in Suisun Marsh would increase the area exposed to saline and brackish surface water. In normal years, groundwater moves from inland areas toward the marsh, where it provides freshwater flushing; thus, in most years, restoration likely would have little to no effect on groundwater salinity. In dry periods, when inland recharge is substantially diminished, there might be some potential for increased infiltration of saline waters into the shallow subsurface in Suisun Marsh. This would represent a return from the marsh’s present condition to a more natural hydrologic pattern, representing an overall benefit. Aquifer stratigraphy in Suisun Marsh is not well documented, so it is unclear whether shallow infiltration could affect the producing aquifer. However, because wells in Suisun Marsh are not used for potable, municipal, or agricultural supply, even if producing aquifers were affected, there would be little or no effect on the use of well water.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact GEO-1: Potential to Create Unstable Cut or Fill Slopes

The proposed action would entail activities requiring fill placement and/or excavation, including but not necessarily limited to placement of locally obtained fill (dredge spoils) and raise levee crest elevations for purposes of managed wetland enhancement. Excavation for enhancement would be limited to the interior areas of managed wetlands and center channels of tidal sloughs. Fill would be applied mainly to improve both interior and exterior levees. Excavation would be limited by both volume and geographic location, thus minimizing risks of soil instability. Additionally riprap and other bank protection would be implemented to protect newly created or modified slopes from excessive instability and erosion. As a result, project activities are not expected to create unstable cut or fill slopes, and would likely benefit slopes in managed wetlands.

Conclusion: Less than significant. No mitigation required.

Impact GEO-2: Potential for Accelerated Soil Erosion

Soils in Suisun Marsh are clay-rich and are not highly erodible, but ground-disturbing activities would have the potential to increase rates and extent of soil erosion. However, managed wetland enhancement activities would not result in ground disturbance substantially above the currently implemented land management. Additionally, areas that may be disturbed within the managed wetlands are contained behind levees, water is not discharged until the wetlands are fully flooded, vegetation within the wetlands helps reduce suspended sediments, the low tide discharges are minimal compared to the total volume of the flooded managed wetland areas and area disturbed, and impacts related to the potential for accelerated soil erosion would be substantially avoided or minimized through BMPs required as part of the CWA permit conditions. As such, impacts are expected to be less than significant.

Conclusion: Less than significant. No mitigation required.

Impact GEO-5: Reduction in Availability of Natural Gas Resources

Several proved natural gas fields are located in or near the plan area, as shown in Figure 5.3-3 above. Enhancement activities would not change the current potential for natural gas extraction because there would be no changes in land use or other factors that would limit extraction potential.

Conclusion: No impact.

Impact GEO-7: Potential for Damage to Structures as a Result of Surface Fault Rupture, Groundshaking and/or Seismically Induced Ground Failure (Liquefaction)

The only three types of structures that would be constructed under the SMP are levees, duck blinds, and pump platforms. The principal concern related to surface fault rupture, groundshaking, and liquefaction would be the potential for structural damage, although injury and loss of life are also possible. As discussed in Geologic Hazards above, the westernmost end of the Suisun Marsh area is traversed by the active Concord and Green Valley faults, both of which are zoned by the State of California under the Alquist-Priolo Earthquake Fault Zoning Act. The eastern edge of the plan area also may be subject to surface fault rupture hazard along the Pittsburg−Kirby Hills fault zone, which is not zoned by the state but likely is also active. The area of Holocene Bay Mud substrate surrounding the Bay—which includes most of the area informally referred to as Suisun Marsh—is also at high risk of liquefaction in moderate and larger earthquakes. Both groundshaking and liquefaction have the potential to damage new project facilities.

If new levees, pump platforms, and duck blinds are constructed near the alignment of the active Concord or Green Valley fault, they could be at risk of damage as a result of surface fault rupture associated with this fault system. There also may be some potential for damage to pump station structures constructed along the Pittsburg−Kirby Hills fault zone.

Duck blinds would be small facilities, occupied only a few hours out of each hunting season month (October–November), and they likely would be exempt from the triggering criteria of the Alquist-Priolo Act, which applies to structures that have a human occupancy rate of more than 2,000 person-hours per year.

This slight increased risk of potential structural damage to new levees, duck blinds, and pump platforms would be in limited locations in the Marsh and would not be considered significant. Additionally, the placement of materials on levees would improve levee stability.

Conclusion: Less than significant. No mitigation required.

Impact GEO-8: Potential for Damage to Structures as a Result of Landslides, Including Seismically Induced Landslides

The project area is located in flat marshland topography, and as such the majority of the project area is not at risk of landslides. However, lands at the base of steep, slide-prone uplifts are in potential landslide runout areas; these include the strip along I-680 at the west edge of Suisun Marsh, and marshlands downslope from the western tip of the Potrero Hills. Any new project facilities constructed in such areas could be at risk of substantial damage with minor corollary risks to personal safety. However, few structures would be constructed in areas subject to damage from landslides, and because these structures generally are not occupied, there would not be a substantial change from current conditions with the implementation of Alternative A.

Conclusion: Less than significant. No mitigation is required.

Alternative B: Restore 2,000–4,000 Acres

Impacts under Alternative B would be very similar to those described for the proposed action, with the following principal differences.

- Alternative B would result in less extensive tidal restoration and could entail less major earthwork because less levee breaching would be required. However, the increased enhancement compared to Alternative A would result in more ground-disturbing activities in managed wetlands and dredging activities in channels. Additionally, there would be more levee improvements through increased enhancement. The level of significance of impacts described for Alternative A would be the same for Alternative B.
- Reduced tidal restoration likely also would decrease land use planning pressures identified as potentially unfavorable to mineral resources and natural gas extraction. This would be particularly true for mineral resources because of substantial reductions in proposed restoration in Regions 1, 2, and 4 (see Figure 5.3-4). The level of significance of impacts described for Alternative A would be the same for Alternative B.

Alternative C: Restore 7,000–9,000 Acres

Impacts under Alternative C would be broadly similar to those described for the proposed action, with the following principal differences.

- Alternative C would result in substantially more extensive tidal restoration than Alternative A, and would have greater potential for temporary soil instability due to levee breaching. Impacts related to ground disturbance, topsoil loss, and accelerated soil erosion in managed wetlands would be less than Alternative A, and still would be less than significant because the same environmental commitments and regulatory requirements identified for the proposed action (topsoil reuse, Erosion and Sediment Control Plan, SWPPP) would apply under Alternative C. The overall level of significance of impacts described for Alternative A would be the same for Alternative C.
- Increased extent of tidal restoration would increase land use planning pressures identified as potentially unfavorable to mineral resources and natural extraction (see Figure 5.3-4). The level of significance of impacts described for Alternative A would be the same for Alternative C.
- Increased extent of tidal restoration would increase the potential for impacts on shallow groundwater. However, impacts still are expected to be less than significant overall for the same reasons identified above for the proposed action.

Section 5.4
Flood Control and Levee Stability

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on flood control and levee stability.

The Affected Environment discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. The environmental setting is intended to be directly or indirectly relevant to the subsequent discussion of impacts.

The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 5.4-1 summarizes impacts on flood control and levee stability from implementing the SMP alternatives. There would be no significant impacts on flood control and levee stability from implementing the SMP alternatives.

Table 5.4-1. Summary of Flood Control and Levee Stability Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
FC-1: Increased Potential for Catastrophic Levee Failure and Flooding Resulting from Restoration Activities That Expose Interior Levees to Tidal Action	A, B, C	Less than significant	None required	–
FC-2: Changes in Flood Stage and Flow Capacity in Suisun Marsh Channels as a Result of Increased Tidal Prism and Flood Storage Capacity	A, B, C	Beneficial	–	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
FC-3: Temporary Decrease in Levee Stability Resulting from Construction Activities	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
FC-4: Reduction in Potential for Catastrophic Levee Failure and Flooding Resulting from Improvements in Exterior Levee Maintenance	A, B, C	Beneficial	–	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section:

- Suisun Marsh Charter Group Levee Conceptual Model—State of Knowledge, Draft Final (California Department of Water Resources 2005).
- Suisun Marsh Numerical Modeling, RMA (January 2008, PowerPoint).
- CALFED Suisun Marsh Levee Investigation Report (California Department of Water Resources 2000).
- DRMS Study Phase 1 Report (California Department of Water Resources 2007).
- Suisun Marsh Levee Evaluation (Ramlit and Associates 1983).

The Suisun Marsh is protected from tidal action and high water events by 200 miles of exterior levees. Several miles of interior levees are also maintained to separate land with differing uses and management practices. Exterior levees provide the Marsh with necessary flood protection and vehicle access. They also play a role in maintaining channels in the Marsh and thus have the potential to influence salinity in the Marsh and as far as the south Delta CVP and SWP diversions. Levees in the Marsh have not been constructed to an engineered standard nor have they been maintained to the standard of an urban or an agricultural levee.

The majority of Suisun Marsh, including wildlife habitat, is situated at or below mean tide elevation. Levees serve as the primary flood protection for Suisun Marsh lands, infrastructure, and natural resources. Exterior levees are used in conjunction with interior levees, ditches, and water control structures to retain, exclude, and direct water.

Where possible, levees were constructed on existing channel berms to take advantage of the existing natural topography throughout the Marsh. Levee configurations throughout the Marsh vary considerably in material composition, cross-sectional geometry, strength, and stability (California Department of Water Resources 2005).

Since the early 1800s levees were constructed primarily with dredged material removed from the adjacent channels. As levees have been maintained, some of the longstanding levees have increased in size as additional dredged material has been placed on the crown, seaward side, and landside. Due to regulatory constraints, options for maintaining Marsh levees are limited to the use of materials from within the managed wetlands or by very limited importation. Subsidence requires additional placement of material to raise and reinforce the levees.

Levee failures can result in flooding that can affect the regional salinity of the adjacent waterways, tidally restored sites, and managed wetlands. Historical flooding, including the flooding in 1998, prompted DWR to complete a levee breach analysis study to determine whether there was a correlation between levee failures in Suisun Marsh and salinity increases in the Delta. The study concluded that portions of the exterior levee system in Suisun Marsh may be important to controlling salinity. The August 1999 breach at the Sunrise Club on Chadbourne Slough (280 acres) is an example of a small breach (180 feet in width) that had localized impacts on salinity for adjacent landowners. Larger, region-wide breaches and flooding in the Marsh, as in 1998, can have water quality effects in the Delta that can affect SWP and CVP operations (California Department of Water Resources 1999, 2000, 2001).

While levee failure mechanisms are well understood, the mechanism causing a sudden failure is rarely able to be determined. Therefore, it is important to inspect levees and adequately maintain them to prevent failure. In Suisun Marsh, levee overtopping has been the historical failure mechanism (Chappell pers. comm.). (Overtopping is a systematic design failure which causes erosion that then breaches the levee as opposed to a breach caused by an internal structural failure of the levee.) As levees subside, the available freeboard (the distance between the high tide or flood elevation and the top of the levee) is reduced and the potential for overtopping is increased. Wave action and sea level rise also can reduce the effective freeboard. Over time, without maintenance all levees eventually will fail.

As described in Chapter 2, most if not all restoration activities will require some amount of levee improvements to ensure that adjacent properties are adequately protected from flooding. These upgrades will likely include levee raises and contouring, brush boxes, riprap, or other wave and wind protection.

Regulatory Setting

Federal

There are no federal mandates for flood control and levee stability in the Marsh.

State

There are no state mandates for flood control and levee stability in the Marsh.

Local

Suisun Resource Conservation District Levee Standards

In 1980, *SRCD's Management Program to Preserve, Protect, and Enhance the Plant and Wildlife Communities within the Primary Management Zone of the Suisun Marsh* was developed, and included minimum standards for levee design in the Marsh. These standards assume that the maximum water depth against an exterior levee is 7 feet above sea level and the maximum depth against an interior levee is 3 feet above sea level. The SRCD management program acknowledges that when these water elevation conditions are exceeded special design levee standards are required. Table 5.4-2 shows the applicable standards for typical exterior and interior levees.

Table 5.4-2. Applicable Standards for Typical Exterior and Interior Levees

Levee Type	Crown Width	Freeboard	Sideslopes
Exterior	12 feet	2 feet; 3 feet where wave action occurs	2:1
Interior	10 feet	1 foot minimum; if water depth is greater than 1 foot, freeboard should be equal to water depth and not exceed 3 feet	2:1

Suisun Marsh Levee Investigation Team

CALFED established the Suisun Marsh Levee Investigation Team (SMLIT) in 1998 to gather information on the costs and benefits of including Suisun Marsh levees in the CALFED Program, especially as they relate to CALFED Water Quality, Water Supply Reliability, and ERP goals. The SMLIT used computer models to evaluate hydrodynamics and salinity impacts of controlled and uncontrolled levee breaches in Suisun Marsh. The SMLIT final report was completed as the Suisun Marsh Charter process was initiated. The SMLIT agreed that implementation of their recommendations should be carried out within the context of the SMP. The SMLIT recommended:

- establishment of an interim plan that emphasizes development of an emergency response program,
- establishment of a base-level Marsh-wide maintenance program,
- establishment of a program for enhanced protection that is modeled on the current special flood control projects program and the special projects program,
- development of a criteria and evaluation methodology for acceptable parcel characteristics,
- establishment of an application of focused research toward an engineering strategy for levee breaching and maintenance,
- development of methods to obtain more accurate topographical data for Suisun Marsh for planning purposes,
- examination of sedimentation processes in the Marsh to explore possible means of creating sediment accretions throughout Suisun Marsh,
- inclusion of adaptive management techniques to pursue any tidal marsh conversion efforts,
- the addition of Suisun Marsh levees to the CALFED Levee Program Risk Assessment and Risk Management Strategy,
- funding for an emergency response element to address Suisun Marsh levees,
- structuring funding for improvements to Suisun Marsh levees to avoid competition with the already strained resources for the maintenance of levees currently included in the Delta Subventions Program,
- concurrent implementation of restoration and maintenance improvements, and
- focus first on lands in public ownership for habitat conversion opportunities.

Environmental Consequences

Assessment Methods

The RMA hydrodynamic and water quality model of the San Francisco Bay and the Delta (described in Appendix A) was used to predict changes in stage, velocity, and flow to compare alternative scenarios for Marsh restoration that impacts flood control and levee stability in Suisun Marsh.

Significance Criteria

Significance of impacts is determined by using significance criteria set forth in the State CEQA Guidelines and professional standards and practices. Impacts on flood risks are considered significant if implementation of an alternative would:

- significantly raise flood stage elevations along flood control levees;
- increase the frequency and duration of inundation on lands within the flood control area; or
- expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a flood control levee.

Impacts on the levee system are considered significant if an alternative would substantially increase:

- seepage,
- levee settlement,
- wind erosion,
- scour,
- sediment deposition, or
- subsidence of land adjacent to levees.

In addition, an impact on the levee system is considered significant if an alternative would substantially decrease:

- levee stability;
- inspection, maintenance, or repair capabilities;
- current levee slope protection;
- emergency response capabilities;
- channel conveyance capacity; or
- ability of the levees to withstand seismic loading.

Environmental Impacts

No Action Alternative

The No Action Alternative would rely on the existing level of maintenance activities to inspect, assess, and maintain the exterior levee system. The inability to obtain permits for managed wetland activities, including levee maintenance, would further reduce the level of maintenance activities. Currently, maintenance efforts are not able to keep up with the current rate of levee degradation. Suisun

Marsh is already susceptible to flooding during major flood events, and continued wave erosion (fetch-generated and boat traffic) rates are putting several miles of exterior levees at risk for failure during less frequent flood events and potential “summer failure” (e.g., Jones Tract). If the No Action alternative is selected, the flood risk in Suisun Marsh would continue to increase as a result of deferred maintenance.

Alternative A: Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact FC-1: Increased Potential for Catastrophic Levee Failure and Flooding Resulting from Restoration Activities That Expose Interior Levees to Tidal Action

As a result of levee breaches and other actions that may be implemented as part of SMP tidal wetland restoration actions, interior levees may become exterior levees, thus increasing their exposure to tidal action for which they were not intended. To reduce the potential risk for failure of these levees, they would be improved to meet exterior levee standards. The Suisun Marsh exterior levee section standard requires a crown (top width) of 12 feet and 2:1 (H:V) side slopes. In addition, the levee must provide necessary freeboard above the 100-year flood. Necessary freeboard is described as 2 feet of freeboard under normal conditions and 3 feet of freeboard in wave-prone areas. The 100-year flood elevation is estimated at 10.0 feet NAVD 88. This datum should be compared against other tidal and survey datums in use in the Marsh prior to any levee evaluation. The 200 miles of exterior levee locations and any proposed “new” exterior levees associated with planned breaches will be evaluated to determine the proper freeboard requirement. Levee profile and crown surveys will be completed to determine compliance with the standard and identify areas needing improvements.

Additionally, benches, berms, and erosion protection such as brush boxes, vegetation, and riprap that would be included to establish a range of marsh habitats also would serve to protect the levee from wind and wave erosion. These improvements would be implemented prior to breaches that would expose them to tidal action to ensure that there is no point during which an unimproved interior levee is exposed to tidal action.

Conclusion: Less than significant. No mitigation required.

Impact FC-2: Changes in Flood Stage and Flow Capacity in Suisun Marsh Channels as a Result of Increased Tidal Prism and Flood Storage Capacity

The creation of additional tidal wetland habitat through breaching of existing exterior levees would increase the acreage of land available to draw tidal flows overland and increase flood storage capacity during storm events. This additional area would have varying effects on the adjacent waters that would supply flow to the tidal wetland areas. Preliminary hydraulic modeling suggests that the addition of tidal prism through the breaching of levees and restoration of tidal wetlands would reduce tidal stages in the adjacent channels and bays (Appendix A, “Numerical Modeling in Support of Suisun Marsh PEIR/EIS Technical Memorandum, March 2008”). The magnitude and extent of stage reduction would be dependent on the volume of additional tidal prism and the location within the Marsh.

This reduction in stage in channels adjacent to restoration areas likely would be a beneficial change relative to flooding, as the channels would have a greater carrying capacity during storm events, and levees within the restoration area would be improved to meet exterior levee standards, as described above.

Conclusion: Beneficial.

Impact FC-3: Temporary Decrease in Levee Stability Resulting from Construction Activities

During construction of new levee sections or rehabilitation of levees to bring them up to a minimum standard, the levee may be subject to ground shaking and increased ground pressures from heavy equipment or placement of fill. This additional loading may exceed the potential for the existing levee material or levee foundation material to support the levee section (i.e., shear strength) and may cause rapid settling or fracture of the levee section. As described in Chapter 2, specific project proponents will control construction equipment access and placement of fill to maintain acceptable loading based on the shear strength of the foundation material.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact FC-4: Reduction in Potential for Catastrophic Levee Failure and Flooding Resulting from Improvements in Exterior Levee Maintenance

The SMP includes a program to improve levee maintenance activities for exterior levees. This would be accomplished by increasing slope stability and reducing erosion, overtopping, and failure through placement of riprap or alternative bank protection measures, as well as modifying the heights of exterior levees, which would require dredging and importation of appropriate levee materials (e.g., mineral soils and clays). Depending on existing conditions, work may occur on the waterside slope, landside slope, or both. Improved levee stability would reduce the risk of catastrophic levee failure.

Conclusion: Beneficial.

Alternative B: Restore 2,000–4,000 Acres

Compared to Alternative A, this alternative includes more managed wetland activities that would accommodate the reduced restoration that leaves more exterior levees to be maintained. Less restoration also would lead to less need to bolster interior levees to meet exterior levee standards. Similarly, there would be fewer changes in tidal stage and muting. However, the level of significance for the impacts identified for Alternative A would be the same for Alternative B.

Alternative C: Restore 7,000–9,000 Acres

This alternative calls for more restoration than Alternative A, which reduces the need for some exterior levee maintenance, but the reduced application of managed wetland activities is not expected to change the overall flood protection improvements described in Alternative A. There would be more changes in tidal stage and muting; nonetheless, the level of significance for the impacts identified for Alternative A is the same for Alternative C.

Section 5.5
Sediment Transport

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on sediment transport.

The Affected Environment discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts.

The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 5.5-1 summarizes impacts on sediment transport from implementing the SMP alternatives. There would be no significant impacts on sediment transport from implementing the SMP alternatives.

Table 5.5-1. Summary of Sediment Transport Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
ST-1: Increased Scour in Bays or Channels Upstream and Downstream of Habitat Restoration Areas	A, B, C	Less than significant	None required	–
ST-2: Deposition of Sediment in the Restored Tidal Wetlands	A, B, C	Beneficial or Less than significant	None required	–
ST-3: Changes in Regional Sedimentation and Scour Patterns in Suisun Marsh	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Managed Wetland Activities Impacts				
ST-4: Increase in Erosion Adjacent to Dredging Sites	A, B, C	Less than significant	None required	–
ST-5: Increase in Deposition at Dredging Sites	A, B, C	Less than significant	None required	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section:

- Draft Results for Discussion. RMA Suisun Marsh Models, January 2008 (PowerPoint) (RMA 2008).
- *Proposed Negative Declaration and Environmental Assessment/Initial Study for the Proposed Blacklock Restoration Project* (California Department of Fish and Game and Bureau of Reclamation 2006).
- *Conceptual Model Scalar Transport and Suisun Marsh Geometry: Implications of Tidal Marsh Restoration on Formerly Diked Wetlands. Suisun Marsh Planning* (California Department of Water Resources).

Suisun Marsh Sediment Supply

The Sacramento–San Joaquin River system in combination with the tidal influences of San Francisco Bay is the primary hydraulic and sediment transport source in Suisun Marsh. The Suisun Marsh sediment supply is influenced by the continuous input of SS from the Sacramento River, which can enter the Marsh through Montezuma Slough. However, tidal currents and wind-driven suspension of mudflats in Suisun Bay and the Marsh channels also provide a continuous source of suspended sediment. Local tributaries north of Suisun Marsh provide infrequent floodflows and sediment pulses that coincide with precipitation events in southern Solano County.

SS concentrations have been measured at several locations throughout Suisun Marsh. Ruhl and Schoellhamer (2004) measured SS concentrations at a shallow-water site (Honker Bay) and a deep-water channel (Mallard Island) from December 1996 through July 1997. They found similar temporal trends caused by tidal velocities and storm events at both the shallow-water and deep-channel sites. In December, SS was relatively low (25–50 mg/l) at both sites but increased following the first-flush winter storm event to 100–150 mg/l in Honker Bay and 50–100 mg/l at Mallard Island.

The Blacklock Restoration Project is located on Nurse Slough adjacent to Little Honker Bay and is a good example of how SS may be affected by restoration activities. DWR measured SS concentrations using optical backscatter sensors at two locations in Nurse Slough from December 2004 to April 2006 as part of background monitoring for the restoration plan. The SS data are displayed in Figure 5.2-5. The average SS concentration was about 100 mg/l. The SS concentrations were lowest, about 50 mg/l, in fall 2005. It appears that Suisun Bay and the Marsh channels have a reasonably high and relatively constant SS concentration of about 50 mg/l. This provides a large amount of particles for adsorbing metals and other potentially toxic chemicals and pollutants.

Suisun Marsh Sediment Transport

RMA has developed a two-dimensional (2-D) hydraulic model of San Francisco Bay and the Delta to assess the potential changes in Suisun Marsh hydrodynamics related to potential restoration scenarios (Appendix A). While this model does not calculate sediment transport or geomorphologic changes expected to occur in the channels and bays over time, it does provide changes in velocity that can be used to better understand how sediment may be mobilized and transported.

In general the Marsh channels could be considered to be in a state approaching equilibrium. Dredging of channels has been limited in scale over the last 10 to 15 years. Channels are accumulating sediment where channel velocities are low enough for sediment to settle out of the water column. Where channel velocities are higher, sediments are suspended and carried in the direction of flow until they settle out again. In addition, wind-driven wave action and boat wakes provide enough energy to re-suspend and mobilize sediment. Scour zones and depositional zones could be expected to remain the same into the future, unless the tidal prism (i.e., upstream tidal volume) or channel geometries in the Marsh are altered (i.e., restoration efforts change tidal prism, and dredging operations alter channel geometry).

Increasing tidal prism would involve breaching levees to provide additional tidal habitat directly connected to bays, sloughs, or channels in the Marsh. Sediment is expected to be carried through these breaches by tidal flows and deposited in the new tidal areas. These sediments would come from the available SS in the water column or from sediment that is mobilized by increased channel velocities or wave energy. Early predictions from the RMA 2-D model indicate that channel velocities will increase by 3 to 4 fps locally at levee breaches and sloughs that will convey increased tidal flows to the breach sites. The modeled velocity increases are localized and do not persist great distances upstream or downstream. Therefore, the sediment contributions from these increased velocities would be limited and may reach a new sedimentation equilibrium quickly. It would be expected that some channel or bank erosion would occur in the area of increased velocity if scour countermeasures or enlarged breach areas are not installed. Based on preliminary hydraulic modeling, it appears that tide-driven channel velocities will not increase enough to mobilize more sediment from the Marsh channels. Therefore, sediment supplies that are expected to deposit in the restoration areas will come from the existing sediment supply in the water column that results from wind/wave–driven re-suspending of sediments on nearby shallow mudflats or shallow water along the channel banks.

Environmental Consequences

Assessment Methods

Assessment of environmental impacts associated with sedimentation and scour has been accomplished through application of quantitative modeling (Appendix A). This modeling has been used to forecast the potential for, and patterns of, sedimentation and erosion in Suisun Marsh channels.

Significance Criteria

The criteria used for determining the significance of an impact on sedimentation and scour are based on the State CEQA Guidelines and professional standards and practices. Impacts may be considered significant if implementation of an alternative would:

- substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation off site or in areas not identified for deposition in the proposed restoration design.

Environmental Impacts

No Action Alternative

For the No Action Alternative, some restoration and natural levee breaching may occur. In these areas, existing sedimentation and/or scour rates could temporarily change. However, managed wetland activities would cease or decrease as a result of regulatory restrictions. Therefore, there would be no impacts.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact ST-1: Increased Scour in Bays or Channels Upstream and Downstream of Habitat Restoration Areas

As tidal restoration is implemented and areas are opened to tidal influences and floodflows, the adjacent waterways that supply the tidal water volume may experience increased velocities and have a greater potential to mobilize sediment. It is expected that each new levee breach would experience local scour as increased volumes of water pass through the opening on the tidal cycle and during flood events. Some adjacent channels would scour and increase their conveyance areas to supply additional tidal water volume to the new habitats. However, as part of the restoration design, breach locations would be selected to minimize scour and channel hydraulic changes. Also, as discussed in Chapter 2 under Environmental Commitments, site-specific hydraulic simulation modeling and scour analysis would occur. All final restoration designs would be simulated with the RMA model (or equivalent model) to verify that the effects of scour are minimized.

Conclusion: Less than significant. No mitigation required.

Impact ST-2: Deposition of Sediment in the Restored Tidal Wetlands

Breaching of levees and dikes would encourage natural deposition of sediment in the tidal wetland restoration areas. Removal of the levee or dike and restoring the tidal function to the managed wetland areas would create slow and shallow tidal flows. Under these conditions, SS from the water column typically will be deposited. The rate of deposition would depend on the residence time of tidal flow, depth of tidal flooding, and concentration and gradation of SS. Natural deposition within the tidal wetlands would restore a range of wetland elevations, providing the expected tidal habitat conditions.

Conclusion: Beneficial or less than significant. No mitigation required.

Impact ST-3: Changes in Regional Sedimentation and Scour Patterns in Suisun Marsh

The intent of the plan is to restore greater tidal function to Suisun Marsh. Breaching exterior levees and dikes that have allowed reclamation of historical marsh lands would return these lands to tidal marsh. The increased marsh area effectively would increase the tidal prism (i.e., the amount of water that can flood the marsh on the high tide). This increase in the tidal prism would increase local channel velocities and provide greater low-velocity tidal habitats in the restored wetland areas, which would change the overall sedimentation in Suisun Marsh.

Some channels may experience local scour attributable to increased velocity as more water travels to the restoration areas. In addition, the restoration areas would have greater capacity to trap or accept deposited sediments. Regionally, the channels in the Marsh would adjust to accommodate the higher restored tidal flow, but the channels would reach a new sedimentation equilibrium over time. Areas that typically are targeted for dredging likely would remain areas of deposition, so the local supply of sediments for levee maintenance and strengthening are not expected to be reduced.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact ST-4: Increase in Erosion Adjacent to Dredging Sites

Channel dredging would occur in center channels and would avoid emergent vegetation. As such, it is not expected to encroach on levee profiles or benches adjacent to levees. Although localized scour and deposition in the vicinity of dredging areas would be temporarily modified as dredged sites refill with sediment, it is not expected that channel erosion would be increased beyond what generally occurs in the dynamic (i.e., tidal) Marsh.

Conclusion: Less than significant. No mitigation required.

Impact ST-5: Increase in Deposition at Dredging Sites

Following dredging operations, the deeper channel sections would have the greatest potential for trapping deposited sediments, which may reduce depositional rates in adjacent channels or restored tidal habitat areas. As the entire sediment budget of the Marsh adjusts to restoration area sediment demands and changes in channel geometry attributable to restoration and dredging, sedimentation rates throughout the Marsh are expected to vary.

Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Impacts for Alternative B would be the same as for Alternative A but to a lesser extent.

Alternative C: Restore 7,000–9,000 Acres

Impacts for Alternative C would be the same as for Alternative A but to a greater extent.

Section 5.6
Transportation and Navigation

Introduction

This section describes the existing transportation and navigation conditions and the consequences of implementing the SMP alternatives on transportation and navigation resources.

The Affected Environment discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts. For example, the setting identifies transportation and navigation in the action area because the action could have an effect on transportation and navigation in the plan area.

The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 5.6-1 summarizes transportation and navigation impacts from implementing the SMP alternatives. There would be no significant impacts on transportation and navigation resources from implementing the SMP alternatives.

Table 5.6-1. Summary of Transportation and Navigation Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
TN-1: Temporary Addition of Vehicles to Roadway System and Alteration of Patterns of Vehicular Circulation during Construction Activities	A, B, C	Less than significant	None required	–
TN-2: Temporary Increases in Road Hazards during Construction Activities	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
TN-3: Damage to Roadway Surfaces from Construction Activities	A, B, C	Less than significant	None required	–
TN-4: Impacts to Air Traffic Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
TN-5: Impacts on Land Use Attributable to Restoration Activities within Travis Air Force Base Zone	A, B, C	Less than significant	None required	–
TN-6: Temporary Reduction in Boat Access during Construction Activities	A, B, C	Less than significant	None required	–
TN-7: Decrease in Rail Line Integrity and Disruption to Rail Service	A, B, C	Less than significant	None required	–
TN-8: Short-Term Reduction in Navigable Areas Resulting from Increased Velocities after Restoration Activities	A, B, C	Less than significant	None required	–
TN-9: Temporary Reduction in Boat Access during Dredging Activities	A, B, C	Less than significant	None required	–
TN-10: Increases in Navigable Areas of Suisun Marsh	A, B, C	Beneficial	–	–
TN-11: Operations and Maintenance Increase in Traffic	A, B, C	Less than significant	None required	–
Managed Wetland Activities				
TN-1: Temporary Addition of Vehicles to Roadway System and Alteration of Patterns of Vehicular Circulation during Construction Activities	A, B, C	Less than significant	None required	–
TN-2: Temporary Increases in Road Hazards during Construction Activities	A, B, C	Less than significant	None required	–
TN-3: Damage to Roadway Surfaces from Construction Activities	A, B, C	Less than significant	None required	–
TN-4: Impacts to Air Traffic Attributable to Restoration Activities	A, B, C	Less than significant	None required	–
TN-5: Impacts on Land Use Attributable to Restoration Activities within Travis Air Force Base Zone	A, B, C	Less than significant	None required	–
TN-6: Temporary Reduction in Boat Access during Construction Activities	A, B, C	Less than significant	None required	–
TN-7: Decrease in Rail Line Integrity and Disruption to Rail Service	A, B, C	Less than significant	None required	–
TN-9: Temporary Reduction in Boat Access during Dredging Activities	A, B, C	Less than significant	None required	–
TN-11: Operations and Maintenance Increase in Traffic	A, B, C	Less than significant	None required	–

Affected Environment

Roadway Network

The primary regional roadways serving Suisun Marsh are located around the Marsh perimeter and include Interstate 80 (I-80) (Urban Interstate Freeway) and SR 12 (Rural Major Arterial) to the north, SR 4 to the south, and Interstate 680 (I-680) (Major Collector) to the west. I-80 connects Solano County to the San Francisco and Sacramento metropolitan areas. I-680 connects the county to the east Bay Area, and SR 12 and SR 4 act as major arterials connecting major urban areas (Figure 5.6-1).

Solano County maintains several roads in the interior Marsh that serve rural developments, managed wetlands and agricultural operations, and other uses in the Marsh. Table 5.6-2 lists these roads in relation to Suisun Bay. The Operations division of the Solano County Public Works Department surveys the roads every 2 weeks to assess public safety issues and need for any repairs. If major repairs are deemed necessary, a 5-year road improvement plan is implemented. The County also conducts annual surveys to measure major road damage and repair needs. The plan area can be accessed via some combination of the local roadways listed below. There are also many roads within the Marsh that are privately owned and maintained. The key local roadways in the Marsh are shown in Figure 5.6-2.

Table 5.6-2. Local Roads in Suisun Marsh

North of Suisun Bay *East of I-80/I-680 and South of SR 12*	**Northeast of Grizzly Bay**	**East of Montezuma Slough**
• O’Rher Road	• Van Sickle Road	• Lambie Road
• Cordelia Road	• Grizzly Island Road	• Flannery Road
• Chadbourne Road	• Redhouse Road	• Little Honker Road
• Thomasson Lane	• Potrero Hill Lane	• Olsen Road
• Ramsey Road	• Killdeer Road	• Birds Landing Road
• Goodyear Road	• Scally Road	• Montezuma Hills Road
• Jacksnipe Road	• Rio Vista Road	• Coleville Road
• Pierce Harbor Lane	• Nurse Slough Road	• Fire Truck Lane
• Morrow Lane	• Explosive Technology Road	
• Lake Herman Road		

Rail

The Union Pacific Railroad (UPRR) runs through the western portion of the Marsh and carries freight cars between Bay Area ports and the rest of the country (Figure 5.6-1). The Capitol Corridor (Amtrak) uses the UPRR line and has a station in Suisun City. This passenger line connects regionally and nationally (Solano County General Plan 2008, T-17). The California Northern Railroad runs a short line freight service. They lease 250 miles of Union Pacific Railroad tracks from Suisun City to Schellville and other areas (California Northern Railroad Company no date).

The Concord Naval Weapons Station is located along the southern perimeter of Suisun Bay, immediately south of Ryer Island and north of SR 4 (Figure 5.6-1). The station houses three commercial class 1 railroads (GlobalSecurity.org 2008).

Boats

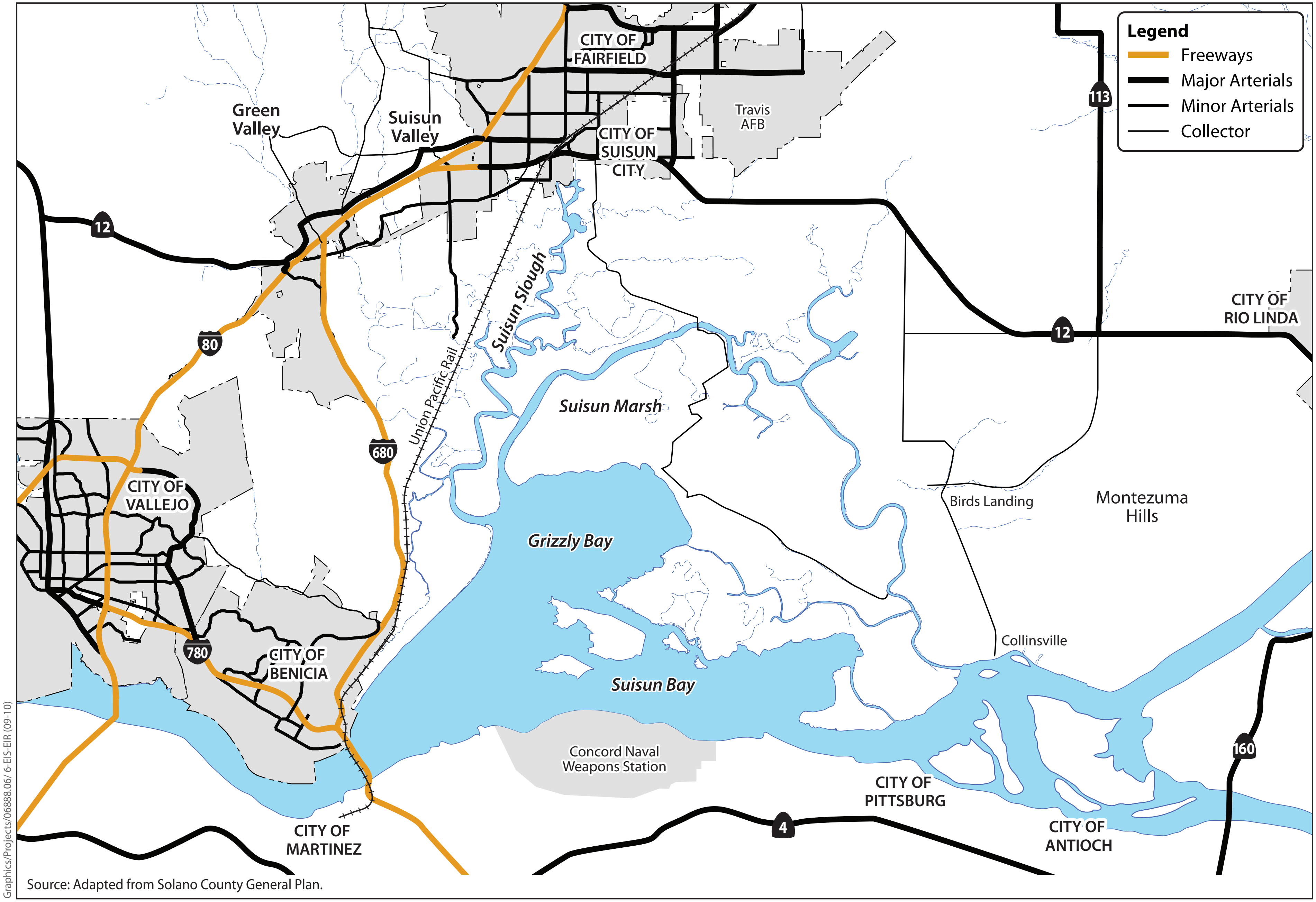
Suisun Bay is a major navigational and recreational water body and serves as the entrance to the Delta. Suisun Marsh is a 102,053-acre marsh with many navigable channels throughout. Figure 5.6-3 shows the major surface waters in and around the Marsh. Bays and minor and major sloughs comprise 26,980 acres of navigable channels (Table 6.2-2, “Suisun Marsh Acreage by Habitat Type and Region”). The two major channels are Montezuma and Suisun Sloughs. Suisun Slough runs from Grizzly Bay to the northern portion of the Marsh, and Montezuma Slough runs from the eastern side of Grizzly Bay to the western side, with several smaller channels diverging from it. Other navigable waterways are Cordelia, Denverton, Nurse, and Hill Sloughs.

Most of the Marsh is navigable by small boats, and some channels, such as Montezuma and Suisun Sloughs, are navigable by much larger boats. A major navigation channel is the Suisun Bay channel, which connects to the Carquinez Strait.

As described in the Recreation section, launching locations in the Marsh include Suisun City boat ramp, Suisun City Marina, and Solano Yacht Club, all located in Suisun Slough, Belden’s Landing located in Montezuma Slough, and McAvoy Yacht Harbor and Yacht Club, located on Suisun Bay at Bay Point. In addition, there are marinas on the Contra Costa shoreline near Pittsburg and Antioch that provide access to Suisun Bay. Most boating in the Marsh is recreational such as fishing, water and jet skiing, kayaking, and canoeing (See Section 7.4, Recreation). Most of the sloughs are narrow, and when tides recede, the sloughs become shallow, limiting some access.

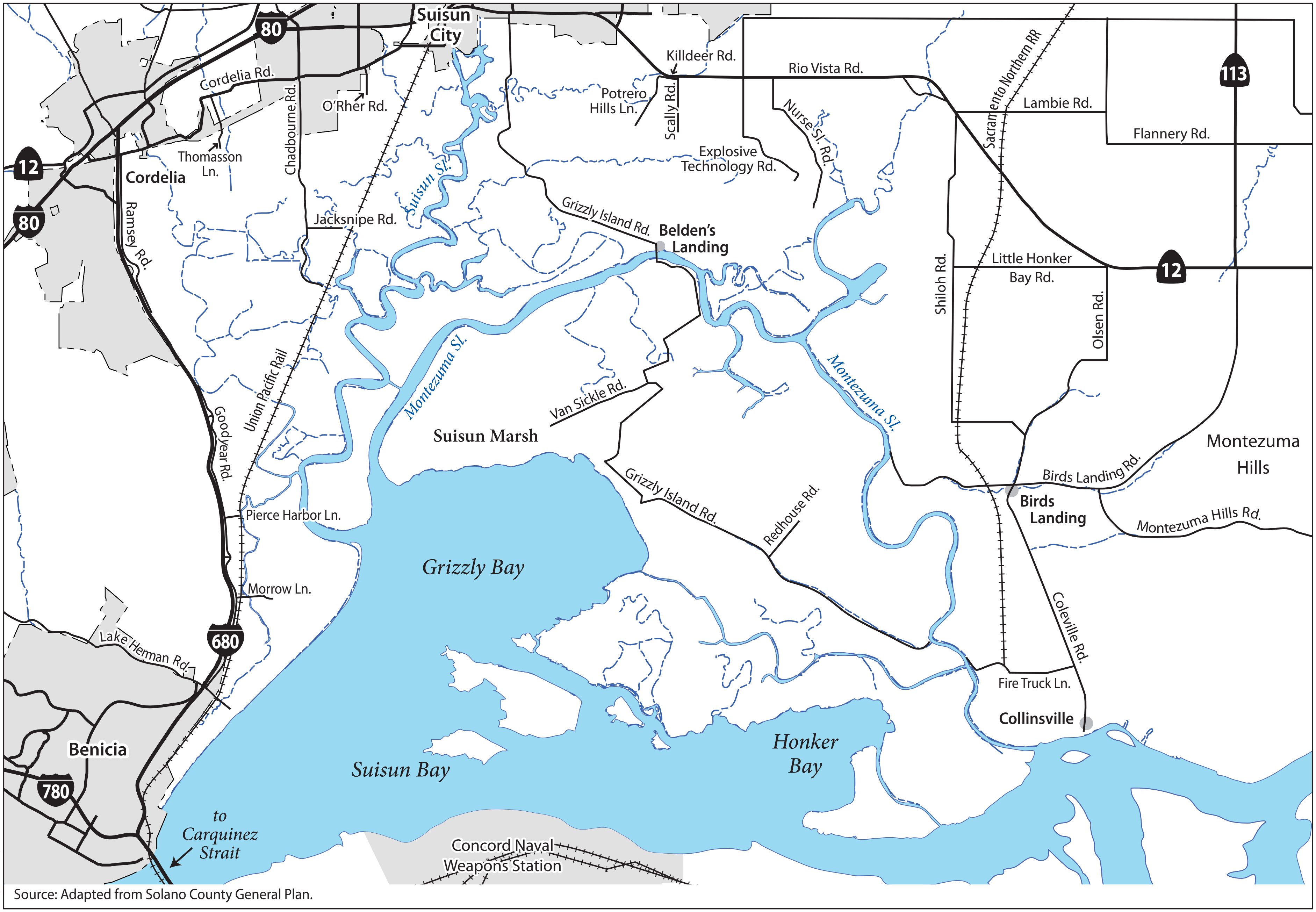
Aviation Facilities

Travis Air Force Base (AFB) is located approximately 1 mile from the northern boundary of the SMP area (on the northeast side of SR 12). Travis AFB handles more cargo and passengers than any other military air terminal in the United States and is home to the 60th Air Mobility Wing, the largest air mobility organization in the United States Air Force (Figure 5.6-1).



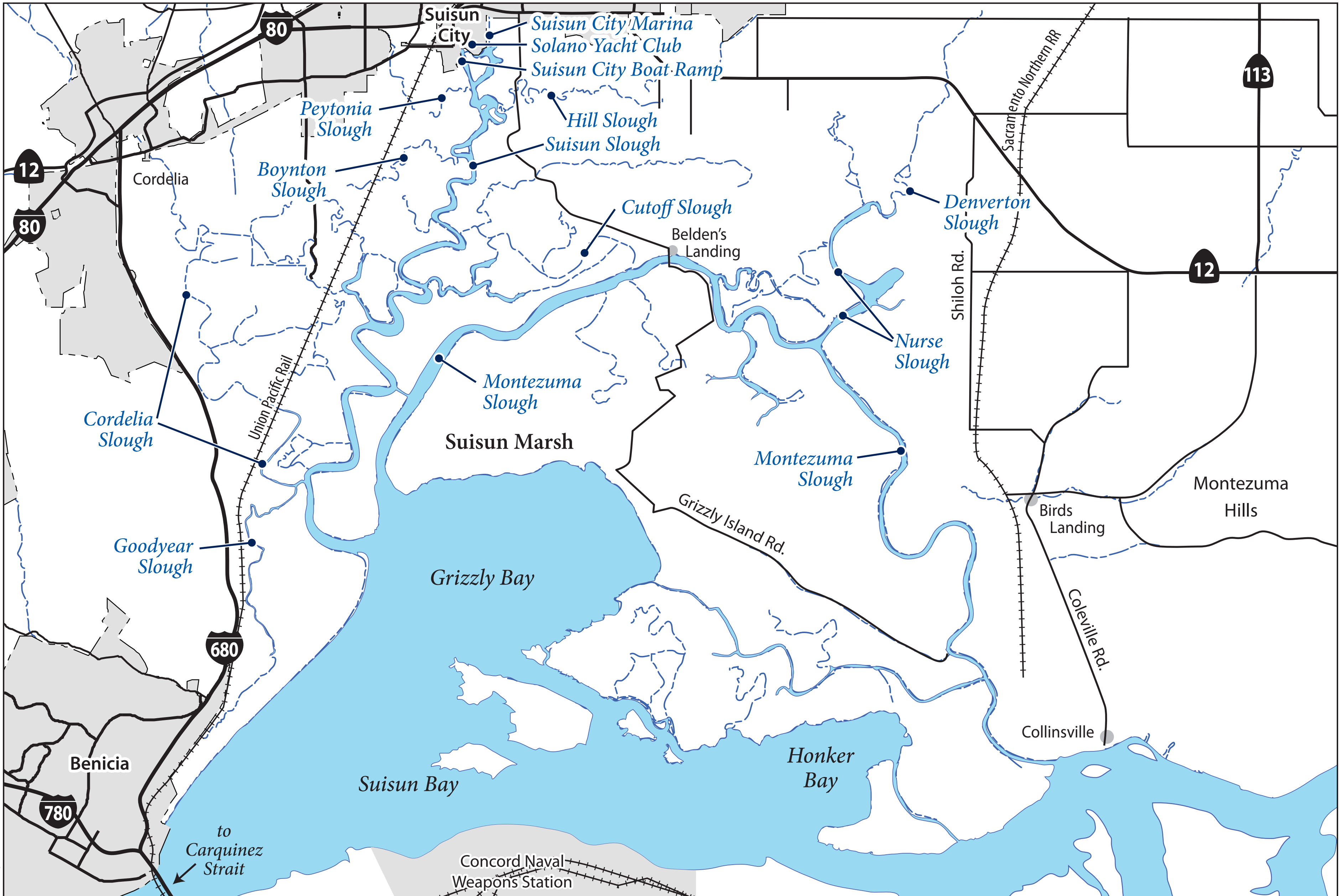
ICF INTERNATIONAL

Figure 5.6-1
Major Highways, Rail Lines, and Aviation Facilities Surrounding Suisun Marsh



ICF INTERNATIONAL

Figure 5.6-2
Local Roadways in and around Suisun Marsh



Source: Adapted from Solano County General Plan.

Graphics/Projects/06888.06/ 6-EIS-EIR (09-10)

ICF INTERNATIONAL

Figure 5.6-3
Surface Waters in and around Suisun Marsh

The Concord Naval Weapons Station, the location of which is described in the Rail section, above, currently has three commercial air terminals and three military air terminals (GlobalSecurity.org 2008).

Sources of Information

The following key sources of information were used in the preparation of this section:

- Solano County General Plan, Land Use and Circulation Element (Solano County Planning Department 1992), and
- City of Suisun City—Wal-Mart Walters Road West Project Draft EIR (Michael Brandman Associates 2008).

Regulatory Setting

Federal

Federal Aviation Administration

Standards for airport and air traffic safety and service are under the jurisdiction of the Federal Aviation Administration (FAA). The FAA's guidance regarding prevention of bird airstrike hazard (BASH) addresses land uses such as waste disposal operations, water management facilities, wetlands, dredge spoil contaminant areas, agricultural activities, golf courses, and landscaping near airports that could attract wildlife. BASH is addressed in Advisory Circular 150/5200-33B Hazardous Wildlife Attractants on or near Airports (Federal Aviation Administration 2007), which recommends setbacks from airport operations. Depending on the aircraft type (piston or turbine-powered) distances regulated by BASH range from 5,000 feet (0.93 mile) to 10,000 feet (1.86 miles) from air operations areas. For all airports, the FAA recommends a perimeter of 5 miles from air operations area for approaching and departing aircraft. The Advisory Circular also recommends that the FAA be given the opportunity to review proposed land uses and evaluate their effects on aviation safety. Based on its review, FAA may request implementation of appropriate management measures to reduce potential hazards to aircraft.

Local

Solano County Transportation Authority

The Solano County Transportation Authority sets forth various goals, objectives, and policies that would apply to projects in the county. Applicable goals, objectives, and policies from the Arterials, Highways, and Freeways Element of the Solano Comprehensive Transportation Plan, dated June 2005, that are applicable to the proposed project include:

- Objective A—Preserve the System: Preserve the physical and operational condition of existing roadway facilities as a means of protecting past transportation investments and maintaining an effective system.
- Policy 1: Encourage member jurisdictions and Caltrans to maintain level of service (LOS) E or better conditions during the a.m. and p.m. peak hours on roadways of countywide significance.

Solano County Airport Land Use Commission

The Solano County Airport Land Use Commission regulates land use around Travis AFB by recommending to cities that projects in their jurisdictions comply with the Travis AFB Land Use Compatibility Plan. The plan identifies land use compatibility policies applicable to future development near Travis AFB. The policies are designed to ensure that future land uses in the surrounding area will be compatible with potential aircraft activity at the base. In certain circumstances, local governments have the ability to override the decisions of the Airport Land Use Commission.

The Travis Air Force Base Land Use Compatibility Plan prohibits land uses that would create glare or distracting lights; sources of dust, steam, or smoke; sources of electrical interference with aircraft communications or navigation; or any land use (e.g., landfills) that may attract an increased number of birds. Land has been acquired to the north and east of Travis AFB and is reserved for open space or future base expansion. Areas surrounding Travis AFB are also designated as Zones A, B1, B2, C, and D (Figure 7.1-3). Compatibility Zone D, in which Suisun Marsh is located, includes all other locations beneath any of the Travis AFB airspace protection surfaces delineated in accordance with Federal Aviation Regulations Part 77. Limitations on the height of structures are the only compatibility factors within this zone.

Solano County General Plan

Cities and counties are responsible for planning, designing, constructing, operating, and maintaining local public roadways within their jurisdictions. The Solano County General Plan Circulation Element informs and describes the existing and future circulation conditions in unincorporated sections of Solano County (Solano County 2008).

According to the *Road Improvement Standards and Land Development Requirements*,

> the goal of Solano County is to maintain a Level of Service C on all roads and intersections. In addition to meeting the design widths and standards contained in this document, all projects shall be designed to maintain a Level of Service C, except where the existing level of service is already

below C, the project shall be designed such that there will be no decrease in the existing level of service.

Solano County will issue an encroachment permit whenever construction activities would be conducted within the public right-of-way. Encroachment permits are intended to safeguard the affected jurisdictions' properties, by providing either preventive measures to be implemented during project construction or corrective measures if damage occurs.

Any encroachment within the right-of-way of a state highway or route would be subject to Caltrans regulations, including issuance of an encroachment permit and the provision of temporary traffic control systems. Such a system could include traffic control warning signs, lights, and/or safety devices to ensure the safety of the traveling public.

Environmental Consequences

Assessment Methods

The impacts resulting from SMP alternatives have been assessed based on assumptions about construction-related traffic and navigational disruptions in the plan area. It is assumed that construction of the various SMP alternative components would occur over the 30-year SMP implementation period and would be intermittent. The types and numbers of equipment in use at one time cannot be determined at this time, but it is assumed that minimal overlap in major restoration or managed wetland activities would occur. However, specific projects may require further analysis to describe in more detail any potential impacts on traffic resulting from implementation of that specific project. The SMP alternatives are compared to the No Action Alternative, and that potential change in transportation and/or navigation is described. The significance of potential changes is determined based on the significance criteria described below. Mitigation measures are recommended, as necessary, to reduce significant transportation and navigation impacts.

While described as a planning tool, existing and potential LOS resulting from Plan implementation is not included because there would be no permanent impacts from roadway modifications and construction impacts would be minimal and short-term. Except for during construction activities, additional vehicle trips would be minimal and are not expected to change vehicle/capacity ratios noticeably.

Significance Criteria

For the purposes of this analysis, a significant traffic impact would occur if the implementation of an SMP alternative would:

- cause traffic operations on a roadway or at an intersection to degrade (e.g., because of increased traffic generated by construction vehicles and/or loss of a travel lane to accommodate the construction work zone);
- cause a substantial increase in traffic relative to the traffic volume of the local traffic network;
- result in lengthy delays for transit riders;
- result in an inadequate parking capacity;
- substantially impede access to local streets or adjacent uses, including emergency access;
- substantially increase hazards because of a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks); or
- cause temporary or permanent disruption of rail operations.

For the purposes of this analysis, a significant air traffic impact would occur if implementation of an SMP alternative would:

- result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that would result in substantial safety risks;
- conflict with the recommendations of the FAA's Advisory Circular 150/5200-33B (Federal Aviation Administration 2007) by creating bird habitat within 5,000 feet of airports serving piston-powered aircraft and/or 10,000 feet of airports serving turbine-powered aircraft; or
- conflict with designated land use zones within Travis AFB.

For the purposes of this analysis, a significant navigation impact would occur if implementation of an SMP alternative would:

- substantially impede or block navigational craft;
- create safety conflicts in Delta waterways; or
- reduce the navigable area of the Marsh.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, limited restoration activities would occur. Traffic generated by private property owners and recreational users would continue to circulate locally within the plan area and on roadways adjacent to the plan area similar to current conditions. Thus, it is not expected that impacts on LOS at major intersections and roadway segments adjacent to and within the plan area would occur.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact TN-1: Temporary Addition of Vehicles to Roadway System and Alteration of Patterns of Vehicular Circulation during Construction Activities

Implementation of the proposed action could result in impacts associated with construction of the various SMP components that would require the use of construction equipment and potentially the importation of fill and other materials. Construction-related impacts could result from trips made by construction equipment and workers to and from a project site. Construction activities associated with implementing the SMP are the major impact mechanism for transportation effects, particularly construction equipment and the importation of soil, plantings, and other materials. During critical construction periods, public access would be restricted or controlled.

Material may be brought to a project area by barge and/or by truck. In addition, short-term construction traffic would consist of the transport of the work crew, and construction trucks delivering equipment and materials. Substantial amounts of fill hauled in to project areas by trucks, as well as other construction-related equipment and worker vehicles, could result in adverse impacts on transportation, including rail and public transit, depending on the number of trucks, total truck trips, and roadways used.

It is anticipated that the average restoration project would require up to 10 roundtrip truck trips and 10 worker trips a day for up to 30 days. The routes would be designed to ensure total loads and capacities are not exceeded. As shown in Figure 5.6-2, the primary roads that would be used for entry into the Marsh are Grizzly Island Road, Chadbourne Road, Shiloh Road, and Birds Landing Road. All of these roads dead-end in the Marsh, and there is no traffic beyond that generated by visitors to the Marsh. These roads are rural connector roads that operate at a high LOS, except during busy recreational events in the Marsh, such as opening day of duck hunting season. As described in Chapter 2, no major construction activities would occur on days known or expected to have a significant increase in traffic as a result of events in the Marsh. As such, the short-term addition of these additional trips is not expected to affect circulation on roads in the Marsh. Arterial roads and highways would not be affected by an additional 20 roundtrips per day of construction vehicles and worker trips.

Some smaller restoration activities would not generate traffic that would cause a substantial increase in the number of vehicles on the road or changes in circulation. However, for those projects that have the potential to result in significant traffic impacts, a traffic control plan, as described in the environmental commitments section of Chapter 2, will be implemented to ensure that impacts related to traffic during construction are minimal and less than significant.

Conclusion: Less than significant. No mitigation required.

Impact TN-2: Temporary Increases in Road Hazards during Construction Activities

The majority of the proposed project would be constructed away from existing major road networks and areas of residential or urban development. As such, the likelihood of accidents involving construction equipment resulting in potentially dangerous situations for the general public is low. The potential for hazards depends on the type of equipment and roadways used, as well as roadway conditions. Increased hazards would occur when roads are narrower or have other characteristics that make maneuvering difficult, equipment is larger and/or more difficult to maneuver, or roadways used include those that are used by the general public to access various areas of the Marsh. Restoration design planning will take into account access to the site, but potential road hazards may remain. As such, a traffic control plan will be implemented for each major site-specific action that has the potential to create a significant hazard to ensure that such risks are minimized or eliminated.

Conclusion: Less than significant. No mitigation required.

Impact TN-3: Damage to Roadway Surfaces from Construction Activities

Implementing the proposed project would require the transport of construction equipment and material, including but not limited to long-reach excavators, excavators, dozers, box scrapers, tractors, pipes, riprap, etc. Some roads within the Marsh may not be designed to accommodate such traffic, and therefore, there is potential for damage to roads by construction activities, construction vehicles, and transport of equipment. As described in the Environmental Commitments section of Chapter 2, the specific project proponent will conduct pre- and post-construction assessments of roadways to determine whether any roads are damaged during construction of the SMP alternatives. If damage is found, and is determined to be attributable to the SMP action, the damage will be repaired through an MOU with Solano County.

Conclusion: Less than significant. No mitigation required.

Impact TN-4: Impacts to Air Traffic Attributable to Restoration Activities

Implementation of the SMP alternatives include restoring tidal marsh habitat, which could result in more diversity of birds and other wildlife to the Suisun Marsh area than currently are present. The total acres of wetlands in the Marsh would be similar to existing conditions, but there would be shifts in the types of wetlands. In some instances, additional wetlands may be created on the periphery of tidal wetlands through inundation of upland areas. Compared to the existing tidal marsh and managed wetland acreage, the overall increase in acreage of these habitats would not significantly change wildlife or bird usage of the Marsh. Additionally, restoration and managed wetland activities would occur far enough away from the airport that bird activity would not affect air traffic patterns.

Conclusion: Less than significant. No mitigation required.

Impact TN-5: Impacts on Land Use Attributable to Restoration Activities within Travis Air Force Base Zone

As discussed above under Solano County Airport Land Use Commission, Suisun Marsh restoration would occur in Zone D under the Travis Air Force Base zoning areas. Zone D compatible land use is restricted only by the height of features that would be built. None of the proposed SMP activities are expected to result in major structures that would be considered tall enough to conflict with the Zone D land use.

Conclusion: Less than significant. No mitigation required.

Impact TN-6: Temporary Reduction in Boat Access during Construction Activities

Implementation of the SMP alternatives would include in-channel work related to restoration. In-channel work may require the reduction of some channel area available for boating and other navigation. It is expected that in-channel work related to levee breaching for restoration, specifically dredging or levee repair, would be conducted sporadically throughout the Marsh over the 30-year period, would be temporary, and would not result in permanent reductions in navigable areas. The only major navigational channel is located in Suisun Bay, and plan activities are not expected to affect this area.

Additionally, as described in the environmental commitments section of Chapter 2, specific project proponents would develop and implement a traffic and navigation control plan in coordination with affected jurisdictions and emergency service providers to reduce construction-related effects and hazards in the waterway during the construction period, including postings warning boaters of construction activities in compliance with the California Uniform State Waterway Marking System.

Conclusion: Less than significant. No mitigation required.

Impact TN-7: Decrease in Rail Line Integrity and Disruption to Rail Service

Restoration or other activities could affect the integrity of levees holding the rail line for the Union Pacific Railroad by causing increased inundation and erosion, depending on the specific location and type of SMP activities implemented. Breaches will be designed to avoid levees where rail lines sit. Restoration activities will be designed to protect rail lines. Work occurring within a particular right-of-way determined by the railroads may result in delays or other temporary disruptions to rail service, depending on the type of activities implemented. As described in the environmental commitments section of Chapter 2 under the Traffic and Navigation Control Plan, specific project proponents will coordinate with the Union Pacific Railroad prior to beginning any work within a right away of a rail line to ensure that the integrity of the rail line is maintained and to minimize disruptions to service.

Conclusion: Less than significant. No mitigation required.

Impact TN-8: Short-Term Reduction in Navigable Areas Resulting from Increased Velocities after Restoration Activities

Levee breaches associated with restoration activities could result in changes in velocities adjacent to the breach location (see Section 5.1, Water Supply, Hydrology, and Delta Water Management, and Section 5.5, Sedimentation Transport.) Increased velocities in these areas are expected to be temporary and localized to the immediate breach site location but could interfere with navigation by temporarily creating areas within the Marsh that are unsafe or not navigable. If such an impact occurs, it is expected to be temporary and minimal and would not interfere substantially with the ability of boats or other watercraft to maneuver through the Marsh area. Additionally, as described in Chapter 2, these areas will be marked to warn boaters of risks and direct them to a safe alternate route.

Conclusion: Less than significant. No mitigation required.

Impact TN-9: Temporary Reduction in Boat Access during Dredging Activities

Dredging from major and minor tidal sloughs and bays over the 30-year SMP implementation period, with the first 10 years as the most intensive period, could result in temporary reductions in boat access in isolated areas throughout the Marsh. Clamshell dredging could occur either from a barge within the channel or from the top of a levee, depending on restrictions caused by channel width or existing vegetation. From a barge, clamshell dredges would require a small tugboat to maneuver within the channel, resulting in a substantial area of the channel occupied by dredging equipment, depending on the width of the channel and the size of the barge. Dredging from the levee crown generally would require less channel space, but restrictions on boating in the immediate area still would be in place. Once dredging is complete, no further restrictions would be implemented. Dredging activities therefore would result in a temporary reduction in boat access, especially within the first 10 years of SMP implementation. Dredging would be temporary and spread throughout the Marsh area over the 30-year implementation period. It is not expected that a substantial number of individual projects or activities would be implemented at the same time, and therefore it is not expected that in-channel work would disrupt boat access in more than a minor area of the Marsh at any given time.

As described in the environmental commitments section of Chapter 2, specific project proponents would develop and implement a traffic and navigation control plan in coordination with affected jurisdictions and emergency service providers to reduce construction-related effects and hazards in the waterway during the construction period. The navigational signage environmental commitment described in Chapter 2 also would help to ensure that there are no substantial disruptions.

Conclusion: Less than significant. No mitigation required.

Impact TN-10: Increases in Navigable Areas of Suisun Marsh

Under the proposed project, the restoration of approximately 5,000 to 7,000 acres of tidal marsh would lead to an increase in the navigable areas of Suisun Marsh. The total increase in navigable areas depends on which areas are restored, beginning elevations, sedimentation rates, and sea-level rise. Some restored areas may begin with large navigable areas, but as sediment accumulates, water becomes shallow and the navigable area is reduced. Regardless, it is expected that there would be a net increase in navigable areas compared to existing conditions.

Conclusion: Beneficial.

Impact TN-11: Operations and Maintenance Increase in Traffic

Upon completion of construction of restoration, minimal traffic would be generated. There could be some monitoring efforts, but the associated increase is not expected to be noticeable. Additionally, it is not expected that the shift in habitat types would generate new trips.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact TN-1: Temporary Addition of Vehicles to Roadway System and Alteration of Patterns of Vehicular Circulation during Construction Activities

Impacts to the roadway system as a result of managed wetland activities would be similar to those described for restoration activities, but to a lesser extent. Most managed wetland activities would not generate traffic that would cause a substantial increase in the number of vehicles on the road or changes in circulation. A traffic control plan will be implemented to ensure that construction-related traffic impacts are minimal and less than significant.

Conclusion: Less than significant. No mitigation required.

Impact TN-2: Temporary Increases in Road Hazards during Construction Activities

Increases in road hazards as a result of managed wetland activities would be similar to those described for restoration activities, but to a lesser extent. In general, the increased frequency of current and the implementation of new managed wetland activities is not expected to require a substantial number of equipment pieces imported to the Marsh during any one period. Restoration actions have the highest potential to increase road hazards.

Conclusion: Less than significant. No mitigation required.

Impact TN-3: Damage to Roadway Surfaces from Construction Activities

This impact would be similar to that described for restoration activities. Certain marsh management activities would require the transport of construction equipment and material, including but not limited to long-reach excavators, tractors, pipes, riprap, etc. There is potential for damage to roads by construction activities, construction vehicles, and transport of equipment. As described in the Environmental Commitments section of Chapter 2, the specific project proponent will conduct pre- and post-construction assessments of roadways to determine whether any roads are damaged during construction of the managed wetland activities. If damage is found, and is determined to be attributable to the managed wetland activity, the damage will be repaired by the County through an MOU between the land owner conducting the managed wetland activity and Solano County.

Conclusion: Less than significant. No mitigation required.

Impact TN-4: Impacts to Air Traffic Attributable to Restoration Activities

This impact would be similar to that described for restoration activities. Enhancing managed wetlands could result in more diversity of birds and other wildlife to the Suisun Marsh area than currently are present. However, compared to the existing tidal marsh and managed wetland acreage, the overall increase in acreage of these habitats would not significantly change wildlife or bird usage of the Marsh. Additionally, managed wetland activities would occur far enough away from the airport that bird activity would not affect air traffic patterns.

Conclusion: Less than significant. No mitigation required.

Impact TN-5: Impacts on Land Use Attributable to Restoration Activities within Travis Air Force Base Zone

This impact would be the same as that described for restoration activities. Managed wetland activities would occur in Zone D under the Travis Air Force Base zoning areas. Zone D compatible land use is restricted only by the height of features that would be built. None of the proposed SMP activities are expected to result in major structures that would be considered tall enough to conflict with the Zone D land use.

Conclusion: Less than significant. No mitigation required.

Impact TN-6: Temporary Reduction in Boat Access during Construction Activities

This impact would be similar to that described for restoration activities. Implementation of the SMP alternatives would include in-channel work related to managed wetland activities, which may require the reduction of some channel area available for boating and other navigation. It is expected that in-channel work related to activities for managed wetland activities, specifically dredging or levee repair, would be conducted sporadically throughout the Marsh over the 30-year period, would be temporary, and would not result in permanent reductions in navigable areas. The only major navigational channel is located in Suisun Bay, and plan activities are not expected to affect this area.

Conclusion: Less than significant. No mitigation required.

Impact TN-7: Decrease in Rail Line Integrity and Disruption to Rail Service

This impact would be similar to that described for restoration activities. Activities associated with wetland management will not impact rail lines. As described in the environmental commitments section of Chapter 2 under the Traffic and Navigation Control Plan, specific project proponents will coordinate with the Union Pacific Railroad prior to beginning any work in the right of way of a rail line to ensure that the integrity of the rail line is maintained and to minimize disruptions to service.

Conclusion: Less than significant. No mitigation required.

Impact TN-9: Temporary Reduction in Boat Access during Dredging Activities

This impact would be the same as that described for restoration activities. Dredging from major and minor tidal sloughs and bays could result in temporary reductions in boat access in isolated areas throughout the Marsh, especially within the first 10 years of SMP implementation.

It is not expected that a substantial number of individual projects or activities would be implemented at the same time, and therefore it is not expected that in-channel work would disrupt boat access in more than a minor area of the Marsh at any given time. Additionally, as described in Chapter 2, alternate boating routes will be identified if dredging impedes navigation. Furthermore, the majority of the managed wetland activities would be conducted on private lands. Therefore, there would be no substantial disruption to boat access during dredging activities.

Conclusion: Less than significant. No mitigation required.

Impact TN-11: Operations and Maintenance Increase in Traffic

This impact would be similar to that described for restoration activities. Minimal traffic would be generated. There could be some increase in traffic during monitoring efforts, but the associated increase is not expected to be noticeable.

Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Impacts for Alternative B are similar to those described for Alternative A. There would be less tidal restoration, and more managed wetland subject to managed wetland activities. The magnitude and types of impacts resulting from Alternative B would be similar to those described above for Alternative A, except that there would be fewer benefits related to navigation because less tidal restoration would occur. Additionally, there would be fewer large construction projects related to restoration and less potential to result in changes in circulation, increased hazards, or road damage. Compared to the No Action Alternative, Alternative B would result in less-than-significant impacts related to traffic circulation, increased traffic, road and air traffic hazards, and roadway damage and beneficial impacts related to increases in navigable areas.

Alternative C: Restore 7,000–9,000 Acres

Impacts for Alternative C are similar to those described for Alternative A. There would be more tidal restoration, and less managed wetland subject to managed wetland activities. The magnitude and types of impacts resulting from Alternative C would be similar to those described above for Alternative A, except that there would be additional benefits related to navigation as more tidal restoration would occur. Additionally, there would be more large construction projects related to restoration and more potential to result in changes in circulation, increased hazards, or road damage. Compared to the No Action Alternative, Alternative C would result in less-than-significant impacts related to traffic circulation, increased traffic, road and air traffic hazards, and roadway damage and beneficial impacts related to increases in navigable areas.

Section 5.7
Air Quality

Introduction

This section describes the existing conditions and the consequences of implementing the SMP alternatives on air quality.

Summary of Impacts

Table 5.7-1 summarizes impacts on air quality from implementing the SMP alternatives. There would be no significant impacts on air quality from implementing the SMP alternatives.

Table 5.7-1. Summary of Impacts on Air Quality

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
AQ-1: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration	A, B, C	Significant	AQ-MM-1: Limit Construction Activity during Restoration AQ-MM-2: Reduce Construction NO_X Emissions AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures	Less than significant
AQ-2: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Current Management Activities	A, B, C	Significant	AQ-MM-2: Reduce Construction NO_X Emissions AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures	Less than significant
AQ-3: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with New Management Activities	A, B, C	Less than Significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
AQ-4: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration and Management Activities Combined	A, B, C	Significant	AQ-MM-1: Limit Construction Activity during Restoration AQ-MM-2: Reduce Construction NO_X Emissions AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures AQ-MM-4: Limit Construction Activity during Restoration and Management	Less than significant
AQ-5: Construction-Related Diesel Health Risk Associated with Restoration	A, B, C	Less than significant	None required	–
AQ-6: Construction-Related Diesel Health Risk Associated with Current Management Activities	A, B, C	Less than significant	None required	–
AQ-7: Construction-Related Diesel Health Risk Associated with New Management Activities	A, B, C	Less than significant	None required	–
AQ-8: Construction-Related Diesel Health Risk Associated with Restoration and Management Activity Combined	A, B, C	Less than significant	None required	–
AQ-9: Increase in Construction Emissions in Excess of Federal *de Minimis* Thresholds	A, B, C	Less than significant	None required	–
AQ-10: Increase in Construction-Related Odor	A, B, C	Less than significant	None required	–

Affected Environment

Sources of Information

The following key sources of information were used in the preparation of this section.

- Bay Area Air Quality Management District (BAAQMD) CEQA Guidelines (Bay Area Air Quality Management District 1999).
- BAAQMD Workshop Draft Options Report: CEQA Thresholds of Significance (Bay Area Air Quality Management District 2009).
- California Air Resources Board's (ARB's) *Proposed Amendments to the Area Designation Criteria and Area Designations for State Ambient Air Quality Standards and Maps of Area Designations for State and National Ambient Air Quality Standards* (California Air Resources Board 2006).

- ARB's Aerometric Data Analysis and Management System (ADAM) databases (California Air Resources Board 2009).
- EPA air data (U.S. Environmental Protection Agency 2009).
- SCAQMD Final Methodology to Calculate Particulate Matter (PM) 2.5 and PM2.5 Significance Thresholds, October 2006 (Santa Clara Air Quality Management District 2006).
- Starcrest Consulting Group, 2007, Puget Sound Maritime Air Emissions Inventory, prepared April 2007 (Starcrest Consulting Group 2007).
- 2008 Estimated annual Average Emissions-San Francisco Bay Area Air Basin (California Air Resources Board 2008a).
- Yolo-Solano County Air Quality Management District (YSAQMD), 2007, Handbook for Assessing and Mitigating Air Quality Impacts, adopted July 11, 2007 (Yolo-Solano County Air Quality Management District 2007).

Regional Climate and Meteorology

Cool rainy winters and warm dry summers characterize the climate of Solano County. Similar to the rest of the Bay Area, Solano County is classified as a Marine West Coast Climate type with Mediterranean characteristics. The average rainfall ranges from 17 to 20 inches per year. Winter temperatures are generally 40º to 60ºF, and summer temperatures are generally 55º to 80ºF. The prevailing wind direction is from the west. Typical wind speeds in the County are less than 5 miles per hour (mph) in the fall and winter and approximately 10 mph in the spring and summer.

The Carquinez Strait runs from Rodeo to Martinez. It is the only sea-level gap between San Francisco Bay and the Central Valley. The Carquinez Strait subregion includes the lowlands bordering the strait to the north and south, as well as the area adjoining Suisun Bay and the western part of the Delta as far east as Bethel Island. Further, the subregion extends from Rodeo in the southwest and Vallejo in the northwest to Fairfield in the northeast and Brentwood in the southeast.

Prevailing winds are from the west in the Carquinez Strait. During the summer and fall, high pressure offshore coupled with low pressure in the Central Valley causes marine air to flow eastward through the strait. The wind is strongest in the afternoon. Afternoon wind speeds of 15 to 20 mph are common throughout the strait region. Annual average wind speeds are 8 mph in Martinez, and 9 to 10 mph farther east. Sometimes atmospheric conditions cause air to flow from the east. East winds usually contain more pollutants than the cleaner marine air from the west. In summer and fall, this can cause elevated pollutant levels to move into the central Bay Area through the strait. These high-pressure periods are usually accompanied by low wind speeds, shallow mixing depths, higher temperatures, and little or no rainfall.

Summer mean maximum temperatures reach about 90°F in the subregion. Mean minimum temperatures in winter are in the high 30s (°F). Temperature extremes are especially pronounced in sheltered areas farther from the moderating effects of the strait itself (e.g., at Fairfield).

Many industrial facilities with significant air pollutant emissions (e.g., chemical plants and refineries) are located in the Carquinez Strait region. The pollution potential of this area is often moderated by high wind speeds. However, upsets at industrial facilities can lead to short-term pollution episodes, and emissions of unpleasant odors may occur at any time. Receptors downwind of these facilities could suffer more long-term exposure to air contaminants than individuals elsewhere. Consequently, it is important that local governments and other lead agencies maintain buffer zones around sources of air pollution sufficient to avoid adverse health and nuisance impacts on nearby receptors. Areas of the subregion that are traversed by major roadways (e.g., Interstate 80) also may be subject to higher local concentrations of carbon monoxide (CO), particulate matter, and certain toxic air contaminants (TACs) such as benzene.

Criteria Pollutants and Local Air Quality

Description of Pollutants

The federal and state governments have established ambient air quality standards for six criteria pollutants: ozone (O_3), CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter, and lead (Table 5.7-2). O_3 and NO_2 generally are considered regional pollutants because these pollutants or their precursors affect air quality on a regional scale. Pollutants such as CO, SO_2, and lead are considered local pollutants that tend to accumulate in the air locally. Particulate matter is considered a local and regional pollutant. The pollutants of greatest concern in the plan area are CO, O_3, and inhalable particulate matter (PM2.5 and PM10 [particulate matter 2.5 microns or less and 10 microns or less in diameter, respectively]). Brief descriptions of these pollutants, as well as TACs, follow.

Table 5.7-2. Ambient Air Quality Standards Applicable in California

			Standard (parts per million)		Standard (micrograms per cubic meter)		Violation Criteria	
Pollutant	Symbol	Average Time	California	National	California	National	California	National
Ozone*	O_3	1 hour	0.09	NA	180	NA	If exceeded	NA
		8 hours	0.070	0.075	137	147	If exceeded	If fourth highest 8-hour concentration in a year, averaged over 3 years, is exceeded at each monitor within an area
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		8 hours	6	NA	7,000	NA	If equaled or exceeded	NA
Nitrogen dioxide	NO_2	Annual arithmetic mean	0.030	0.053	57	100	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.18	NA	339	NA	If exceeded	NA
Sulfur dioxide	SO_2	Annual arithmetic mean	NA	0.030	NA	80	NA	If exceeded
		24 hours	0.04	0.14	105	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	NA	655	NA	If exceeded	NA
Hydrogen sulfide	H_2S	1 hour	0.03	NA	42	NA	If equaled or exceeded	NA
Vinyl chloride	C_2H_3Cl	24 hours	0.01	NA	26	NA	If equaled or exceeded	NA
Inhalable particulate matter	PM10	Annual arithmetic mean	NA	NA	20	NA	NA	NA
		24 hours	NA	NA	50	150	If exceeded	If exceeded on more than 1 day per year
	PM2.5	Annual arithmetic mean	NA	NA	12	15	NA	If 3-year average from single or multiple community-oriented monitors is exceeded
		24 hours	NA	NA	NA	35	NA	If 3-year average of 98th percentile at each population-oriented monitor within an area is exceeded
Sulfate particles	SO_4	24 hours	NA	NA	25	NA	If equaled or exceeded	NA
Lead particles	Pb	Calendar quarter	NA	NA	NA	1.5	NA	If exceeded no more than 1 day per year
		30-day average	NA	NA	1.5	NA	If equaled or exceeded	NA
		Rolling 3-Month average	NA	NA	NA	0.15	If equaled or exceeded	Averaged over a rolling 3-month period

Notes: All standards are based on measurements at 25ºC and 1 atmosphere pressure. National standards shown are the primary (health effects) standards. NA = not applicable.

* The U.S. Environmental Protection Agency recently replaced the 1-hour ozone standard with an 8-hour standard of 0.08 part per million. EPA issued a final rule that revoked the 1-hour standard on June 15, 2005. However, the California 1-hour ozone standard will remain in effect.

Source: California Air Resources Board 2008b.

Ozone

O_3 is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections, and can cause substantial damage to vegetation and other materials. O_3 is a severe eye, nose, and throat irritant. O_3 also attacks synthetic rubber, textiles, plants, and other materials and causes extensive damage to plants by leaf discoloration and cell damage. O_3 is not emitted directly into the air; it is formed by a photochemical reaction in the atmosphere. O_3 precursors—reactive organic gases (ROG) and oxides of nitrogen (NO_X)—react in the atmosphere in the presence of sunlight to form O_3. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, O_3 is primarily a summer problem. ROG and NO_X are emitted by mobile sources and stationary combustion equipment.

Carbon Monoxide

CO is essentially inert to plants and materials but can have significant impacts on human health. It combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. Effects on humans range from slight headaches to nausea to death. Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground-level temperature inversions, typically from evening through early morning. These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

Inhalable Particulate Matter

Particulates can damage human health and retard plant growth. Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates also reduce visibility and corrode materials. Particulate emissions are generated by a wide variety of sources, including agricultural activities, industrial emissions, dust suspended by vehicle traffic and construction equipment, and secondary aerosols formed by reactions in the atmosphere. The federal and state standards for particulate matter apply to two classes of particulates: PM10 and PM2.5.

Toxic Air Contaminants

TACs are pollutants that may be expected to result in an increase in mortality or serious illness, or that may pose a present or potential hazard to human health. Health effects of TACs include cancer, birth defects, neurological damage, damage to the body's natural defense system, and diseases that lead to death. The ARB identifies diesel exhaust particulate matter as a TAC.

Federal and State Ambient Air Quality Standards

The State of California and the federal government each have established ambient air quality standards for air pollutants (see Table 5.7-2). For some pollutants, separate standards have been set for different periods, with most standards set to protect public health; however, for some pollutants, standards have been based on other values, such as protection of crops, protection of materials, or avoidance of nuisance conditions.

Monitoring Data and Attainment Status

The existing air quality conditions in the plan area can be characterized by monitoring data collected in the region. The nearest air quality monitoring station in the vicinity is located at 304 Tuolumne Street, Vallejo, CA 94590, which is located in an urbanized area upwind of the Marsh. Air quality monitoring data from the Vallejo monitoring station are summarized in Table 5.7-3. These data represent air quality monitoring data for the last 3 years for which complete data are available (2006 to 2008).

As indicated in Table 5.7-3, the station has experienced no violations of the state 1-hour O_3 standard, 12.6 violations of the state PM10 standard, three violations of the federal 8-hour O_3 standard, no violations of the federal and state CO standards, and 25.1 violations of the federal PM10 standard during the last 3 years for which complete data are available.

Table 5.7-3. Ambient Air Quality Monitoring Data Measured at the Vallejo 304 Tuolumne Street Monitoring Station

Pollutant Standards	2006	2007	2008
1-Hour Ozone			
Maximum 1-hour concentration (ppm)	0.080	0.078	0.109
1-hour California designation value	0.08	0.08	0.08
1-hour expected peak day concentration	0.083	0.077	0.083
Number of days standard exceeded[a]			
CAAQS 1-hour (>0.09 ppm)	0	0	0
8-Hour Ozone			
National maximum 8-hour concentration (ppm)	0.069	0.066	0.075
National second-highest 8-hour concentration (ppm)	0.064	0.056	0.072
State maximum 8-hour concentration (ppm)	0.070	0.067	0.075
State second-highest 8-hour concentration (ppm)	0.064	0.056	0.073
8-hour national designation value	0.057	0.054	0.060
8-hour California designation value	0.065	0.061	0.067
8-hour expected peak day concentration	0.066	0.061	0.067
Number of days standard exceeded[a]			
NAAQS 8-hour (>0.075 ppm)	0	0	0
CAAQS 8-hour (>0.070 ppm)	0	0	3

Pollutant Standards	2006	2007	2008
Carbon Monoxide (CO)			
National[b] maximum 8-hour concentration (ppm)	2.94	2.70	2.31
National[b] second-highest 8-hour concentration (ppm)	2.73	2.60	1.96
California[c] maximum 8-hour concentration (ppm)	2.94	2.70	2.31
California[c] second-highest 8-hour concentration (ppm)	2.73	2.60	1.96
Maximum 1-hour concentration (ppm)	3.7	3.3	2.7
Second-highest 1-hour concentration (ppm)	3.5	3.3	0.9
Number of days standard exceeded[a]			
NAAQS 8-hour (≥9 ppm)	0	0	0
CAAQS 8-hour (≥9.0 ppm)	0	0	0
NAAQS 1-hour (≥35 ppm)	0	0	0
CAAQS 1-hour (≥20 ppm)	0	0	0
Particulate Matter (PM10)[d]			
National[b] maximum 24-hour concentration (μg/m^3)	46.6	49.1	42.1
National[b] second-highest 24-hour concentration (μg/m^3)	43.9	47.3	31.4
State[c] maximum 24-hour concentration (μg/m^3)	50.1	52.4	43.6
State[c] second-highest 24-hour concentration (μg/m^3)	47.2	51.1	32.4
State annual average concentration (μg/m^3)[e]	19.8	19.0	–
National annual average concentration (μg/m^3)	19.1	18.2	16.0
Number of days standard exceeded[a]			
NAAQS 24-hour (>150 μg/m^3)[f]	0	0	–
CAAQS 24-hour (>50 μg/m^3)[f]	0	12.6	–
Particulate Matter (PM2.5)			
National[b] maximum 24-hour concentration (μg/m^3)	42.2	40.8	50.0
National[b] second-highest 24-hour concentration (μg/m^3)	40.5	40.0	47.0
State[c] maximum 24-hour concentration (μg/m^3)	44.0	41.5	51.2
State[c] second-highest 24-hour concentration (μg/m^3)	43.2	41.3	50.0
National annual designation value (μg/m^3)	10.2	9.8	9.8
National annual average concentration (μg/m^3)	9.8	9.8	9.9
State annual designation value (μg/m^3)	13	12	12
State annual average concentration (μg/m^3)[e]	12.4	12.0	–
Number of days standard exceeded[a]			
NAAQS 24-hour (>35 μg/m^3)	5.9	12.1	7.1

Sources: California Air Resources Board 2009; U.S. Environmental Protection Agency 2009.

Notes: CAAQS = California Ambient Air Quality Standards. NAAQS = National Ambient Air Quality Standards.
– = insufficient data available to determine the value.

[a] An exceedance is not necessarily a violation.

[b] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

[c] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California approved samplers.

[d] Measurements usually are collected every 6 days.

[e] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

[f] Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard had each day been monitored.

If monitored pollutant concentrations meet state or federal standards over a designated period of time, the area is classified as being in attainment for that pollutant. If concentrations violate the standards, the area is considered a nonattainment area for that pollutant. If data are insufficient to determine whether a pollutant is violating the standard, the area is designated as unclassified. The attainment status of Solano County is listed in Table 5.7-4.

Table 5.7-4. Federal and State Attainment Status for Solano County

	Solano County	
Pollutant	Federal	State
1-hour O_3	–[1]	Nonattainment
8-hour O_3	Marginal nonattainment	–
CO	Moderate (≤12.7 ppm) maintenance	Attainment
PM10	Unclassified/attainment	Nonattainment
PM2.5	Nonattainment (pending)	Nonattainment

[1] Previously in nonattainment area, no longer subject to the 1-hour standard as of June 15, 2005.

Sensitive Receptors

According to the YSAQMD, a sensitive receptor is generically defined as a location where human populations, especially children, seniors, or sick persons are found, and there is reasonable expectation of continuous human exposure according to the averaging period for the ambient air quality standards (e.g., 24-hour, 8-hour, 1-hour). Examples of sensitive receptors are residences, hospitals, and schools. Sensitive receptors in the plan area include scattered single-family residences and waterfowl hunting clubhouses.

Regulatory Setting

Federal

The federal Clean Air Act (CAA), promulgated in 1963 and amended twice thereafter (including the 1990 amendment), establishes the framework for modern air pollution control. This act directs the EPA to establish ambient air standards for six pollutants: O_3, CO, lead, NO_2, particulate matter, and SO_2. The standards are divided into primary and secondary standards; the former are set to protect human health within an adequate margin of safety and the latter to protect environmental values, such as plant and animal life.

The primary legislation that governs federal air quality regulations is the Clean Air Act Amendments of 1990 (CAAA). The CAAA delegates primary responsibility for clean air to the EPA. The EPA develops rules and regulations to preserve and improve air quality, as well as delegating specific responsibilities to state and local agencies.

Federal Conformity Requirements

The CAAA of 1990 requires that all federally funded projects come from a plan or program that conforms to the appropriate state implementation plan (SIP). Federal actions are subject to either the transportation conformity rule (40 CFR 51[T]), which applies to federal highway or transit projects, or the General Conformity Rule (40 CFR 51[W]), which applies to all other federal actions.

General Conformity Requirements

The purpose of the General Conformity Rule is to ensure that federal actions conform to applicable SIPs so that they do not interfere with strategies employed to attain the national ambient air quality standards (NAAQS). The rule applies to federal actions in areas designated as nonattainment areas for any of the six criteria pollutants and in some areas designated as maintenance areas. The rule applies to all federal actions except:

- programs specifically included in a transportation plan or program that is found to conform under the federal transportation conformity rule,
- projects with associated emissions below specified *de minimis* threshold levels, and
- certain other projects that are exempt or presumed to conform.

A general conformity determination would be required if a proposed action's total direct and indirect emissions fail to meet any of the following two conditions:

- emissions for each affected pollutant for which the region is classified as a maintenance or nonattainment area for the national standards are below the *de minimis* levels indicated in Tables 5.7-5 and 5.7-6. As described below, the *de minimis* thresholds applicable to this proposed action are:
    - NO_X: 100 tons/year
    - Volatile organic compounds (VOCs): 100 tons/year, and
    - CO: 100 tons/year.

If any of the two conditions above are not met, a general conformity determination must be performed to demonstrate that total direct and indirect emissions for each affected pollutant for which the region is classified as amaintenance or nonattainment area for the national standards would conform to the applicable SIP.

However, if the above two conditions are met, the requirements for general conformity do not apply because the proposed action is presumed to conform to the applicable SIP for each affected pollutant. As a result, no further analysis or determination would be required.

Table 5.7-5. Federal *de Minimis* Threshold Levels for Criteria Pollutants in Nonattainment Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (ROG/VOC or NO_X)	
Serious nonattainment areas	50
Severe nonattainment areas	25
Extreme nonattainment areas	10
Other ozone nonattainment areas outside an ozone transport region[1]	100
Other ozone nonattainment areas inside an ozone transport region[1]	
ROG/VOC	50
NO_X	100
CO: All nonattainment areas	100
SO_2 or NO_2: All nonattainment areas	100
PM10	
Moderate nonattainment areas	100
Serious nonattainment areas	70
PM2.5	
Direct emissions	100
SO_2	100
NO_X (unless determined not to be a significant precursor)	100
ROG/VOC or ammonia (if determined to be significant precursors)	100
Pb: All nonattainment areas	25

Note: *de minimis* threshold levels for conformity applicability analysis.

[1] Ozone Transport Region is comprised of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, the Consolidated Metropolitan Statistical Area that includes the District of Columbia and northern Virginia (Section 184 of the Clean Air Act).

Underlined text indicates pollutants for which the region is in non-attainment, and a conformity determination must be made.

Source: 40 CFR 51.853.

Table 5.7-6. Federal *de Minimis* Threshold Levels for Criteria Pollutants in Maintenance Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (NO_X, SO_2 or NO_2)	
All maintenance areas	100
Ozone (ROG/VOC)	
Maintenance areas inside an ozone transport region[1]	50
Maintenance areas outside an ozone transport region[1]	100
<u>CO: All maintenance areas</u>	<u>100</u>
PM10: All maintenance areas	100
PM2.5	
Direct emissions	100
SO_2	100
NO_X (unless determined not to be a significant precursor)	100
ROG/VOC or ammonia (if determined to be significant precursors)	100
Pb: All maintenance areas	25

Note: *de minimis* threshold levels for conformity applicability analysis.

[1] Ozone Transport Region is comprised of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, the Consolidated Metropolitan Statistical Area that includes the District of Columbia and northern Virginia (Section 184 of the Clean Air Act).

<u>Underlined</u> text indicates pollutants for which the region is in maintenance, and a conformity determination must be made.

Source: 40 CFR 51.853.

Because the plan has federal funding, and is not a transportation project, it is subject to the General Conformity Rule. As indicated in Table 5.7-4, the plan area is classified federally as a marginal nonattainment area for the 8-hour O_3 standard, a pending nonattainment area for the PM2.5 standard, and a moderate maintenance area for CO. Consequently, to fulfill general conformity requirements, an analysis must be undertaken to identify whether the proposed action's total emissions of O_3, PM2.5, and CO are below the appropriate *de minimis* levels indicated in Tables 5.7-5 and 5.7-6.

It should be noted that after June 15, 2005, federal conformity for O_3 is based on the 8-hour standard rather than the 1-hour standard. To represent a worst-case scenario, the conformity determination in this analysis is based on the most stringent *de minimis* classification from Tables 5.7-5 and 5.7-6.Responsibility for achieving California's standards, which are more stringent than federal standards, is placed on the ARB and local air districts and is to be achieved through district-level air quality management plans that will be incorporated into the SIP. In California, the EPA has delegated authority to prepare SIPs to the ARB, which, in turn, has delegated that authority to individual air districts.

The ARB traditionally has established state air quality standards, maintaining oversight authority in air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving SIPs.

Responsibilities of air districts include overseeing stationary source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required by CEQA.

The California Clean Air Act of 1988 (CCAA) substantially added to the authority and responsibilities of air districts. The CCAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation control measures. The CCAA focuses on attainment of the state ambient air quality standards (CAAQS), which, for certain pollutants and averaging periods, are more stringent than the comparable federal standards.

The CCAA requires designation of attainment and nonattainment areas with respect to CAAQS. The CCAA also requires that local and regional air districts expeditiously adopt and prepare an air quality attainment plan if the district violates state air quality standards for CO, SO_2, NO_2, or O_3. These Clean Air Plans are designed specifically to attain these standards and must be designed to achieve an annual 5% reduction in district-wide emissions of each nonattainment pollutant or its precursors. No locally prepared attainment plans are required for areas that violate the state PM10 standards.

The CCAA requires that the CAAQS be met as expeditiously as practicable but, unlike the federal CAA, does not set precise attainment deadlines. Instead, the act established increasingly stringent requirements for areas that will require more time to achieve the standards.

Local

The air quality management agencies of direct importance in the plan area are the EPA, ARB, and the BAAQMD. The EPA has established federal standards for which the ARB and BAAQMD have primary implementation responsibility. The ARB and BAAQMD are responsible for ensuring that state standards are met, implementing strategies for air quality improvement, and recommending mitigation measures for new growth and development. At the local level, air quality is managed through land use and development planning practices and is implemented in the counties through the general planning process. The BAAQMD is responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws. The SMP may be subject to the air quality management district rules discussed below. In addition, the plan may be subject to additional rules.

Bay Area Air Quality Management District

The following discussion describes applicable air quality plans in the plan area within the BAAQMD's jurisdiction. The most recent versions of these plans are the 2001 Revised San Francisco Bay Area Ozone Attainment Plan for the 1-Hour National Ozone Standard (OAP), the Bay Area 2000 Clean Air Plan and Triennial Assessment (CAP), and the Bay Area 2005 Ozone Strategy (BAOS).

Ozone Attainment Plan

The OAP is the Bay Area's portion of California's SIP to achieve the national O_3 standard. In 1999, the BAAQMD, Association of Bay Area Governments (ABAG), and the Metropolitan Transportation Commission (MTC) adopted the 1999 OAP, which was submitted to the ARB in June 1999. The 1999 OAP was approved by the ARB in July 1999 and submitted to the EPA for approval. The EPA proposed to partially approve and partially disapprove portions of the 1999 OAP on March 30, 2001. The disapproved portions were the reasonably available control measures (RACMs) demonstration, attainment demonstration, and motor vehicle emissions budgets (MVEBs). This disapproval by the EPA started a sanctions clock, and the Bay Area became subject to the imposition of a 2:1 offset sanction.

In response, the BAAQMD, ABAG, and MTC began preparation of the 2001 OAP to correct the deficiencies in the 1999 OAP. On October 24, 2001, they adopted the 2001 OAP. The 2001 OAP was approved by the ARB on November 1, 2001, and submitted to the EPA for approval as a revision to the California SIP on November 30, 2001. The 2001 OAP included two commitments for further planning—a commitment to conduct a mid-course review of progress toward attaining the national 1-hour O_3 standard by December 2003 and a commitment to provide a revised O_3 attainment strategy to the EPA by April 2004. On April 22, 2004, the EPA approved the following elements of the 2001 OAP: emissions inventory; RACMs; commitments to adopt and implement specific control measures; MVEBs; and commitments for further study measures. The EPA's approval of RACMs and MVEBs in the 2001 OAP terminated the sanctions clock for those plan elements.

The EPA made a final finding in April 2004 that the BAAQMD had attained the federal 1-hour O_3 standard. As a result, certain planning commitments outlined in the 2001 OAP were no longer required. Although the EPA has prepared a finding of attainment for the region, the Bay Area has not been formally reclassified as an attainment area for the 1-hour standard. To be reclassified as an attainment area, the region must submit a redesignation request to the EPA.

Clean Air Plan

The CAP is a plan to reduce ground-level O_3 levels in the Bay Area and attain the state 1-hour O_3 standard. It was developed by the BAAQMD, in cooperation with ABAG and the MTC, in response to the CCAA, which requires all air districts exceeding the state O_3 standard to reduce pollutant emissions by 5% per year (calculated from 1987) or achieve emission reductions through all feasible measures. The CCAA further requires that the CAP be updated every 3 years. Because the Bay Area attained the state CO standard in 1993, the CCAA planning requirements for CO nonattainment areas no longer apply to the Bay Area. The first CAP prepared in 1991 includes a comprehensive strategy to reduce air pollutant emissions by focusing on control measures to be implemented from 1991 to 1994, 1995 through 2000, and beyond. The 1994 update to the CAP continued the comprehensive strategy established by the 1991 CAP and its goals of reducing health impacts from O_3 levels above the CAAQS to compliance with the CCAA. The 1994 CAP included eight new proposed control measures for stationary and mobile sources, in addition to changes in the organization and scheduling of some of the control measures from the 1991 CAP. The control measures proposed in the 1994 CAP constitute all feasible O_3-reducing measures in the Bay Area. In addition, the 1994 CAP projects pollutant trends and possible control activities beyond 1997.

The BAAQMD adopted the most recent update of the CAP on December 20, 2000. It is the third triennial update of the original CAP. The 2000 CAP includes a review of control strategies to ensure that "all feasible measures" to reduce O_3 are incorporated into the CAP. In addition, the 2000 CAP updates the BAAQMD's emission inventory, estimates emission reductions resulting from the CAP, and assesses air quality trends in the region.

Bay Area 2005 Ozone Strategy

The BAAQMD has finalized the BAOS in cooperation with ABAG and the MTC. The BAOS is a comprehensive document that describes the Bay Area's strategy for compliance with state 1-hour O_3 standard planning requirements.

O_3 conditions in the Bay Area have improved significantly, but there is still a need for continued improvement to meet the state 1-hour O_3 standard. The BAOS describes how the Bay Area will fulfill CCAA planning requirements for the state 1-hour O_3 standard and transport mitigation requirements through a proposed control strategy. The control strategy includes stationary source, mobile source, and transportation control measures to be implemented through BAAQMD regulations, incentive programs, and transportation programs, respectively.

Environmental Consequences

Assessment Methods

The activities required for the proposed tidal wetland restoration may generate significant air emissions from construction activities. Terrestrial construction-related emissions are generally short-term but still may cause adverse air quality impacts. PM10 is the pollutant of greatest concern with respect to terrestrial construction activities. PM10 emissions can result from a variety of construction activities, including excavation, grading, demolition, vehicle travel on paved and unpaved roads, and emission of vehicle and equipment exhaust. Terrestrial construction-related emissions of PM10 can vary greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, weather conditions, and other factors.

Particulate emissions from construction equipment exhaust can lead to adverse health effects, as well as nuisance concerns such as reduced visibility and soiling of exposed surfaces (Bay Area Air Quality Management District 1999).

The URBEMIS 2007 (version 9.2.4) model was used to estimate emissions associated with construction of the proposed project. To estimate construction emissions, URBEMIS 2007 analyzes the type of construction equipment used and the duration of the construction period associated with construction of each of the land uses. URBEMIS calculates unmitigated emissions, but also calculates mitigated emissions based on standard measures that are incorporated into the model. These measures include the following:

- Soil disturbance (apply soil stabilizers to inactive soil, replace ground cover in disturbed areas, water exposed surfaces, and equipment loading/unloading);
- Unpaved roads (reduce speed and manage haul road dust);
- Off-road equipment (use aqueous diesel fuel, diesel particulate filters, and diesel oxidation catalysts).

The soil disturbance mitigation measures, which are typically used to mitigate for fugitive dust, were not used. The project area consists of marsh land and because much of the ground would be wet, soil disturbing activity would not cause dust. The URBEMIS 2007 model calculates both PM10 and PM2.5 in terms of exhaust and dust. For the purposes of this analysis, the PM dust emissions were zeroed out because construction activity would not create PM dust during soil disturbing activities due to the marshy nature of the project site.

The BAAQMD has developed thresholds of significance and because both restoration and management activities could occur simultaneously, they were modeled as such to determine the maximum potential impact of SMP implementation on air quality. Because a detailed schedule of construction activity is not available, it is assumed that construction would take place primarily between June through September for 30 years for restoration activity, and June through September on any given year for management activity. However, dredging would be conducted from September through November as described in Chapter 2.

The Puget Sound Maritime Air Emissions Inventory methodology was used to estimate tugboat emissions. The tugboat emissions calculation spreadsheet is attached as Appendix B. In addition, the SCAQMD Final Methodology to Calculate Particulate Matter (PM) 2.5 and PM2.5 Significance Thresholds (South Coast Air Quality Management District 2006) was used to calculate PM 2.5 for tug emissions.

Significance Criteria

Because the plan has federal funding, general conformity significance criteria must be considered. Further, because of the location of the plan area, both CEQA and the BAAQMD must be considered. The most stringent significance criteria must be applied to implementing the plan.

Federal General Conformity

Under general conformity, the implementation of the plan would adversely affect air quality if construction emissions of O_3 precursors (ROG and NO_X) would exceed 100 tons per year and CO emissions would exceed 100 tons per year.

California Environmental Quality Act

Based on the State CEQA Guidelines and standard professional practice, implementation of the SMP would result in a significant impact on air quality if it would:

- conflict with or obstruct implementation of the applicable air quality management plan;
- violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- result in a cumulatively considerable net increase of any criteria pollutant for which the plan region is nonattainment under an applicable NAAQS or CAAQS (including releasing emissions that exceed quantitative thresholds for O_3 precursors);
- expose sensitive receptors to substantial pollutant concentrations; or
- create objectionable odors affecting a substantial number of people.

The State CEQA Guidelines further state that the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the determinations above.

Operational emissions are not evaluated because activities associated with restoration and management are considered construction. Therefore, only the BAAQMD draft construction thresholds are used.

Construction

BAAQMD currently does not require quantification of construction emissions. Instead, it requires implementation of effective and comprehensive feasible control measures to reduce PM10 emissions (Bay Area Air Quality Management District 1999). PM10 emitted during construction activities varies greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, and weather conditions. Despite this variability in emissions, experience has shown that a number of feasible control measures can be reasonably implemented to reduce PM10 emissions during construction; these measures are summarized in Environmental Commitments in Chapter 2. According to BAAQMD, if all control measures listed in Chapter 2 are implemented (as appropriate, depending on the size of the plan area), air pollutant emissions from construction activities are to be considered less than significant (Bay Area Air Quality Management District 1999). However, quantification of emissions for large projects is useful as a means to provide information on the magnitude of emissions from construction.

Construction equipment also emits CO and O_3 precursors (ROG and NO_X). Construction-related emissions of these pollutants were not estimated, however, because they are already included in the emission inventory that forms the basis for BAAQMD's regional air quality plans and because those emissions are not expected to impede attainment or maintenance of O_3 and CO standards in the Bay Area (Bay Area Air Quality Management District 1999).

Bay Area Air Quality Management District Draft Construction Thresholds

The BAAQMD recently has released draft significance thresholds for construction-related emissions (Bay Area Air Quality Management District 2009). According to the draft thresholds, construction would result in a significant impact on the environment if it would generate criteria air pollutant emissions in excess of those shown below in Table 5.7-7.

Table 5.7-7. Thresholds of Significance for Project Construction

Pollutant	Lbs/day
ROG	54
NO_X	54
SO2	219
PM10	82
PM2.5	54

For the purposes of this plan area, the draft construction thresholds were used because they likely will be adopted in the future.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, a small amount of wetland restoration would occur and managed wetland activities are expected to decrease. As such, it is expected that there would be a reduction or no change in PM10, CO, O_3 precursors, or other pollutants, and there would be no impacts.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Impact AQ-1: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration

Temporary construction activity would involve the use of heavy equipment, which may generate emissions in excess of the draft BAAQMD construction thresholds. Construction impacts have been assessed in this analysis using the URBEMIS 2007 9.2.4 model and anticipated construction equipment that would be used during construction activities, which are based on typical restoration activity (Table 5.7-8). Construction would take place over a 30-year period in the form of small projects on parcels at an average of 300 acres.

Restoration projects generally are broken into three phases: site preparation, water management, and levee breaching. The site preparation phase entails grading, improving levees, and building channels and islands. The water management phase does not include the use of heavy equipment. Assumptions were made for the types of construction equipment that likely would be used for each phase, the total operating hours of each piece, and the horsepower of each piece to represent a worst-case scenario to demonstrate maximum emissions. These assumptions were based on what typically is used for restoration projects, information provided by the project proponent, and URBEMIS default values.

Table 5.7-8. Anticipated Construction Equipment for Restoration Activity

Equipment Pieces by Phase	Number of Equipment Pieces Used	Horsepower	Hours per Day
Site Preparation			
Tractor/loader/backhoe	1	180	8
Rubber-tired dozer	1	357	8
Excavator	1	168	8
Grader	1	174	8
Box scraper	1	313	8
Levee Breaching			
Excavator	1	168	8

Construction of the proposed project would result in the temporary increase in emissions of ROG, NO_X, CO, PM10, PM2.5, and CO_2. Total daily unmitigated and mitigated emissions resulting from construction of the proposed project are summarized in Table 5.7-9. As a worst-case scenario, site preparation and levee breaching emissions were combined into a total daily emissions value, because it is possible that two different projects could occur at the same time. Evaluating a worst-case scenario is necessary to compare emissions to the BAAQMD emission thresholds.

Table 5.7-9. Maximum 2009 Emissions from Restoration Activities for the Proposed Project Projects (lbs/day)

Project Phase	ROG	NO_X	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Unmitigated						
Site Preparation	6.54	54.63	29.87	2.71	2.49	5,072.67
Levee Breaching	0.72	5.45	3.55	0.32	0.30	572.66
Total Daily Unmitigated Emissions	7.26	60.08	33.42	3.03	2.79	5,645.33
Mitigated						
Site Preparation	6.54	46.45	29.87	0.41	0.38	5,072.67
Levee Breaching	0.72	4.63	3.55	0.05	0.04	572.66
Total Daily Mitigated Emissions	7.26	51.08	33.42	0.46	0.42	5,645.33
BAAQMD Draft Construction Threshold	54	54	N/A	82	54	N/A
Exceeds Threshold?	No	No	N/A	No	No	N/A

As shown above, unmitigated emissions from two projects (one in the site preparation phase and one in the levee breaching phase) exceed the BAAQMD draft construction thresholds of 54 pounds per day of NO_X, but mitigated emissions from two projects do not. In addition, if two projects began simultaneously and both were in the site preparation phase at the same time, NO_X emissions would exceed the BAAQMD threshold of 54 pounds per day. It should be noted that the proposed project is located in a rural setting and these activities would be spread out over the landscape of 50,000 acres in the middle of 27,000 acres of agricultural uplands and 30,000 acres of bays and sloughs, over a long period of time. Nevertheless, Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3 are required to reduce this impact to less than significant.

Conclusion: Less than significant with Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3 incorporated.

Mitigation Measure AQ-MM-1: Limit Construction Activity during Restoration

The project proponent will limit construction activity so that site preparation can occur on only one parcel at a time. This will ensure that construction emissions do not exceed the draft BAAQMD threshold for NO_X.

Mitigation Measure AQ-MM-2: Reduce Construction NO_X Emissions

The project proponent will ensure that construction emissions do not exceed the BAAQMD's draft construction threshold of 54 pounds per day for NO_X. Tables 5.7-8 (above) and 5.7-10 (below) show appropriate levels of construction equipment that can be operating at any given time in the marsh. Such measures include, but are not limited to, the following:

- Implement off road equipment mitigation, including installing 1^{st} tier diesel particulate filters (DPFs), and installing diesel oxidation catalysts to reduce NO_x emissions by 40%.

Mitigation Measure AQ-MM-3: Implement All Appropriate BAAQMD Mitigation Measures

The project proponent will implement BAAQMD standard mitigation measures where appropriate and feasible. These measures include:

- Cover all haul trucks transporting soil, sand, or other loose material off-site.
- Remove all visible mud or dirt track-out onto adjacent public roads.
- Minimize idling times either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations[CCR]). Clear signage shall be provided for construction workers at all access points.
- Maintain all construction equipment in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.

- Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.

Impact AQ-2: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Current Management Activities

Various types of management activity, such as constructing ditches, coring and repairing levees, repairing and replacing structures, etc., currently occur in the Marsh. These activities would increase in frequency under the SMP. Temporary construction activity would involve the use of heavy equipment, which may generate emissions in excess of the draft BAAQMD construction thresholds.

Construction impacts regarding existing management activity that would increase in frequency have been assessed in this analysis using the URBEMIS 2007 9.2.4 model and anticipated construction equipment that would be used during construction activities, which are based on typical wetland management activity. Because it is unknown how much these activities would be increased, the maximum allowable mitigated emissions were modeled to find the appropriate number of pieces of construction equipment that would be permitted to operate at any given time in the Marsh. It was assumed that management projects would take place from June through September on parcels averaging 300 acres in size. Estimated construction equipment that would be used for these projects is shown in Table 5.7-10.

Table 5.7-10. Estimated Construction Equipment for Management Activity That Would Increase in Frequency

Equipment Pieces Used for Management Activities	Number of Equipment Pieces Used	Horsepower	Hours per Day
Excavator	2	168	8
Tractor/loader/backhoe	3	108	8
Grader	3	174	8
Rubber tired dozer	3	357	8

Increased frequency of management activities would result in the temporary increase in emissions of ROG, NO_X, CO, PM10, PM2.5, and CO_2. Total daily unmitigated and mitigated project emissions resulting from operations of the proposed project are summarized in Table 5.7-11.

Table 5.7-11. Maximum 2009 Emissions from Management Activity That Would Increase in Frequency under the Proposed Action (lbs/day)

Management Activity That Would Increase in Frequency	ROG	NO_X	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Unmitigated	11.11	88.28	52.73	4.75	4.37	8,041.40
Mitigated	11.11	53.73	52.73	0.72	0.66	8,041.40
BAAQMD Draft Construction Threshold	54	54	N/A	82	54	N/A
Exceeds Threshold?						
Unmitigated	No	Yes	N/A	No	No	N/A
Mitigated	No	No	N/A	No	No	N/A

As illustrated in Table 5.7-11, emissions associated with increased frequency of management activities would be below the BAAQMD draft construction thresholds for all pollutants, if the equipment used does not exceed the anticipated construction equipment in Table 5.7-10. Mitigation Measures AQ-MM-2 and AQ-MM-3 will be implemented to reduce this impact to less-than-significant. In addition, environmental commitments, including annual monitoring of equipment and use of basic control measures to manage fugitive dust, would be implemented as part of the proposed action (see Chapter 2, environmental commitments section). The modeling in Table 5.7-11 is based on the anticipated construction equipment in Table 5.7-10.

Conclusion: Less than significant with Mitigation Measures AQ-MM-2 and AQ-MM-3 incorporated.

Impact AQ-3: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with New Management Activities

New management activities, including dredging tidal sloughs, interior levee construction, and replacing riprap, would occur under the SMP. Temporary construction activity would involve the use of heavy equipment that may generate emissions in excess of the draft BAAQMD construction thresholds.

Construction impacts regarding management activities have been assessed in this analysis using the URBEMIS 2007 9.2.4 model and anticipated construction equipment that would be used during construction activities, based on typical wetland management activity. The quantification of tug emissions was performed using emission factors provided by NONROAD2005 (U.S. Environmental Protection Agency 2005), entered into an Excel spreadsheet model.

To assess whether activity associated with the proposed action would exceed significance thresholds, the maximum placement per year was modeled by estimating a total of 100,000 cubic yards of dredge spoils. The analysis assumed a boxscraper, backhoe/loader, and pickup would be used from August through November for dredge spoil and riprap placement, and that 9,700 cubic yards would be moved per day. The calculated emissions, based on these assumptions, are presented in Table 5.7-12 and compared to the draft BAAQMD construction thresholds.

Table 5.7-12. Calculated Emissions Associated with New Management Activities

Activity	Emissions (lbs/day)					
	ROG	NO_X	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Tug Activity	0.12	4.82	0.88	0.39	0.36	302.42
Dredging/Interior Levee Construction/Placement of Riprap, Unmitigated	3.91	34.23	15.13	1.52	1.40	3,590.34
Dredging/Interior Levee Construction/Placement of Riprap, Mitigated	3.91	20.56	15.13	0.23	0.21	3,590.34
Total Unmitigated	4.03	39.05	16.01	1.91	1.76	3,892.76
Total Mitigated	4.03	25.38	16.01	0.62	0.57	3,892.76
BAAQMD Draft Construction Significance Thresholds (lbs/day)	54	54	N/A	82	54	N/A
Exceeds Threshold?	No	No	N/A	No	No	N/A

As illustrated in Table 5.7-12, unmitigated emissions associated with implementing the marsh management activities would be below the BAAQMD draft construction thresholds for all pollutants. In addition, environmental commitments, including annual monitoring of equipment and use of PM10 control measures, would be implemented as part of the proposed action.

Conclusion: Less than significant. No mitigation required.

Impact AQ-4: Generation of Construction-Related Emissions in Excess of Draft BAAQMD Standards Associated with Restoration and Management Activities Combined

Construction activity associated with restoration and management activity potentially could occur simultaneously. Tables 5.7-13 and 5.7-14 summarize the combined emissions associated with restoration activity, management activity that would increase in frequency, and new management activity.

Table 5.7-13. Combined Unmitigated Emissions from Restoration and Management Activities

Activity	ROG	NO_x	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Restoration	7.26	60.08	33.42	3.03	2.79	5,645.33
Management Activity That Would Increase in Frequency	11.11	88.28	52.73	4.75	4.37	8,041.40
New Management	4.03	39.05	16.01	1.91	1.76	3,892.76
Emission Totals	22.40	**187.41**	102.16	9.69	8.92	17,579.49
BAAQMD Draft Construction Threshold	54	54	N/A	82	54	N/A
Exceeds Threshold?	No	Yes	N/A	No	No	N/A

Table 5.8-14. Combined Mitigated Emissions from Restoration and Management Activities

Activity	ROG	NO_x	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Restoration	7.26	51.08	33.42	0.46	0.42	5,645.33
Management Activity That Would Increase in Frequency	11.11	53.73	52.73	0.72	0.66	8,041.40
New Management	4.03	25.38	16.01	0.62	0.57	3,892.76
Emission Totals	22.67	**130.19**	102.16	1.8	1.65	17,579.49
BAAQMD Draft Construction Threshold	54	54	N/A	82	54	N/A
Exceeds Threshold?	No	Yes	N/A	No	No	N/A

The modeling shown in Tables 5.7-13 and 5.7-14 is based on the anticipated construction equipment in Tables 5.7-8 and 5.7-10. Therefore, if the construction equipment in Tables 5.7-8 and 5.7-10 changes, then the results in Tables 5.7-13 and 5.7-14 will change as well. As shown above in Table 5.7-14, the worst-case scenario mitigated emissions would exceed the BAAQMD draft construction thresholds for NO_X if all of the various restoration activity, new management activity that would increase in frequency, and new management activity were to all happen concurrently. While multiple phases of construction can overlap, the pieces of equipment being used on the marsh at any given time should not exceed the list of equipment described in Tables 5.7-8 and 5.7-10 so as not to exceed the BAAQMD threshold of 54 pounds per day of NO_X. Therefore, in addition to mitigation measures MM-AQ-1, MM-AQ-2, and MM-AQ-3, Mitigation Measure AQ-MM-4 is required to reduce this impact to less than significant.

Mitigation Measure AQ-MM-4: Limit Restoration and Management Activity

The project proponent will limit restoration and management activity so that the equipment being used in the SMP area does not exceed equipment described in

Tables 5.7-8 an 5.7-10. This will ensure that construction emissions do not exceed the draft BAAQMD threshold for NO_X.

Conclusion: Less than significant with Mitigation Measures AQ-MM-1, AQ-MM-2, AQ-MM-3 and AQ-MM-4 incorporated.

Impact AQ-5: Construction-Related Diesel Health Risk Associated with Restoration

Construction activities associated with restoration activity would involve the operation of diesel-powered equipment. In October 2000, the ARB identified diesel exhaust as a TAC. As described above, construction activities would occur in June through September over 30 construction seasons. The assessment of cancer health risks associated with exposure to diesel exhaust typically is associated with chronic exposure (70-year exposure period is often assumed). Although cancer can result from exposure periods of less than 70 years, acute exposure periods (2 to 3 years) to diesel exhaust are not anticipated to result in an increased health risk. Health impacts associated with exposure to diesel exhaust from implementing activities are anticipated to be less than significant because diesel particulate emission rates would be low, the emissions would be distributed over a large geographic area rather than clustered near any individual sensitive receptors, and construction activities would occur sporadically over a 30-year period and would not result in long-term emissions of diesel exhaust at the project sites. It also is anticipated that concentrations of diesel exhaust would attenuate to levels well below acceptable exposure limits because of the distances of sensitive receptors from construction activities. In addition, the environmental commitments described in Chapter 2 will be implemented.

Conclusion: Less than significant. No mitigation required.

Impact AQ-6: Construction-Related Diesel Health Risk Associated with Current Management Activities

Management activities, including dredging, would involve the operation of diesel-powered equipment. Health impacts associated with exposure to diesel exhaust from marsh management activities are anticipated to be less than significant because diesel particulate emission rates would be low, the emissions would be distributed over a large geographic area rather than clustered near any individual sensitive receptors, and construction activities would occur sporadically and would not result in long-term emissions of diesel exhaust at the project sites. It also is anticipated that concentrations of diesel exhaust would attenuate to levels well below acceptable exposure limits because of the distances of sensitive receptors from construction activities.

Conclusion: Less than significant. No mitigation required.

Impact AQ-7: Construction-Related Diesel Health Risk Associated with New Management Activities

Impacts from new management activities would be similar to those described above under Management Activities That Would Increase in Frequency.

Conclusion: Less than significant. No mitigation required.

Impact AQ-8: Construction-Related Diesel Health Risk Associated with Restoration and Management Activity Combined

Impacts from restoration and management activity combined would be similar to those described above under Restoration and Management Activities That Would Increase in Frequency.

Conclusion: Less than significant. No mitigation required.

Impact AQ-9: Increase in Construction Emissions in Excess of Federal *de Minimis* Thresholds

Table 5.7-15 summarizes annual emissions resulting from activities associated with both restoration and management activity combined. This represents worst-case scenario emissions that are not anticipated to exceed the *de minimis* thresholds of significance.

Table 5.7-15. Calculated Unmitigated Emissions Compared to Federal *de Minimis* Thresholds

	Pollutant Emissions (tons/year)					
Activity	ROG	NO_X	CO	PM10 exhaust	PM2.5 exhaust	CO_2
Restoration	0.35	2.10	1.55	0.02	0.02	276.24
Management Activities That Would Increase in Frequency	0.20	1.16	0.90	0.03	0.03	151.22
New Management Activities	0.18	1.30	0.70	0.03	0.03	171.28
Emission Totals	0.72	4.56	3.16	0.08	0.07	598.74
Federal *de Minimis* Significance Thresholds	50	100	100	100	N/A	N/A
Exceeds Thresholds?	No	No	No	No	N/A	N/A

Source: 2008 Estimated annual Average Emissions-San Francisco Bay Area Air Basin. <http://www.arb.ca.gov/ei/maps/basins/absfmap.htm>.

As shown in Table 5.7-15 above, even if all activities are running concurrently, federal *de minimis* thresholds would not be exceeded.

Conclusion: Less than significant. No mitigation required.

Impact AQ-10: Increase in Construction-Related Odor

The proposed action may generate odors during ground-disturbing activities, and disposal and settling of dredged material. However, the environmental commitments outlined in Chapter 2, for restoration activities, including dust management, would minimize the potential for odor generation. Furthermore, it is anticipated that any odors generated from the dredging spoils would not be any more objectionable than the naturally occurring odors around the Marsh.

Conclusion: Less than significant. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres

Under Alternative B, approximately 2,000–4,000 acres of tidal wetland would be restored, which is less than what would be restored under Alternative A. More management activity would occur under Alternative B than would occur under Alternative A. Although more projects related to Marsh management would occur annually under Alternative B, more would not occur on a daily basis. Thus daily emissions would not exceed those summarized above under Alternative A.

Alternative C: Restore 7,000–9,000 Acres

Under Alternative C, approximately 7,000–9,000 acres of tidal wetland would be restored, which is more than would be restored under Alternative A. Less management activity would occur under Alternative C than would occur under Alternative A. Although more restoration projects would occur annually under Alternative C, more would not occur on a daily basis. Thus daily emissions would not exceed those summarized above under Alternative A.

Section 5.8
Noise

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives on noise.

The Affected Environment discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the action. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts. For example, the setting identifies how noise would change as a result of construction and maintenance activities.

The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary.

Summary of Impacts

Table 5.8-1 summarizes noise impacts from implementing the SMP alternatives. There would be no significant impacts on noise from implementing the SMP alternatives.

Table 5.8-1. Summary of Noise Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Restoration Impacts				
NZ-1: Temporary Increases in Ambient Noise during Construction Activities Associated with Restoration	A, B, C	Less than significant	None required	–
NZ-2: Temporary Exposure of Sensitive Land Uses to Groundborne Vibration or Noise from Construction Activities	A, B, C	Less than significant	None required	–

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
NZ-3: Permanent Increases in Ambient Noise	A, B, C	Less than significant	None required	–
NZ-4: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations	A, B, C	Less than significant	None required	–
Managed Wetland Activities Impacts				
NZ-2: Temporary Exposure of Sensitive Land Uses to Groundborne Vibration or Noise from Construction Activities	A, B, C	Less than significant	None required	–
NZ-3: Permanent Increases in Ambient Noise	A, B, C	Less than significant	None required	–
NZ-4: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations	A, B, C	Less than significant	None required	–
NZ-5: Temporary Increases in Ambient Noise during Construction Activities Associated with Management Activities	A, B, C	Less than significant	None required	–
NZ-6: Exposure of Noise-Sensitive Land Uses to Noise from Portable Pump Operations	A, B, C	Significant	NZ-MM-1: Limit Noise from Pump Operations	Less than significant

Affected Environment

The plan area is located in Solano County. The following discussion provides background information on noise terminology and describes the existing environment in terms of sensitive receptors, existing noise levels, and regulatory requirements.

Noise Terminology

Following are brief definitions of acoustic and vibration terminology used in this section:

- **Sound.** A vibratory disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

- **Decibel (dB).** A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
- **Maximum Sound Level (L_{max}).** The maximum sound level measured during the measurement period.
- **Minimum Sound Level (L_{min}).** The minimum sound level measured during the measurement period.
- **Equivalent Sound Level (L_{eq}).** The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy.
- **Percentile-Exceeded Sound Level (L_{xx}).** The sound level exceeded x% of a specific time period. L_{10} is the sound level exceeded 10% of the time.
- **Day-Night Level (L_{dn}).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
- **Peak Particle Velocity (PPV).** The maximum velocity of a particle in vibrating medium such as soil. PPV is usually expressed in inches/sec.

L_{dn} and CNEL values rarely differ by more than 1 dB. As a matter of practice, L_{dn} and CNEL values are considered to be equivalent and are treated as such in this assessment. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level.

Sources of Information

The following key sources of information were used in the preparation of this section:

- Solano County General Plan (Solano County 2008).
- *Noise Control Engineering Journal* article, “Construction noise control program and mitigation strategy at the Central Artery/Tunnel project” (Thalheimer 2000).
- Federal Transit Administration’s (FTA’s) transit noise and vibration impact assessment (Federal Transit Administration 2006).

- Clamshell dredge noise measurements taken in 1997 in support of the Oakland Harbor Navigation Improvement Project EIS (Geier & Geier Consulting 1997).
- Hoover and Keith's *Noise control for buildings, manufacturing plants, equipment and products* (Hoover and Keith 2000).

Regulatory Setting

In general, the federal government sets noise standards for transportation noise sources that are related to interstate commerce. These typically include aircraft, trains, and trucks. State governments establish noise standards for those sources not regulated by federal standards, such as automobiles, light trucks, motorboats and motorcycles. Other noise sources associated with construction and industrial and commercial activities are usually regulated by noise ordinances and general plan policies, which are established by local jurisdictions.

Federal

Federal Noise Control Act of 1972

The federal Noise Control Act of 1972 (Public Law 92-574) established a requirement that all federal agencies administer their programs to promote an environment free of noise that would jeopardize public health or welfare. The EPA was given the responsibility for:

- providing information to the public regarding identifiable effects of noise on public health and welfare,
- publishing information on the levels of environmental noise that will protect the public health and welfare with an adequate margin of safety,
- coordinating federal research and activities related to noise control, and
- establishing federal noise emission standards for selected products distributed in interstate commerce.

The Noise Control Act also directed that all federal agencies comply with applicable federal, state, interstate, and local noise control regulations.

U.S. Environmental Protection Agency

In 1974, in response to the requirements of the federal Noise Control Act, EPA identified indoor and outdoor noise limits to protect public health and welfare (communication disruption, sleep disturbance, and hearing damage). Outdoor L_{dn} limits of 55 dB and indoor L_{dn} limits of 45 dB are identified as desirable to protect against speech interference and sleep disturbance for residential, educational, and healthcare areas. Sound-level criteria to protect against hearing damage in commercial and industrial areas are identified as 24-hour L_{eq} values of 70 dB (both outdoors and indoors).

State

California Department of Health Services Guidelines

In 1987, the California Department of Health Services published guidelines for the noise elements of local general plans. These guidelines include a sound level/land use compatibility chart that categorizes various outdoor L_{dn} ranges by land use. These guidelines identify the normally acceptable range for low-density residential uses as less than 65 dB and conditionally acceptable levels as 55–70 dB.

Local

Solano County General Plan, Noise Element

Solano County has established policies and regulations concerning the generation and control of noise that could adversely affect its citizens and noise-sensitive land uses.

The County's General Plan is a document required by state law that serves as the County's guidance document for land use and development. The General Plan sets an overall framework for development in Solano County and protection of its natural and cultural resources; it is a comprehensive, long-term document that provides details for the physical development, sets policies, and identifies ways to put the policies into action. The noise element of the County General Plan contains planning guidelines relating to noise and identifies goals and policies to support achievement of those goals. Noise element guidelines relate primarily to land use compatibility with noise sources that are not regulated at the local level, such as traffic, aircraft, and trains. (Solano County 2008.)

The County's noise ordinance is the primary enforcement tool for operation of locally regulated noise sources such as mechanical equipment and construction activity.

The Solano County General Plan includes noise thresholds for permanent facilities and construction-related activities. The maximum allowable noise levels from construction equipment typically is 75 dBA at 50 feet. (Solano County 2008.) Solano County's Land Use Noise Compatibility Guidelines, Table 5.8-2, indicates that <70 CNEL is the normally acceptable standard for water-based recreational uses, and that <60 CNEL is the normally acceptable standard for residential uses.

Table 5.8-2. Land Use Noise Compatibility Guidelines

	Community Noise Exposure (L_{dn} or CNEL, dBA)			
Land Use Category	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
All residential, lodging, schools, libraries, places of worship, nursing homes	<60	60–65	65–75	75+
Auditoriums, concert halls, amphitheaters	–	<70	70+	–
Sports arena, outdoor spectator sports	–<75	70+	–	
Playgrounds, neighborhood parks	<67.5	–	67.5–75	75+
Golf courses, riding stables, water recreation, cemeteries	<70	–	70–80	80+
Retail, movie theaters, restaurants	<65	65–75	75–80	80+
Office building, business commercial and professional	<67.5	67.5–77.5	77.5+	–
Industrial, manufacturing, utilities, agriculture	<75	70–80	75+	–
Noise-sensitive manufacturing and communications	<55	55–70	70–80	80+

Notes:

CNEL = community noise equivalent level; dBA = A-weighted decibel; Ldn = day-night average noise level.

[1] Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

[2] New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

[3] New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor areas must be shielded.

[4] New construction or development should generally not be undertaken.

[5] These standards are not applicable for development within the airport compatibility review area. Development in the airport compatibility review areas are subject to standards in the applicable airport land use plan.

Source: Solano County 2008 Draft General Plan (Solano County 2008).

Physical Setting

Noise-Sensitive Land Uses

Noise-sensitive land uses generally are defined as locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, guest lodging, libraries, and certain types of recreational uses. A noise-sensitive land use also can be defined as an area of frequent human use that would benefit from a lowered noise level. In general, an area of frequent human use is an area where people spend at least 1 hour on a regular basis.

Noise-sensitive uses in the plan area include scattered single-family residences and waterfowl hunting areas with associated clubhouses.

Existing Noise Environment

Although portions of Solano County are urbanized, most of the county is generally considered rural. Ambient noise levels in urban areas typically range from approximately 60 to 70 dBA, and in rural areas from approximately 40 to 50 dBA.

Ambient sound levels associated with noise-sensitive land uses in the vicinity of the project site vary depending on the proximity of major existing noise sources such as traffic, aircraft, and industrial uses. Ambient sound levels in similar suburban/rural settings are typically in the range of 40 to 60 dBA.

Environmental Consequences

Assessment Methods

Potential construction noise impacts were determined using methodology developed by the FTA (Federal Transit Administration 2006). The types of construction equipment used for each proposed activity have been developed based on the description of the proposed activity. Reference noise levels for each piece of equipment were taken from FTA (2006). Utilization factors were estimated from factors provided in Thalheimer (2000). Impacts were determined based on the assumption that no major site-specific projects would be implemented at the same time in the same vicinity.

Significance Criteria

The State CEQA Guidelines, county standards, and standard professional practice were used to determine whether constructing and operating the SMP alternatives would result in a significant noise impact. Noise impacts would be considered significant if constructing or operating the alternatives would:

- expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies;
- expose persons to or generate excessive groundborne vibration or groundborne noise levels;
- result in a substantial permanent increase in ambient noise levels in the vicinity above levels existing without the plan; or

- result in a substantial temporary or periodic increase in ambient noise levels in the vicinity above levels existing without the plan.

Solano County has a list of maximum allowable noise levels from construction equipment. Maximum noise levels for most construction equipment is 75 dBA at 50 feet but is up to 95 dBA for pile drivers.

For the purposes of this analysis, construction noise would be considered significant if it would exceed 75 dBA L_{max} at the outdoor use area of a residence or would occur within 1,000 feet of a residence during evening/nighttime hours (6:00 p.m. to 7:00 a.m.). Noise from trucking activities would be considered significant if it would exceed 60 dBA-L_{eq} at the outdoor use area of a residence.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, some construction would occur. As such, there could be minor, localized increases in noise levels during construction of the restoration areas. Noise generated by managed wetland activities is expected to decrease, but could continue to affect their associated sensitive receptors. Overall, a reduction in noise is expected as a result in a reduction in activities in the Marsh. Therefore, there would be no impact.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Restoration Impacts

Impact NZ-1: Temporary Increases in Ambient Noise during Construction Activities Associated with Restoration

Most noise associated with construction activities would be highly localized. However, noise from trucks would not be localized and would occur on roads throughout the plan area and on roads used to access specific project sites. Because noise-sensitive land uses are sparsely located throughout the plan area, it is unlikely that noise from these activities would have a substantial impact on any sensitive receptors. However, as described above, noise impacts exceeding 75 dBA L_{max} at the outdoor use area of a residence or would occur within 1,000 feet of a residence during evening/nighttime hours (6:00 p.m. to 7:00 a.m.) would be considered significant. Truck noise would be considered significant if it would exceed 60 dBA L_{eq} at the outdoor use area of a residence. To ensure that there would be no significant impact associated with these temporary increases in ambient noise during construction, construction hours would be limited when occurring near residences and noise reduction practices would be implemented as described in the Environmental Commitments section of Chapter 2.

Conclusion: Less than significant. No mitigation required.

Impact NZ-2: Temporary Exposure of Sensitive Land Uses to Groundborne Vibration or Noise from Construction Activities

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. Vibration produced by grading activities has been assessed using an analysis method recommended by FTA (Federal Transit Administration 2006). A reasonable worst-case assumption is that a bulldozer would generate the highest vibration of any heavy equipment used. The recommended reference vibration amplitude or reference PPV for a large bulldozer is 0.089 inch per second at 25 feet. The estimated vibration amplitude at various distances has been calculated and is summarized in Table 5.8-3.

Table 5.8-3. Estimated Vibration Amplitude from a Large Bulldozer

Distance (feet)	Peak Particle Velocity (inch/second)
25	0.089
50	0.031
100	0.011
200	0.0039

Source: California Department of Transportation 2004.

The threshold of perception for groundborne vibration is about 0.02 inch/second (California Department of Transportation 2004). Accordingly, perceptible vibration from the operation of heavy equipment is expected to be limited to an area within about 75 feet of the activity. Because residences are not anticipated to be located within 75 feet of heavy equipment operation, this impact is considered to be less than significant.

Conclusion: Less than significant. No mitigation required.

Impact NZ-3: Permanent Increases in Ambient Noise

Noise generated from individual site-specific projects would occur sporadically over the 30-year implementation period. This could result in slight, isolated occurrences of increased noise (described above under Impact NZ-1) that together would represent an overall permanent (30-year) increase in the ambient noise in Suisun Marsh. However, specific projects would occur throughout the plan area over time. As such, it is not expected that overlaps in substantial noise generation would occur in the same areas of the Marsh that would affect the same sensitive receptors at the same time in a manner that would be considered permanent.

Conclusion: Less than significant. No mitigation required.

Impact NZ-4: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 5.7, Transportation and Navigation. It is not possible at this time to determine specific truck volumes on specific roadways. However, a reasonable worst-case assumption is that up to 20 heavy trucks per hour could use any given roadway. Using the Federal Highway Administration Traffic Noise Model (TNM) Version 2.5 and a nominal speed of 45 mph, 20 trucks per hour would produce the following hourly sound levels:

- 54 dBA at 100 feet
- 50 dBA at 200 feet
- 45 dBA at 400 feet

Because noise from project-related trucking operations is not predicted to exceed 60 dBA L_{eq} within about 100 feet of the trucking activity, it is unlikely that trucking noise would exceed 60 dBA L_{eq} at the outdoor use areas of any residences.

Conclusion: Less than significant. No mitigation required.

Managed Wetland Activities Impacts

Impact NZ-2: Temporary Exposure of Sensitive Land Uses to Groundborne Vibration or Noise from Construction Activities

This impact would be similar to that described for restoration activities. Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. Perceptible vibration from the operation of heavy equipment is expected to be limited to an area within about 75 feet of the activity. Because residences are not anticipated to be located within 75 feet of heavy equipment operation, this impact would be considered less than significant.

Conclusion: Less than significant. No mitigation required.

Impact NZ-3: Permanent Increases in Ambient Noise

This impact would be similar to that described for restoration activities. Noise generated from individual site-specific projects would occur sporadically over the 30-year implementation period, which could result in slight, isolated occurrences of increased noise (described below under Impact NZ-5) that together would represent an overall permanent (30-year) increase in the ambient noise in Suisun Marsh. However, specific projects would occur throughout the plan area over time. Therefore, it is not expected that overlaps in substantial noise generation would occur in the same areas of the Marsh that would affect the same sensitive receptors at the same time in a manner that would be considered permanent.

Conclusion: Less than significant. No mitigation required.

Impact NZ-4: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

This impact would be similar to that described for restoration activities. Truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. Because noise from project-related trucking operations is not predicted to exceed 60 dBA L_{eq} within about 100 feet of the trucking activity, it is unlikely that trucking noise would exceed 60 dBA L_{eq} at the outdoor use areas of any residences.

Conclusion: Less than significant. No mitigation required.

Impact NZ-5: Temporary Increases in Ambient Noise during Construction Activities Associated with Management Activities

Some of the managed wetland activities would involve the use of heavy construction equipment. These activities include dredging equipment, box scrapers, dozers, and trucks. Table 5.8-4 summarizes typical noise levels produced by construction equipment commonly used for managed wetland activities. As indicated, equipment involved in construction is expected to generate noise levels ranging from 55 dB to 95 dB at a distance of 50 feet. Noise produced by construction equipment would be reduced at a rate of about 6 dB per doubling of distance.

Table 5.8-4. Construction Equipment Inventory and Noise Emission Levels and Utilization Factor

Equipment	Typical Noise Level (dBA) 50 ft from Source[1]	Utilization Factor[5]
Long-reach excavator	85 [1]	0.4
Diesel-powered barges	85 [2]	0.5
Small to medium bulldozers	85	0.4
Dump trucks	84	0.4
Small clamshell dredge	80 [3]	0.4
Crane	88	0.2
Front-end loader	85	0.4
Small boat	55 [4]	–

[1] Assumed same as excavator.
[2] Assumed same as dump truck.
[3] Geier & Geier Consulting 1997.
[4] Assumed same as pickup truck.
[5] Thalheimer 2000.

A reasonable worst-case assumption is that the three loudest pieces of equipment (crane, excavator, and bulldozer) would be operated simultaneously and continuously over a period of at least 1 hour within the same area. Table 5.8-4 shows the noise levels produced by each piece of equipment described above along with a related utilization factor (Thalheimer 2000). The predicted 1-hour L_{eq} value is calculated from the maximum noise level and the utilization factor. The combined noise level, assuming simultaneous operation of each piece of equipment, is provided along with predicted noise levels at various distances from the source. The predicted noise levels at various distances take into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 5.8-5 indicate that construction operations could result in noise that exceeds 75 dBA within about 200 feet of construction operations.

Table 5.8-5. Construction Noise

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Construction Condition: Suisun Marsh Restoration			
Source 1: Crane—Sound level (dBA) at 50 feet	88	0.2	81.0
Source 2: Excavator—Sound level (dBA) at 50 feet	85	0.4	81.0
Source 3: Bulldozer—Sound level (dBA) at 50 feet	85	0.4	81.0
Average Height of Sources—Hs (feet)			10
Average Height of Receiver—Hr (feet)			5
Ground Type (soft or hard)			soft
Calculated Data:			
All Sources Combined—L_{max} sound level (dBA) at 50 feet			91
All Sources Combined—L_{eq} sound level (dBA) at 50 feet			86
Effective Height (Hs+Hr)/2			7.5
Ground Factor (G)			0.62

Distance between Source and Receiver (feet)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{max} Sound Level (dBA)	Calculated L_{eq} Sound Level (dBA)
50	0	0	91	86
100	-6	-2	83	78
200	-12	-4	75	70
300	-16	-5	71	65
400	-18	-6	67	62
500	-20	-6	65	60
600	-22	-7	63	58
700	-23	-7	61	56
800	-24	-7	60	54
900	-25	-8	58	53
1,000	-26	-8	57	52
1,200	-28	-9	55	50
1,400	-29	-9	53	48
1,600	-30	-9	52	46
1,800	-31	-10	50	45

Distance between Source and Receiver (feet)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{max} Sound Level (dBA)	Calculated L_{eq} Sound Level (dBA)
2,000	-32	-10	49	44
2,500	-34	-10	47	41
3,000	-36	-11	44	39

Source: Calculations based on Federal Transit Administration 2006.

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

Although highly unlikely, management activities could take place within 200 feet of residences. Noise-reducing practices, as described in the Environmental Commitments section of Chapter 2, would be implemented if noise levels adjacent to a sensitive receptor are anticipated to exceed standards.

Conclusion: Less than significant. No mitigation required.

Impact NZ-6: Exposure of Noise-Sensitive Land Uses to Noise from Portable Pump Operations

Pumps would be used to dewater managed wetlands to augment flood and drain practices. It is reasonable to assume the pumps used for dewatering would be diesel-powered, and approximately 75 horsepower (Hp). It is anticipated that up to eight dewatering pumps may be used at any one time but would be spread throughout the plan area.

Noise levels from operation of dewatering pumps were calculated based on information provided by the project engineers, methodology developed by the FTA, and methodology developed by Hoover and Keith (Hoover and Keith 2000). A single 75-Hp dewatering pump is anticipated to generate a noise level of 80dBA at a distance of 50 feet.

A reasonable worst-case assumption is that eight pumps would operate simultaneously and continuously over a 24-hour day. Simultaneous operation of eight dewatering pumps would result in a combined source level of 89 dBA at 50 feet. For a sound source that operates continuously over a 24-hour period, the CNEL value is about 7 dB greater than the 1-hour L_{eq} value. In this case the CNEL value would be 96 CNEL at 50 feet. Table 5.8-6 calculates estimated sound levels from the operation of dewatering pumps as a function of distance. The predicted noise levels at various distances takes into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance).

The results in Table 5.8-6 indicate that pumping noise may exceed 70 CNEL within 275 feet of the pump. Noise-sensitive land uses may be located within 275 feet of the pump locations.

Table 5.8-6. Pump Operation Noise

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Condition: pump operation			
Source 1: 8 pumps - Sound level (dBA) at 50 feet =	96	0.4	92.0
Average Height of Sources - Hs (feet) =			2
Average Height of Receiver - Hr (feet) =			5
Ground Type (soft or hard) =			soft
Calculated Data:			
All Sources Combined - L_{eq} sound level (dBA) at 50 feet =			94
Effective Height (Hs+Hr)/2 =			3.5
Ground factor (G) =			0.66

Distance Between Source and Receiver (feet)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	94
100	-6	-2	86
200	-12	-4	78
300	-16	-5	73
400	-18	-6	70
500	-20	-7	67
600	-22	-7	65
700	-23	-8	63
800	-24	-8	62
900	-25	-8	60
1,000	-26	-9	59
1,200	-28	-9	57
1,400	-29	-10	55
1,600	-30	-10	54
1,800	-31	-10	52
2,000	-32	-11	51
2,500	-34	-11	48
3,000	-36	-12	46

Source: Calculations based on Federal Transit Administration 2006.

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers which may reduce sound levels further.

In instances where the operation of portable pumps is occurring under the existing condition, there would be no impact unless additional pumps are used, it is placed in an area that increases the noise at sensitive land uses, or it generates additional noise. Otherwise, a significant impact could occur.

Conclusion: Less than significant with Mitigation Measure NZ-MM-1 incorporated.

Mitigation Measure NZ-MM-1: Limit Noise from Pump Operations
The specific project proponent will limit noise from pump operations, where feasible, such that noise from pump operations does not exceed 70 CNEL in the surrounding areas. Noise control measures that can be implemented to reduce noise from pumps on adjacent land uses include those following.

- All internal combustion engine–driven equipment will be equipped with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
- Unnecessary idling of internal combustion engines will be strictly prohibited.

Staging of pump equipment within 275 feet of residences will be avoided. Where equipment must be located within 275 feet of residences, enclosures or barriers will be provided around pumps to reduce noise to acceptable levels.

Alternative B: Restore 2,000–4,000 acres

Impacts for Alternative B are the same as for Alternative A.

Alternative C: Restore 7,000–9,000 acres

Impacts for Alternative C are the same as for Alternative A.

Section 5.9
Climate Change

Introduction

This section describes the existing environmental conditions and the consequences of implementing the SMP alternatives and how climate change may affect future restoration sites.

The Affected Environment discussion below describes the current setting of the plan area. The purpose of this information is to establish the existing environmental context against which the reader can understand the environmental changes caused by the plan. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts.

The environmental changes associated with the action are discussed under Impact Analysis. This section identifies impacts, describes how they would occur, and prescribes mitigation measures to reduce significant impacts, if necessary. Adaptation refers to actions that are taken (separate from a specific project) to prepare for the effects of ongoing climate change. This section identifies mitigation measures, not adaptation measures, for addressing the effects of implementing the SMP in light of climate change through the 30-year planning horizon. However, indirect effects of implementation of the SMP itself can be considered a form of climate adaptation as restored wetlands would be more resilient to sea level rise effects.

Summary of Impacts

Table 5.9-1 summarizes climate change impacts from implementing the SMP alternatives. There would be no significant impacts on climate change from implementing the SMP action alternatives.

Table 5.9-1. Summary of Climate Change Impacts

Impact	Alternative	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
CC-1: Construction-Related Changes in Greenhouse Gas Emissions	A, B, C	Less than significant	None required	–
CC-2: Permanent Changes in Greenhouse Gas Sources and Sinks	A, B, C	Beneficial	None required	–
CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated with Sea Level Rise	No Action Alternative	–	–	–
CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated with Sea Level Rise	A, B, C	Beneficial	None required	–

Affected Environment

Regulatory Setting

Federal

There are no federal standards for greenhouse gas (GHG) emissions or contributions to climate change and no requirements to address climate change in NEPA analysis. However, recent activity suggests that regulation may be forthcoming, with the EPA serving in a leadership role to implement such a program. However, EPA regulation may be preempted by congressional action should a cap and trade bill be passed prior to adoption of EPA regulation.

This section summarizes recent legal cases, legislation, and policy related to climate change and GHG regulation.

Massachusetts et al. v. *Environmental Protection Agency* (2007)

Twelve U.S. states and cities including California, in conjunction with several environmental organizations, sued to force the EPA to regulate GHGs as a pollutant pursuant to the Clean Air Act (CAA) in *Massachusetts* et al. v. *Environmental Protection Agency*. On April 2, 2007, the U.S. Supreme Court held that EPA has the authority to regulate GHG emissions as a pollutant pursuant to the CAA. However, the court did not decide whether EPA is required to regulate GHG emissions at this time, or may exercise discretion to not regulate at this time.

Despite the Supreme Court ruling and the EPA proposal, there are no promulgated federal regulations to date limiting GHG emissions that are applicable to the project.

EPA Finding of Endangerment (2007)

On April 17, 2009, the EPA issued a Proposed Endangerment and Cause or Contribute Finding for Greenhouse Gases under the CAA. Through this Finding of Endangerment, the EPA Administrator proposed that current and projected concentrations of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6) threaten the public health and welfare of current and future generations. Additionally, the Administrator proposed that combined emissions of CO_2, CH_4, N_2O and HFCs from motor vehicles contribute to the atmospheric concentrations and thus to the threat of climate change. Although the Endangerment Finding in itself does not place requirements on industry, it is an important step in the EPA's process to develop regulation.

Environmental Protection Agency Advance Notice of Proposed Rulemaking 2008

In June 2008, the EPA issued an Advance Notice of Proposed Rulemaking (ANPR) inviting comments on options and questions regarding regulation of GHGs under the CAA but has not yet proposed or adopted regulations in response to the Massachusetts case decision.

Environmental Protection Agency Rule: Mandatory Reporting of Greenhouse Gases (2009)

On September 22, 2009, the EPA Administrator signed a rule requiring mandatory reporting of emissions of GHGs from large sources within the United States. The rule was published in the *Federal Register* on October 30, 2009, and goes into effect December 29, 2010. The rule includes emissions of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, nitrogen trifluoride (NF_3), hydrofluorinated ethers (HFE), and select other fluorinated compounds. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to report annual emissions to the EPA. The first annual reports for the largest emitting facilities, covering calendar year 2010, will be submitted to the EPA in 2011.

State

California Global Climate Change Solutions Act of 2006

In Assembly Bill 32 (AB32) (California Global Warming Solutions Act of 2006), the Legislature recognized California's vulnerability to weather events triggered by global warming. The Legislature found that global warming will "have detrimental effects on some of California's largest industries." Residents likely will be affected by many of these climate change effects, given the importance of agriculture, tourism, and recreation to Solano County (Yolo-Solano Air Quality Management District 2007).

AB32 mandates that emissions of GHGs be reduced to 1990 levels by 2020. Considering that 40% of GHG emissions come from motor vehicles, projects that generate new vehicle trips can conflict with AB32 goals.

Senate Bill 97 Chapter 185, Statutes of 2007

Senate Bill (SB) 97 requires that the Office of Planning and Research (OPR) prepare guidelines to submit to the California Resources Agency regarding feasible mitigation of GHG emissions or the effects of GHG emissions as required by CEQA. The Resources Agency is required to certify and adopt these revisions to the State CEQA Guidelines by January 1, 2010. The Guidelines will apply retroactively to any incomplete environmental impact report, negative declaration, mitigated negative declaration, or other related document.

Executive Order S-03-05 (2005)

California Executive Order S-03-05, issued by Governor Arnold Schwarzenegger, established the following GHG emission reduction targets for California's state agencies:

- By 2010, reduce GHG emissions to 2000 levels;
- By 2020, reduce GHG emissions to 1990 levels; and
- By 2050, reduce GHG emissions to 80% below 1990 levels.

The order also required that the Secretary of the California Environmental Protection Agency (CalEPA) oversee and coordinate emission reduction efforts with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the CEC, and the President of the Public Utilities Commission (PUC). The Secretary of CalEPA is required to report to the governor and state legislature biannually on the impacts of global warming on California, mitigation and adaptation plans, and progress made toward reducing GHG emissions to meet the targets established in this executive order.

Executive Orders are directives to state agencies from the Governor of California. They do not govern local agency actions nor do they affect the state legislature. While S-03-05 is an indicator of state policy as interpreted by the governor, it may or may not reflect the view of the legislature. It is, however, one of the factors being considered by state agencies such as the CARB, CEC, and the Building Standards Commission in formulating their GHG reduction strategies.

Executive Order S-13-08 (2008)

California Executive Order S-13-08, issued by Governor Arnold Schwarzenegger, directed the California Resources Agency to develop a state Climate Adaptation Strategy by June 30, 2009, and complete the first California Sea Level Rise Assessment Report by December 1, 2010. The assessment report must advise how California should plan for future sea level rise and should account for California-specific sea level rise projections; scientific uncertainty; impacts on state infrastructure, natural areas, and coastal/marine ecosystems; and a discussion of future research needs. The Executive order also requires that state agencies must address, for construction projects in areas vulnerable to sea level rise, project vulnerability to sea level rise, and as feasible, reduce risks and increase resiliency to sea level rise.

The 2009 California Climate Adaptation Strategy was released in December, 2009, and summarizes the best known science on climate change impacts in seven specific sectors and provides recommendations on how to manage against those threats. This strategy discusses adaptation strategies related to sea level rise, biodiversity, and ocean and coastal resources. It calls for the creation of statewide guidance and regional planning forums to help local governments update local plans and make planning decisions in light of sea level rise. Strategies include:

- Management of Watersheds, Habitat, and Vulnerable Species
- Establish State Policy to Avoid Future Hazards and Protect Critical Habitat
- Provide Statewide Guidance for Protecting Existing Critical Ecosystems, Existing Coastal Development, and Future Investments
- State Agencies Should Prepare Sea Level–Rise and Climate Adaptation Plans
- Support Regional and Local Planning for Addressing Sea Level–Rise Impacts
- Complete a Statewide Sea Level–Rise Vulnerability Assessment Every Five Years

Senate Bill 1107, Chapter 230, Statutes of 2004

This bill, approved August 16, 2004, includes a provision requiring that the Secretary of CalEPA coordinate GHG emission reductions and climate change efforts in the state government (California Energy Commission 2005).

Senate Bill 812, Chapter 423, Statutes of 2002

SB 812 requires the California Climate Action Registry to cooperate with the CARB to develop and adopt protocols for reporting and certification of GHG emissions reductions from forestry conservation and conservation-based management projects. This bill also requires the registry to develop protocols for reporting and certifying GHG reduction projects of participants.

Senate Bill 527, Chapter 769, Statutes of 2001

SB 527, approved October 11, 2001, requires the California Climate Action Registry to coordinate with the State Energy Resources Conservation and Development Commission to adopt industry-specific GHG reporting metrics. The bill requires separate reporting of direct and indirect emissions of participants in the California Climate Action Registry and requires the registry to periodically report the number of participating organizations and the percentage of total state emissions represented by participants as well as any GHG reductions achieved by participating organizations. Under SB 527, the responsibilities of the California Climate Action Registry are adjusted to meet state goals to promote voluntary reporting and reduction of GHG emissions. The bill defines the terms *annual emissions results, baseline, certification, emissions, emissions inventory, greenhouse gases, material,* and *de minimis emissions* as they pertain to climate change and the California Climate Action Registry and CARB.

Senate Bill 1771, Chapter 1018, Statues of 2000

SB 1771 (Chapter 1018, Statutes of 2000) established the California Climate Action Registry (CCAR) in 2000. In 2001 SB 527 (Chapter 769, Statutes of 2001) modified CCAR as a nonprofit voluntary registry for GHG emissions. (SB 1771 enacted Sections 42800–42870 of the California Health and Safety Code and Public Resources Code Section 25730; SB 527 amended Sections 42810, 42821–42824, 42840–42843, 42860, and 42870 of the Health and Safety Code.) The purpose of CCAR is to help companies and organizations with operations in the state establish GHG emissions baselines against which future GHG emissions reduction requirements may be applied. CCAR has developed general protocols and additional industry-specific protocols that provide guidance on how to inventory GHG emissions for participation in the registry.

Local

Solano County General Plan

The Solano County General Plan (Solano County 2008) recognizes AB32 and its goal of reducing GHG emissions. The County's goal is to reduce GHG emissions by 20% below 1990 levels by 2020. The general plan integrates the reduction throughout different resource areas such as Land Use, Public Facilities and Services, Transportation and Circulation, Health and Safety, Economic Development, Resources, and Agriculture. One of the first strategies will be to develop and adopt the Solano County Climate Action Plan (CAP) by June 30, 2010. The CAP will address both GHG emissions from activity within the county (residential, commercial, industrial, transportation, and agricultural sectors) and emissions specifically from county operations. The CAP first will create a GHG emissions inventory for the base year 1990 and forecast GHG emissions for the year 2020. The CAP will determine the quantity of emissions to be reduced in order to meet the reduction target of 20% below 1990 levels. The CAP's third step will be to establish additional policies and programs necessary to achieve the county's reduction target. The fourth step of the CAP will describe strategies, policies, and measures that will be used to protect the county from and facilitate adaptation to the potential effects of climate change. Finally, the CAP will identify benchmarks, monitoring procedures, and other steps needed to ensure the county achieves its GHG reduction, protection, and adaptation goals. The following emission reduction benchmarks will be included (Solano County 2008: HS-102–109):

- overall emissions reductions of at least10% below 1990 levels by 2015,
- overall emissions reductions of at least 20% below 1990 levels by 2020, and
- reductions of total countywide energy consumption of at least 2% per year to achieve a minimum 20% reduction by 2020.

Solano County also will develop and adopt a Sea Level Rise Strategic Program (SLRSP). The SLRSP will have three primary objectives—(1) investigate the potential effects of sea level rise on Solano County, (2) identify properties and resources susceptible to sea level rise in order to prioritize management strategies, and (3) develop protection and adaptation strategies to meet the county's and region's goals. The program will encompass all areas identified within a sea level–rise planning area and will be coordinated with San Francisco BCDC, CBDA, and other relevant agencies (Solano County 2008: HS-13).

San Francisco Bay Conservation and Development Commission

The BCDC has developed a Climate Change Planning Project with the following goals:

1. identify and report on the impacts of climate change on San Francisco Bay;

2. identify strategies for adapting to climate change;
3. develop a regional task force to inform and coordinate local governments, stakeholders, and land use planning bodies in the Bay Area regarding the potential bay-related impacts of and approaches for adapting to global climate change;
4. identify the findings and policies in the San Francisco Bay Plan pertaining to climate change, such as the findings and policies on sea level rise, and update other relevant Bay Plan policies to incorporate new information about the impacts of climate change (San Francisco Bay Conservation and Development Commission 2006).

Current Climate Change Predictions

Global Warming and Greenhouse Gases

Global warming is the name given to the increase in the average temperature of the earth's near-surface air and oceans since the mid-20th century and its projected continuation. Warming of the climate system now is considered to be unequivocal (Intergovernmental Panel on Climate Change 2007) with global surface temperature increasing approximately 1.33°F over the last 100 years. Continued warming is projected to increase global average temperature between 2 and 11°F over the next 100 years.

The causes of this warming have been identified as both natural processes and as the result of human actions. The Intergovernmental Panel on Climate Change (IPCC) concludes that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from pre-industrial times to 1950 and had a small cooling effect afterward. However, after 1950, increasing atmospheric GHG concentrations resulting from human activity such as fossil-fuel burning and deforestation have been responsible for most of the observed temperature increase. These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion.

Increases in GHG concentrations in the earth's atmosphere are thought to be the main cause of human-induced climate change. Greenhouse gases are gases that naturally trap heat by impeding the exit of solar radiation that has hit the earth and is being reflected back into space. Some greenhouse gases occur naturally and are necessary for keeping the earth's surface inhabitable. However, increases in the concentrations of these gases in the atmosphere during the last hundred years have decreased the amount of solar radiation that is reflected back into space, intensifying the natural greenhouse effect and resulting in the increase of global average temperature.

The principal greenhouse gases are CO_2, CH_4, N_2O, SF_6, PFCs, HFCs, and water vapor (U.S. Environmental Protection Agency 2009a). Each of the principal greenhouse gases has a long atmospheric lifetime (1 year to several thousand years). In addition, the potential heat-trapping abilities of each of these gases vary significantly from one another.

CH_4 is 21 times as potent as carbon dioxide, while SF_6 is 22,200 times more potent than CO_2. Conventionally, GHGs have been reported as carbon dioxide equivalents (CO_2e). CO_2e takes into account the relative potency of non-CO_2 GHGs and converts their quantities to an equivalent amount of CO_2 so that all emissions can be reported as a single quantity.

The primary human-made processes that release these gases are: burning of fossil fuels for transportation, heating and electricity generation; agricultural practices such as livestock grazing and crop residue decomposition that release CH_4; and industrial processes that release smaller amounts of high global warming–potential gases such as SF_6, PFCs, and HFCs. Deforestation and land cover conversion also have been identified as contributing to global warming by reducing the earth's capacity to remove CO_2 from the air and altering the earth's albedo or surface reflectance, allowing more solar radiation to be absorbed.

Although the international, national, state, and regional community is beginning to address GHGs and the potential effects of climate change, it is expected that worldwide GHG emissions will continue to rise over the next several years.

In the plan area, most GHG emissions are generated from vehicle use, industrial activities, and residential uses.

Greenhouse Gases and Wetlands

Analysis of GHG fluxes from wetlands has received a considerable amount of study in the last two decades. However, given that carbon cycling, CH_4 production, and nitrogen cycling vary substantially in different wetlands at different times of the year and because of highly site-specific chemical and biological characteristics, there is a substantial amount of uncertainty in estimating potential changes in GHG emissions and sequestration in such dynamic environments. The values below should be considered an illustrative evaluation of the potential changes in carbon sequestration and CH_4 production associated with the proposed project, but given the level of uncertainty in the underlying supporting research, the values derived below should not be considered predictive. However, as described below, the evidence does allow for concluding the direction of change in carbon sequestration and CH_4 production, but not for the precise determination of the extent of such change.

Water salinity plays a major role in wetland carbon cycling, CH_4 production, and nitrogen cycling. Wetlands with higher salinity tend to sequester more carbon and emit less CH_4 than wetlands with lower salinity. The concentration of salts (salinity) in ocean water is approximately 33 parts sea salt per thousand parts of water (ppt, or grams per liter [g/L]) (psu), while the salinity of fresh water is near zero (U.S. Geological Survey 2007). Salinity measurements taken at the Suisun wetlands between 2002 and 2003 are presented in Section 5.2, Water Quality. Figure 5.2-3 shows the variation in salinity within Suisun Bay from Martinez to Collinsville. Salinity in the Marsh varies with Delta outflow. Figure 5.2-4 indicates that salinity averages about 15 milliSiemens per centimeter (mS/cm) in the western Marsh and about 5 mS/cm in the eastern portion of the Marsh.

Carbon Dioxide Sequestration

Through the process of photosynthesis, plants take up CO_2 from the atmosphere. Along with water, nutrients, and minerals, CO_2 is incorporated into the living tissue of plants to allow for development, growth, and reproduction of the plant. This is the process through which carbon is sequestered into plants and stored as carbon stock. Some portion of the carbon removed from the atmosphere is returned to the atmosphere through several processes, including respiration, decay, and disturbance. CO_2 emissions from respiration can be as much as 25% of "gross primary productivity," or the net rate at which plants fix and store carbon as energy.

Like other plant matter, vegetation in wetlands can capture carbon by taking in atmospheric CO_2, converting it to plant mass through photosynthesis and then sequestering the carbon in the inundated soils that form as plant matter decomposes. Pilot studies being undertaken in tule marshes on Twitchell Island (approximately 15 miles east of Suisun Marsh) have found a very high primary productivity (carbon fixation) and sequestration (C-immobilization, or long-term "storage") of belowground carbon that would remain stable if continuously inundated. When coupled with the CO_2 emissions reduction associated with preservation of historic peat deposits, as much as 25 metric tons of carbon per acre per year may be sequestered by freshwater marshes in the Delta according to indications in these studies. The results vary widely depending on many factors such as temperature, inundation regime, and plant species (U.S. Geological Survey 2007, 2008).

Saline and freshwater wetlands can represent net sinks of CO_2. Because tidal marshes are extremely productive, they are one of the most effective environments for carbon sequestration (Chmura et al. 2003; Trulio 2007; Mitsch and Gosselink 2000). Recent research estimates the carbon sequestration potential of saline marshes to range between 0.8 and 5.7 metric tons per acre per year (54 g/m^2 and 385 g/m^2/year) (U.S. Climate Change Science Program 2007; Trulio 2007). Freshwater mineral soil wetlands also sequester CO_2. The first State of the Carbon Cycle Report (SOCCR) estimates the sequestration potential of freshwater wetlands to be 0.3 metric ton per acre per year (21 g/m^2/year) (U.S. Climate Change Science Program 2007). These values represent the net, long-term storage of carbon in the system, after accounting for losses attributable to respiration. Research on sequestration in brackish wetlands is limited. Because the salinity in these environments is lower than in a salt marsh, but higher than in a freshwater marsh, it can be theorized that the carbon sequestration potential of brackish wetlands likely would fall somewhere between the range of a freshwater wetland and the range of a saltwater wetland.

Methane Emissions

While freshwater, saltwater, and brackish wetlands sequester amounts of CO_2, they also produce CH_4 through anaerobic decomposition of biomass; CH_4 is a more potent GHG than CO_2.[1] Approximately 76% of global naturally produced CH_4 comes from wetlands (U.S. Environmental Protection Agency 2009b). CH_4 is naturally produced and emitted from wetlands by CH_4-producing bacteria that need anoxic conditions combined with labile organic matter.

Saline marshes, in general, often are thought to release less CH_4 than freshwater environments, but the absolute differences depend on site characteristics (Trulio 2007; U.S. Climate Change Science Program 2007). Sulfates can suppress CH_4 production from CO_2 respiration (Chmura et al. 2003). Research suggests that tidal brackish wetlands release 6.4 g/m^1 to 22.4 g/m^2 of CH_4 per year, or 0.5 to 1.9 metric tons of CO_2e per acre per year (U.S. Climate Change Science Program 2007; Bartlett et al. 1987), while freshwater wetlands release 18.7 to 91.4 g/m^2 of CH_4, or 1.6 to 7.8 metric tons of CO_2e per acre per year (U.S. Climate Change Science Program 2007).[2] As mentioned above, the salinity in Suisun Marsh ranges from 3 to 10 psu, which corresponds to the high range of CH_4 emissions for tidal brackish wetlands presented above, or 1.6 to 1.9 metric tons of CO_2e per acre per year (Bartlett et al. 1987). Because CH_4 is a far more potent GHG on a pound-for-pound basis than CO_2, in freshwater wetlands CH_4 production may overwhelm the benefits obtained from carbon sequestration (U.S. Climate Change Science Program 2007). Recent work on wetland mesocosms[3] and restored wetlands (Altor 2009) has shown that the soils that originally formed under flooded or saturated conditions and are continually inundated with water release higher levels of CH_4 than periodically inundated soils.

CH_4 flux out of the marsh is controlled by numerous environmental factors, one of which is evapotranspiration. Evapotranspiration is the transport of water from soil or surfaces (evaporation) and from the open stomata of plants (transpiration) to the atmosphere. Other gases, such as CH_4 or N_2O discussed below, follow physical paths similar to water vapor as they move from an ecosystem to the atmosphere; thus, the evapotranspiration potential (ETP) of an ecosystem and its GHG flux are related. In Suisun Marsh, the ETP is estimated to increase

[1] Different GHGs are compared using their global warming potential (GWP) over a 100-year period. On this basis, CH_4 is approximately 21 times more powerful on a pound for pound comparison to CO_2 and thus has a GWP of 21. N_2O has a GWP of 310.
[2] The highest CH_4 values for brackish and freshwater marshes, 97 and 213 g/m^2 respectively, were assumed to be outliers and excluded from the calculations. In addition, higher CH_4 values were reported for non-tidal marshes. Uncertainty associated with these statistics can be as high as 100%.
[3] A mesocosm is any system larger than a microcosm (a smaller system which is representative of or analogous to a larger one) but smaller than a macrocosm (a complex structure, such as a society, considered as a single entity that contains numerous similar, smaller-scale structures). In the research cited above, mesocosm refers to a small study area within the marsh that was examined and assumed to be representative of conditions throughout a larger area

dramatically from the western to eastern portions of the Marsh. This gradient, together with numerous other mediating factors, ultimately determines the amount and patterns of CH_4 released in the Marsh.

Nitrous Oxide Emissions

Natural emissions of N_2O result primarily from bacterial breakdown of nitrogen in soils and in the earth's oceans. Globally, tropical soils (primarily wet forest soils, but also savannas and agricultural systems) are estimated to produce 6.3 million tons (Tg) of N_2O annually, and oceans are thought to add around 4.7 Tg of N_2O annually to the atmosphere (Intergovernmental Panel on Climate Change 2001; U.S. Environmental Protection Agency 2009c). Together, these two sources account for more than 70% of the natural sources. Similar microbial processes in temperate-region soils produce smaller quantities of N_2O. In some ocean areas, large areas of surface water can become oxygen-depleted, allowing active denitrification in open water. Large amounts of oceanic N_2O also can arise from denitrification in marine sediments, particularly in nutrient-rich areas such as those of estuaries.

All wetlands produce N_2O through nitrification and denitrification processes, which are the generation and diagenesis of nitrate (NO_3), respectively. However, research on N_2O production rates from wetlands is limited. In addition, the research that has been conducted has an extremely high degree of uncertainty because of the compound's complex chemistry and unknown strength of nitrifying and denitrifying processes in certain environments. As such, depending on biogeochemical characteristics of a wetland (e.g., labile carbon availability, nitrate availability, redox potential), N_2O production could vary significantly. Given the current research limitations, N_2O production was not included in this analysis.

It is important in studies of N_2O emissions to account for the various interactions between natural processes and human influences in the nitrogen cycle, because human impacts can significantly enhance the natural processes that lead to N_2O formation. For example, the nitrogen nutrient loading in water bodies attributable to fertilization and runoff to streams can enhance N_2O emissions from these natural sources. Human-related ammonia emissions also have been shown to cause N_2O emissions in the atmosphere through ammonia oxidation.

Peat Soil Subsidence and Oxidation

Globally, peat oxidation accounts for 2–3 gigatons (Gt) per year of CO_2 equivalents (one tenth of fossil-fuel emissions) with rates ~tenfold greater in temperate and tropical soils than in boreal soils (Intergovernmental Panel on Climate Change 2007). In addition, global emissions of CO_2 from drained peatlands amounted to 1.4 Gt in 2008 (Wetlands International 2009).

Subsidence of organic soil in drained wetlands can produce CO_2 through microbial oxidation of the carbon in the organic component of the soil. Subsidence also can produce CH_4 and N_2O. Subsidence of organic soils is common in the Delta region. According to multiple studies, subsidence is caused primarily by microbial oxidation of soil organic carbon, which produces emissions of CO_2. Subsidence also can occur through anaerobic decomposition; consolidation; shrinkage; wind erosion; gas, water, and oil withdrawal; wetting and drying of the soil; and dissolution of organic matter (Deverel 2008). Peat soil lands in the Delta region are subsiding significantly, with an estimated subsidence rate between 0.2 and 2.5 inches per year that results primarily from the oxidation of the peat soil (Deverel and Rojstaczer 1996). However, research on peat soil oxidation rates from the Suisun area is limited. Much subsidence and peat soil oxidation in the Delta occur from agricultural practices on drained wetlands, and such practices are not occurring at Suisun. Consequently, subsidence at Suisun marsh is significantly less than subsidence in other Delta regions. In addition, oxidation and subsidence rates depend on soil organic content, carbon content, temperature, and other factors. Understanding these characteristics at Suisun improves the ability to predict net effects of hydrologic changes on peat oxidation.

Sea Level Rise

With respect to Suisun Marsh, the most critical climate change problem is the potential for significant increase in mean sea level. Such a rise may result from a combination of (a) the volumetric expansion of existing seawater as water temperatures rise significantly and (b) the increase in total (liquid) sea water as large ice deposits on land (e.g., in Antarctica, in Greenland, and worldwide in large glaciers) melt into the sea. Local sea level rise may be affected by both global sea level rise and geotectonic land mass movements and subsidence. Subsidence has the potential to affect local regional sea level to the same extent as climate change.

Atmospheric pressure, ocean currents, and local ocean temperatures also affect local rates of sea level rise. The sea level has risen approximately 4,800 inches (400 feet) since the peak of the last ice age about 18,000 years ago, but the bulk of that occurred before 6,000 years ago (Axelrod 1981). From 3,000 years ago to the late 1800s, the rate of sea level rise held almost constant (average rate of 0.0 to 0.2 millimeter per year, or 0.0 to 0.8 inch per century [Intergovernmental Panel on Climate Change 2007]); however, it appeared to increase worldwide in the twentieth century (e.g., 8.4 inches/century or 4.2 inches/50 years near San Francisco).

Most climate scientists agree that anthropogenically induced global warming will cause the rate of sea level rise to increase further. In 2001, the IPCC released a report with projections of global sea level rise over the next century. More recent studies project different rates of sea level rise for specific regions of the globe. These regional projections are considered more reliable on a region-by-region basis than the IPCC projections. To provide a comprehensive discussion of sea level rise, both IPCC and regional projections are presented below.

IPCC projections of sea level rise vary depending on several different GHG emissions scenarios analyzed in the IPCC Special Report on Emissions Scenarios. As such, the IPCC estimates sea level rise to be between 3.6 and 34.8 inches between years 1990 and 2100 (Intergovernmental Panel on Climate Change 2001). The IPCC model range of estimates for global sea level average rise by 2060 is predicted to be between 2.4 and 15.6 inches. However, the models used by the IPCC do not predict uniform global sea level rise, and there are substantial regional variations. The IPCC model predictions for the eastern Pacific indicate a range of sea level rise of 3.6 to 19.2 inches by 2100, which is on the lower end of the global range noted above. Most of the sea level rise predictions on the top end of the global range are for the top and bottom of the world (i.e., the polar latitudes), not the middle latitudes. Assuming net rise between 1990 and 2060 to be half of the net rise between 1990 and 2100, the geographic prediction for 2060 from the IPCC models for the eastern Pacific would be 1.8 to 9.6 inches.

While IPCC assessments of climate change and associated sea level rise rely on global models, adapting to climate change and associated sea level rise requires an understanding of how climate change will affect specific regions so that planning can take place at the state and regional levels. The California Climate Action Team relies on the IPCC Special Report on Emissions Scenarios for assessing primary impacts of climate change, namely changes in the frequency and intensity of precipitation and temperature increases, on a regional level (Cayan et al. 2006; Cayan et al. 2008). IPCC-projected temperature increases range from 2.5°F for the lowest emissions scenario to 10.4°F for the highest emissions scenario. However, the California Climate Action Team uses Rahmstorf's methodology for projecting sea level rise.

In 2007, German scientist, Stefan Rahmstorf, developed an empirical approach to projecting future sea level rise that entails calculating the relationship between sea level rise and global mean surface temperature. Rahmstorf first determined the historical trend in this relationship and then projected that trend into the future using IPCC's projected temperature increases associated with Special Report on Emissions Scenarios, which range from 2.5°F for the lowest emissions scenario to 10.4°F for the highest emissions scenario (Rahmstorf 2007). Rahmstorf's corresponding estimates of sea level rise by 2100 range from 10 inches to 55 inches.

IPCC's and Rahmstorf's sea level rise estimates did not include the effects of dams on sea level rise (Cayan et al. 2008). Dams constructed primarily during the 1950s to 1970s may have stored enough water worldwide to mask acceleration in the rate of sea level rise prior to the notable acceleration detected in 1993. As building of dams for additional upland water storage has slowed, sea level rise now may be accelerating faster than the IPCC and scientists such as Rahmstorf have predicted (Chao 2008).

The Delta Vision Blue Ribbon Task Force established by Governor Schwarzenegger to develop a strategic management plan for the Delta employed an Independent Science Board to review literature and provide recommendations on sea level rise. The Independent Science Board found that: (1) current IPCC projections are conservative and underestimate recently measured sea level rise; (2) empirical models, such as Rahmstorf's empirical method, yield significantly higher estimates of sea level over next few decades and are better for short- to mid-term planning; and (3) neither the IPCC nor Rahmstorf accounts for accelerating contributions from ice sheet melting, which likely will contribute significantly to future sea level rise with the potential for very rapid increases of up to 39 inches by 2100. Based on these findings, the Independent Science Board recommended adopting an estimated rise in sea level of 55 inches by 2100 and recommended adopting a sea level rise estimate for 2050 as well.

Therefore, even though the California Climate Action Team still relies on IPCC-projected temperature increases and Rahmstorf's methodology for projecting sea level rise, the team goes further to account for effects of dams and accelerated ice sheet melting on sea level rise. As a result, California Climate Action Team–funded research for a 2009 report (the 2009 California Climate Adaptation Strategy) to Governor Schwarzenegger estimates that sea level rise will increase in California between 12 and 17 inches by 2050 and between 20 and 55 inches by 2099 (San Francisco Bay Conservation and Development Commission 2009b). In addition, DWR supports a range in sea level rise of 7 to 55 inches along California's Coast by 2100 (California Department of Water Resources 2008). The most recent climate science report, the 2009 Copenhagen Diagnosis, estimates that global sea level rise will increase up to approximately 78.7 inches by 2100 (Allison et al. 2009). Based on these predictions, sea level rise would likely cause flooding in the urbanized areas of Suisun City and Fairfield.

The 2009 California Climate Adaptation Strategy includes many adaptation actions to respond to changes in sea level rise. Some of these actions are summarized below:

- identify and strategically prioritize for protection lands at the boundaries of the San Francisco Bay and the Delta that will provide the habitat range for tidal wetlands to adapt to sea level rise;
- minimize the adverse effects of sea level rise and storm activities by carefully consider new development within areas vulnerable to inundation;
- prepare agency-specific adaptation plans, guidance, and criteria, as appropriate (state agencies responsible for the management and regulation of resources and infrastructure subject to potential sea level rise); and
- identify and protect key habitats that may require more protection as a result of climate change impacts, including sea level rise.

See Chapter 2 of this EIS/EIR for further discussion of ways to respond to predicted sea level rise.

Water Quality

Trace elements such as copper can be present in wetland sediments, and copper toxicity to wildlife is a current water quality concern in the western Suisun Marsh. The increase in atmospheric CO_2 associated with climate change results in a decrease of ocean pH, because of carbonic acid increase associated with the ocean's increased absorption of CO_2. As copper desorption in aqueous environments is sensitive to changes in pH, copper toxicity is susceptible to increase as a result of climate changes. A change of 1 pH unit can result in a hundredfold increase in availability coming from copper bound in sediments (Sparks 1995). It is estimated that surface ocean pH will drop by up to 0.5 pH units by 2100, as the oceans absorb more CO_2. However, copper toxicity effects related to climate change would not change with implementation of the proposed project, as these copper toxicity effects would occur regardless of whether the proposed project is implemented. For more impact discussion related to wetland restoration and water quality, see Section 5.2, Water Quality.

Disease Vectors

There have been positive human test results for the West Nile virus across the United States, including the Bay Area, specifically Contra Costa County (U.S. Geological Survey 2009). Coccidioidomycosis (valley fever) also is located in the southwestern U.S. where temperatures are high and the soils are dry. With more severe, frequent, and lasting heat events associated with climate change, there could be a greater chance of infectious disease such as West Nile spread by insects (e.g., mosquitoes) or valley fever spread by fungi (e.g., *Coccidioides immitis*). This would be attributable to an increased range of warmer temperatures in the region that could lead to a wider ecosystem in which such insects and fungi thrive (U.S. Global Change Research Program 2000). Infectious disease effects related to climate change would not change with implementation of the proposed project, as the expansion of disease vectors would occur regardless of whether the proposed project is implemented. For more impact discussion related to wetland restoration and infectious diseases, see Section 7.8, Public Health and Environmental Hazards.

Temperature, Ecology, and Other Changes

Climate change impacts will substantially alter the bay ecosystem through erosion and loss of wetland habitat, changing sediment demand, altered species composition, changing freshwater inflow and salinity, altered food web, and impaired water quality. Warmer water temperatures and reducing amounts of tidal marsh may make it harder to recover the diverse range of threatened and endangered species living in the Bay and may increase the number of species considered threatened and endangered. These changes have the potential to overwhelm the bay ecosystem's ability to rebound and continue functioning (San Francisco Bay Conservation and Development Commission 2009a).

One predicted outcome of climate change is an increase in rainfall during the winter and spring months, and a decrease in snowmelt runoff in spring and summer months, making downstream areas more flood-prone in the winter and drier in the summer. Managed wetland draining within the bay could be more difficult because of the difference in water levels between the managed wetland interior and the exterior channels.

Climate change also may affect storm frequency and intensity, which can increase flooding when coupled with sea level rise. From 1993 to 2003, there was an increase in the number of storm surge events and high tides exceeding previously observed extremes. Increasing storm activity and more frequent extreme tides are projected to occur over time. If state water reservoirs lack the capacity to handle increased rainfall and earlier snowmelt, water managers may need to release flows through the Delta during winter months, resulting in even higher water levels (San Francisco Bay Conservation and Development Commission 2009a).

The combined effects of sea level rise, storm surge, and river flooding may result in water levels elevated as high as 51 inches for a period of 10 to 12 hours in the Delta and Suisun Marsh region, an area already below mean tide elevation surrounded by fragile levees (San Francisco Bay Conservation and Development Commission 2009a). Consequently, flooding impacts from sea level rise can be expected during the first half of this century as a result of winter storms and sea level rise.

Increased flows also would result in increased erosion, which may alter sediment loading, affecting the bay ecosystem by changing the dynamics of sedimentation over time. Decreased summertime flows may affect aquatic habitats by reducing the amount of open water and channel habitat, and by increasing the frequency of water quality issues related to temperature, salinity, and DO. These changes in how water is distributed throughout the year also will affect soil moisture. It is expected that climate change could result in drier soils in the summer and wetter soils in the winter. Reduced flows also could result in an increase in salinity, especially during the summer and fall months. Changing salinity affects fish, wildlife, and other aquatic organisms in intertidal and subtidal habitats.

Climate change may encourage new and existing invasive species to become established in the bay, causing biodiversity loss. Increasing temperatures and changes in salinity may result in conditions that better suit such invasive species or diseases that native species are not currently able to combat.

Environmental Consequences

Assessment Methods

This analysis discloses both the SMP's contribution to climate change and the effects that climate change may have on implementation of the SMP alternatives.

The only contributions to climate change that the SMP may make are related to construction activities that would be implemented as part of the plan and the potential sequestration of carbon and emissions of CH_4 as a result of creating tidal wetlands. These potential contributions are described here and in Chapter 10, "Cumulative Impacts," of this EIS/EIR.

Several assumptions were made to estimate the impacts implementation of the proposed project would have on carbon sequestration and CH_4 production in the Suisun wetlands. First, based on the salinity values from Section 5.2, it can be assumed that the western portion of the wetlands function more on the saline end of the brackish environment spectrum. Conditions in the eastern portion, on the other hand, function more on the fresh end of the brackish environment spectrum.[4] Second, because both areas of the wetland are flooded and drained seasonally such that they are saturated with water for about 9 months of the year, they are producing CH_4 only for these 9 months. When organic soil wetlands are dried, in general, they release more soil carbon through oxidation than taken up by photosynthesis, but also stop producing significant amounts of CH_4.[5]

Peat soil subsidence and organic matter oxidation also were analyzed because these processes release CO_2. It is likely that the soil is oxidized continuously when not submerged and that the oxidation rate would be reduced entirely if converted to tidal wetlands, thereby reducing CO_2 emissions. For purposes of this analysis, a potential range of peat soil oxidation reduction for the plan is presented below. However, it should be noted that quantifying the amount of released carbon is difficult and depends on the unique biology of the environment.

Carbon sequestration and CH_4 production in the Suisun wetlands were estimated for all plan conditions using values obtained from multiple literature sources (U.S. Climate Change Science Program 2007; Trulio 2007; Bartlett et al. 1987; Chmura et al. 2003; Deverel 2008). Potential net carbon fluxes resulting from these processes were estimated for both a brackish and freshwater wetland to better represent the actual conditions in the wetlands. It was assumed that under existing conditions, carbon flux in the wetlands while drained was zero or positive (as a result of carbon oxidation). Therefore, implementation of the proposed project would result in a 100% decrease in carbon oxidation and a 33% increase in CH_4 production (most CH_4 production occurs when the wetland is wet) relative to existing conditions because the wetlands no longer would be drained for 3 months of the year. As the values used to calculate CH_4 production, sequestration, and oxidation were obtained from different sources, there is a high degree of uncertainty in estimating the net CO_2e balance, considering the

[4] No specific boundary separates the eastern and western portions of the wetland. Assumptions were made using monitoring values for stations that are located in these regions. Water salinity between the monitoring stations will fall somewhere between the observed values, with salinity decreasing the farther east. Given this, sequestration potentials and methane production were estimated for both brackish and freshwater environments using the entire project acreage in each calculation.

[5] Regarding CH_4, during the dry period, anaerobic decay may continue in wetland vegetation, and thus there may be some methane production that will occur in buried vegetation, but aerobic exposure is expected to suppress methane production in general.

offsetting influences of carbon sequestration and CH_4 production. Therefore, the results of this analysis have been used to illustrate the carbon flux and CH_4 production changes, but the magnitude of the net change (considering the combined effect of carbon sequestration and CH_4 production) should be considered relatively uncertain.

The analysis does not assume that the restored marsh will be 100% vegetated. The amount of vegetation in wetlands is correlated with the CO_2 sequestration capacity of the wetland because sequestration is driven largely by photosynthesis of vegetation. The analysis assumes that the restored marsh would sequester carbon at a rate similar to other North American and Delta region marshes with similar salinity and characteristics as Suisun. These marshes include both vegetated areas and open water areas. It is currently unknown what percentage of the restored marsh would revegetate and what percentage would be open water. It is possible that the project would result in more open water or subtidal habitat than other North American or Delta marshes, potentially resulting in lower carbon sequestration rates than these marshes. To provide a conservative estimate of sequestration for the project, a relatively low range of sequestration values for similar wetlands was used in this analysis.

The sections below describe the potential sea level rise impacts of climate change on the study area and on the SMP alternatives. The sea level–rise impact of global climate change on Suisun Marsh is described as a quantitative range because local and regional projections of specific climate change impacts have high uncertainty. Scientific findings are summarized and discussed in terms of broad implications for the Bay-Delta, which encompasses Suisun Marsh.

Significance Criteria

The SMP alternatives' contributions to GHGs are assessed for significance. The following significance criterion applies only to the plan's emission and sequestration of GHGs: An impact would be considered significant if the alternative's GHG emissions would impede compliance with the GHG emissions reduction goals mandated in AB32.

With respect to the analysis of climate change impacts on the SMP alternatives (sea level rise, in this case), climate change effects on an alternative are compared to the climate change effects on the future no action scenario. The reasonably foreseeable affected environment, described under the No Action Alternative analysis, serves as the basis for evaluating and comparing the incremental effects of the SMP alternatives.

Environmental Impacts

No Action Alternative

Under the No Action Alternative, some restoration activities would occur. Similar to Alternative A as described below, a temporary increase in GHG emissions could occur as a result of the construction activities, but it is not expected that substantial GHG emissions would be generated. Also, increased inundation caused by sea level rise likely would reduce current carbon sequestration rates.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Impact CC-1: Construction-Related Changes in Greenhouse Gas Emissions

Construction activities associated with tidal restoration and managed wetland activities would result in temporary increased emissions over the 30-year SMP implementation period. These activities would occur intermittently over time, and it is not expected that substantial GHG emissions would be generated during construction of any of the proposed project activities.

GHG emissions from construction activity are described in Section 5.7, Air Quality. According to this analysis, implementing the SMP alternatives would generate approximately 598.7 tons of CO_2 per year, of which 276.3 tons are from restoration activities and 322.5 tons are from management activities. Over the 30-year construction timeline, this is equivalent to 17,962 tons of CO_2, or 16,295 metric tons of CO_2. CO_2 emissions associated with management activities would occur beyond the 30-year construction timeline in the amount of 292.6 metric tons per year.

Because the activities are temporary and localized, it is not expected that implementation of the proposed project would result in a permanent or substantial increase in GHG emissions. In addition, construction emissions likely would be offset though changes in net GHG sources and sinks as a result of the proposed project described in Impact CC-2 below.

Conclusion: Less than significant. No mitigation required.

Impact CC-2: Permanent Changes in Greenhouse Gas Sources and Sinks

The proposed project would restore approximately 5,000 to 7,000 acres of tidal wetlands. Improved recreational access may result in a slight increase in the number of users and the associated vehicle use, but it is not expected that this increase would result in a substantial increase in permanent or short-term GHG emissions. Changes in the types of wetlands and the total area of tidal wetlands could result in changes in carbon sequestration. However, the existing wetlands cover a range of conditions—the entire marsh is a brackish environment, but the western portion is generally saltier, whereas the eastern portion of the wetlands is generally fresher. In addition, the wetlands are subject to drought-wet cycles that can create wide swings in salinity. For the purposes of this analysis to provide a conservative estimate of carbon sequestration and CH_4 emissions, the eastern portion of the marsh was assumed to be more similar to a freshwater environment. While both brackish and freshwater wetlands sequester, or act as a sink for, carbon (peat soil formation), brackish wetlands generally sequester more carbon per unit area than freshwater wetlands (U.S. Climate Change Science Program 2007; Trulio 2007).

Over the long term, changing managed wetlands to permanent tidal wetlands, where the potential for anoxic conditions and abundant organic matter is higher, has the potential to result in an increase in CH_4 production. As discussed above, wetlands produce CH_4 through anaerobic decomposition of biomass. While both brackish and freshwater tidal wetlands produce CH_4, brackish wetlands tend to produce less CH_4 per unit area than freshwater tidal wetlands (U.S. Climate Change Science Program 2007; Bartlett et al. 1987). Because CH_4 is a far more potent GHG than CO_2, in freshwater wetlands CH_4 production may overwhelm the benefits obtained from carbon sequestration (U.S. Climate Change Science Program 2007).

Table 5.9-2 presents the changes in carbon sequestration and CH_4 emissions associated with implementation of Alternative A, assuming that the restored wetlands fall within the widest possible range of carbon sequestration and CH_4 emission values for freshwater and brackish wetlands. Based on the information presented in Table 5.9-2, the following conclusions can be made:

1. Implementation of the plan alternatives would result in increased carbon storage in both brackish and freshwater environments for the restored wetlands relative to existing conditions. This increase in carbon storage would be roughly one-third the current potential.
2. Sequestration in the western, brackish portion of the wetlands would be higher than sequestration in the eastern, more freshwater environment.
3. Implementation of the plan alternatives would result in increased CH_4 production. This increase in CH_4 production would be roughly one-third the current production.
4. CH_4 production in the western, brackish portion of the wetlands would be lower than CH_4 production in the eastern, more freshwater environment.

The sequestration potential and CH_4 production of freshwater and brackish wetlands were combined to obtain net CO_2e production, as shown in Table 5.9-2. As stated previously, it should be noted that there is a high degree of uncertainty in the results, given the uncertainty in applying literature-based values from different studies of wetlands for carbon sequestration and CH_4 production to the plan area. The following conclusions are illustrated in Table 5.9-2, but should be considered a range of uncertainty for implementation of the SMP alternatives and are inconclusive with regard to the plan's net GHG impact.

1. Carbon benefits from sequestration in a brackish wetland may exceed emissions from CH_4 production. As such, implementation of the plan alternatives in the western portion of the Suisun wetlands could result in a net decrease in GHG emissions.
2. Carbon benefits from sequestration in a freshwater wetland may be overwhelmed by CH_4 production. As such, implementation of the plan alternatives in the eastern portion of the Suisun wetlands could result in a net increase in GHG emissions.

The analysis above shows the wide range of net GHG emissions from implementing Alternative A for wetlands ranging from pure fresh water to highly brackish. However, the plan activities would produce GHG emissions that fall between the high and low ranges. In addition to the broad analysis presented above, a more refined analysis using Suisun area–specific values was prepared to provide a smaller range of potential GHG emissions from the plan alternatives. This analysis was based on the following assumptions:

1. For the low range of CO_2 sequestration values (under the *low* category below), the restored wetlands are assumed to be freshwater, mineral soil wetlands.
2. For the high range of CO_2 sequestration values (under the *high* category below), the restored wetlands are assumed to be the average for tidal wetlands in the conterminous U.S.
3. For the high range of CH_4 emission values (under the *high* category below), the restored wetlands are assumed to be tidal brackish/fresh marsh with an average salinity of 5 ppt (characteristic of the eastern areas of Suisun Marsh).
4. For the low range of CH_4 emission values (under the *low* category below), the restored wetlands are assumed to be tidal brackish marsh with an average salinity of 10 ppt (characteristic of the western areas of Suisun Marsh).

These assumptions result in the low-high range of GHG emissions presented in Table 5.9-2, compared to the wider range of results presented above.

Table 5.9-2. Net Change over Baseline for Yearly Carbon Sequestration Benefits and Methane Production and Net CO_2e[1] Production for Alternative A

	Carbon Sequestration (metric tons CO_2)[1]		**Methane Production (metric tons CO_2e)[1]**		**NET CO_2e Production (metric tons)[1]**	
Scenario/Range[2]	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Freshwater (Yearly)						
Low	390	545	2,380	3,331	9,320	13,048
High	390	545	9,709	13,593	1,990	2,786

Scenario/Range[2]	Carbon Sequestration (metric tons CO_2)[1]		Methane Production (metric tons CO_2e)[1]		NET CO_2e Production (metric tons)[1]	
	Min	Max	Min	Max	Min	Max
Brackish (Yearly)						
Low	1,002	1,402	595	833	1,378	1,929
High	7,141	9,997	2,380	3,331	-6,546	-9,165
Suisun Proxy Range (Yearly)						
Low	390	545	1,933	2,707	1,990	2,786
High	4,081	5,713	2,380	3,331	-2,147	-3,006

Sources: Trulio 2007; Bartlett et al. 1987; U.S. Climate Change Science Program 2007.

Notes: Net CO_2e only includes carbon sequestration and CH_4production because of limited information regarding other GHGs such as N_2O.

[1] Values include acreage for the entire project area. Net CO_2e production represents *low* carbon sequestration plus *high* CH_4 emissions to estimate the widest possible range of GHG emissions.

[2] Values are a range of carbon sequestration and CH_4 production in fresh to saline wetlands. Low values represent the low end of the range of potential carbon sequestration and CH_4 production for fresh and saline wetlands, and high values represent the high end of the range.

The above results suggest that implementation of the proposed project could increase or decrease net GHG emissions related to the Suisun wetlands, depending on the specific location of the restored wetlands (i.e., west versus east). If the restoration occurs more to the east where the salinity of the wetlands is lower, the restored wetlands likely would be a source of GHGs as presented above under the *low* classification. However, if the restoration occurs more to the west where the salinity of the wetlands is higher, the restored wetlands likely would be a sink of GHGs as presented above under the *high* classification. These results are representative of the net annual CO_2e emissions, after the initial 3–4 years required to offset the one-time construction emissions.

Additionally, Choi et al. (2001) found that as sea levels rise, marsh plains continue to build up (accrete), and they continually store carbon in the process. Thus, tidal marshes continue to take carbon from the atmosphere as sea levels rise, as long as there is a large enough input of mineral sediments to build marsh soil and keep pace with sea level rise. Biomass accumulation also can occur without the accretion of mineral soils. Over time, it is expected that the combination of sea level rise and sediment accretion would increase carbon sequestration in the marsh. However, in areas without enough sediment input to keep pace with sea level rise, marshes can break up and be converted to open water (Patrick 1990). Specific research is needed to quantify the precise carbon sequestration capacity and CH_4 production of the Suisun wetlands as well as the sediment fluxes and potential effects of sea level rise on GHG emissions. In addition, the results presented in these studies are likely relevant only up to a certain sea level rise, after which wetlands would be inundated with water and no longer would function as wetlands.

As discussed above, direct emissions of CO_2 are known to be emitted from oxidation of peat soils when those soils are exposed to the atmosphere. For example, research shows that when wetlands are drained, anaerobic soils become exposed to the air, thus releasing stored carbon (Trulio 2007). This process would occur during the periods when the Suisun wetlands are drained. Restoring these areas to permanent marshes would eliminate a majority of peat soil oxidation emissions, resulting in an additional GHG emissions benefit. A number of studies of peat soil subsidence and carbon loss in the Sacramento/San Joaquin Valley region show that carbon losses range from 0.05 gram/cm^2 to 0.15 gram/cm^2 per year (Deverel 2008; Volk 1973; Deverel and Rojstaczer 1996). This range is equivalent to approximately 7.4 to 22.3 metric tons of CO_2 release per acre per year. Another study found that measured subsidence rates in the Delta from 1988 to 2006 range from 0.7 to 3.7 cm/year, and up to 1.7 cm/year in western areas of the Delta, where soil organic matter contents are lower (Deverel 2008).

As noted above, subsidence and peat soil oxidation in the Delta region results mainly from agricultural practices on drained wetlands; such practices are not occurring in Suisun. In addition, oxidation and subsidence rates depend on soil organic content, carbon content, temperature, and other factors. Consequently, subsidence at Suisun Marsh is significantly less than subsidence in other Delta regions. However, subsidence in Suisun was estimated using the lower end of Delta subsidence rates to provide a potential range of oxidation rates for Suisun. The organic soil content affects carbon loss; Suisun Marsh is composed of Joice, Tamba, and Suisun soils (see Section 5.3, Geology and Groundwater), which range 15–60% in organic matter content (National Cooperative Soil Survey 2001). This analysis assumes an average soil organic composition in Suisun Marsh of 40%, based on an average of the three soil types. Assuming a carbon fraction of the organic content of 40%, this range is equivalent to approximately 1.8 to 4.2 metric tons of CO_2 release per acre per year. This range is equivalent to a subsidence rate of approximately 0.7 to 1.5 cm/year and falls within the lower range of estimated subsidence rates in western Delta marshes, representing a conservative estimate of peat soil oxidation.

The Suisun Proxy Range in Table 5.9-3 shows the possible net GHG emissions from implementing Alternative A for Suisun-area specific values. The following assumptions were made:

1. The restored wetlands are assumed to have lowest rates of peat soil oxidation presented above because the Suisun wetland soils vary in organic carbon content and are not currently under agricultural practices.
2. The soil is oxidized continuously when not submerged, and the soil oxidation rate would be reduced by 90% when converted to wetlands.

Table 5.9-3. CO_2 Reductions from Reduced Peat Soil Oxidation as a Result of Project Implementation for Alternative A (Net Change over Baseline)

	CO_2 Reduction (metric tons)[1]	
Scenario/Range[2]	**Min**	**Max**
Suisun Proxy Range (Yearly)		
Low	-2,041	-2,857
High	-4,723	-6,612

Sources: Trulio 2007; Deverel 2008; Deverel and Rojstaczer 1996; National Cooperative Soil Survey 2001.

Notes:

[1] Values include acreage for the entire project area.

[2] Values are a range of carbon sequestration and CH_4 production in fresh to saline wetlands. Low values represent the low end of the range of potential carbon sequestration and CH_4 production for fresh and saline wetlands, and high values represent the high end of the range.

See limitations and discussion of uncertainty in text.

This analysis demonstrates that implementation of SMP alternatives could result in a large reduction in CO_2 emissions, if peat soil oxidation is taken into account. However, these results should be considered estimates based on the best available science because the amount of released carbon depends on the unique biology of the environment and has not been measured specifically for the site.

Regardless of the uncertainty associated with the GHG benefits of Alternative A, restoring tidal wetlands is recommended by the IPCC as an effective method for removing CO_2 from the atmosphere (Intergovernmental Panel on Climate Change 2001). Table 5.9-4 presents the net change over baseline for CO_2e production for Alternative A in comparison to construction and operational emissions using the results from Table 5.9-3 above. As the net change over baseline in CO_2e production likely would fall within this range, a mid value for the net CO_2e change for wetlands also was estimated. Using this mid value, Alternative A would offset one-time construction emissions within about 6–9 years. The net lifetime result of the proposed project is a net sink of CO_2e over existing conditions.

Table 5.9-4. Direct Construction Emissions, Wetland Emissions, and Net Change over Baseline for CO_2e Production for Alternative A (Metric Tons CO_2e)

Emissions Type/Range		
Direct Emissions		
Construction One-Time Emissions (30 Years)		16,295
Management (Yearly)		292.6
Wetland Emissions (Yearly)	**Min**	**Max**
Carbon Sequestration		
Low	-390	-545

Emissions Type/Range		
High	-4,081	-5,713
Methane Production		
Low	1,933	2,707
High	2,380	3,331
Peat Soil Oxidation		
Low	-2,041	-2,857
High	-4,723	-6,612
Net CO_2e Change for Wetlands[1]		
Low	-51	-71
Mid[2]	-2,119	-2,967
High	-6,870	-9,618
NET CO_2e Change (Yearly)[3]		
Low	242	221
Mid[2]	-1,827	-2,675
High	-6,578	-9,326

Notes: Net CO_2e includes only carbon sequestration and CH_4production because of limited information regarding other GHGs such as N_2O.

[1]Represents net CO_2e production; represents *low* carbon sequestration plus *high* CH_4 emissions plus *low* peat soil oxidation to estimate the widest possible range of GHG emissions.

[2] Represents mid range of carbon sequestration and CH_4 production combined with the low range of peat soil oxidation.

[3] Represents the net change from direct emissions from maintenance activities and wetland emissions. Direct emissions from construction were not included in the net CO_2e because these emissions occur on a different time scale. The plan's overall benefit is equivalent to the yearly accumulation of the net CO_2e change minus the one-time construction emissions.

See limitations and discussion of uncertainty in text.

Although the low range of values presented in Table 5.9-4 above for net CO_2e change over baseline resulting from Alternative A are positive, it is likely that the mid values presented for the net CO_2e change would more closely represent actual project conditions. Using this mid value, as stated above, Alternative A would offset one-time construction emissions within about 6–9 years such that the proposed project would result in a net GHG benefit.

Conclusion: Beneficial. No mitigation required.

Alternative B: Restore 2,000–4,000 Acres, and Alternative C: Restore 7,000–9,000 Acres

Alternatives B and C would have the same restoration and managed wetland activities, only over a different acreage of land. Impacts of both alternatives would be similar to Alternative A. However, Alternative B has less restoration and more managed wetland activities, so the potential for carbon sequestration and CH_4 emissions is lower. Alternative C has more restoration, and therefore greater potential for carbon sequestration and CH_4 emissions. It is assumed that construction-related emissions would be similar for all three alternatives as wetlands would be either restored or enhanced, requiring construction equipment and worker vehicles.

The same analysis prepared for Alternative A was prepared for Alternatives B and C. In addition, the same conclusions described for Alternative A can be made for Alternatives B and C. Table 5.9-5 presents the changes in carbon sequestration, CH_4 emissions, and net CO_2e production associated with implementation of Alternatives B and C. Table 5.9-5 also presents the possible net GHG emissions from implementing Alternatives B and C with a more refined analysis using Suisun area–specific values (Suisun Proxy Range). Table 5.9-6 presents the possible net GHG reductions from reduced peat soil oxidation from implementing Alternatives B and C using Suisun area–specific values (Suisun Proxy Range).

It should be noted again that a high degree of uncertainty is associated with these numbers because of the number of sources used in this analysis and limited data on Suisun Marsh characteristics. The conclusions should be considered uncertain and inconclusive, given the uncertainty of using literature-based values from different studies of wetlands for carbon sequestration and CH_4 production. Regardless of the uncertainty associated with the GHG benefits of Alternatives B and C, restoring tidal wetlands is recommended by the IPCC as an effective method for removing CO_2 from the atmosphere (Intergovernmental Panel on Climate Change 2001).

Table 5.9-7 presents the net change over baseline for CO_2e production for Alternatives B and C in comparison to construction and operational emissions using the results from Tables 5.9-5 and 5.9-6 below. Because the net change over baseline in CO_2e production likely would fall within this range, a mid value was estimated to represent the most likely plan conditions. Using this mid value, Alternative B would offset one-time construction emissions within about 12–29 years, and Alternative C would offset one-time construction emissions within about 5–7 years. The net lifetime result of the proposed project is a net sink of CO_2e over existing conditions.

Table 5.9-5. Net Change over Baseline for Yearly Carbon Sequestration Benefits and Methane Production and Net CO_2e Production for Alternatives B and C

	Carbon Sequestration (metric tons CO_2)[1]				Methane Production (metric tons CO_2e)[1]				NET CO_2e Production (metric tons)[1]			
	Alternative B		Alternative C		Alternative B		Alternative B		Alternative B		Alternative B	
Scenario/Range[2]	**Min**	**Max**	**Min**	**Min**	**Min**	**Min**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Freshwater (Yearly)												
Low	156	312	467	701	952	1,904	2,855	4,283	3,728	7,456	11,184	16,776
High	156	312	467	701	3,884	7,768	11,651	17,477	796	1,592	2,388	3,582
Brackish (Yearly)												
Low	401	801	1,202	1,803	238	476	714	1,071	551	1,102	1,654	2,480
High	2,856	5,713	8,569	12,854	952	1,904	2,855	4,283	-2,618	-5,237	-7,855	-11,783
Suisun Proxy Range (Yearly)												
Low	156	312	467	701	773	1,547	2,320	3,480	796	1,592	2,388	3,582
High	1,632	3,264	4,897	7,345	952	1,904	2,855	4,283	-859	-1,718	-2,577	-3,865

Sources: Trulio 2007; Bartlett et al. 1987; U.S. Climate Change Science Program 2007.

Notes: Net CO_2e includes only carbon sequestration and CH_4production because of limited information regarding other GHGs such as N_2O.

[1] Values include acreage for the entire project area. Net CO_2e production represents *low* carbon sequestration plus *high* CH_4 emissions to estimate the widest possible range of GHG emissions.

[2] Values are a range of carbon sequestration and CH_4 production in fresh to saline wetlands. Low values represent the low end of the range of potential carbon sequestration and CH_4 production for fresh and saline wetlands, and high values represent the high end of the range.

Table 5.9-6. CO_2 Reductions from Reduced Peat Soil Oxidation as a Result of Plan Implementation for Alternatives B and C (Net Change over Baseline)

	CO_2 Production (metric tons)[1]			
	Alternative B		**Alternative C**	
Scenario/Range[2]	**Min**	**Max**	**Min**	**Max**
Suisun Proxy (Yearly)				
Low	-816	-1,633	-2,449	-3,674
High	-1,889	-3,778	-5,668	-8,501

Sources: Trulio 2007; Deverel 2008; Deverel and Rojstaczer 1996; National Cooperative Soil Survey 2001.

Notes: Net CO_2e includes only carbon sequestration and CH_4production because of limited information regarding other GHGs such as N_2O.

[1] Values include acreage for the entire project area.

[2] Values are a range of carbon sequestration and CH_4 production in fresh to saline wetlands. Low values represent the low end of the range of potential carbon sequestration and CH_4 production for fresh and saline wetlands, and high values represent the high end of the range.

Table 5.9-7. Direct Construction Emissions, Wetland Emissions, and Net Change over Baseline for CO_2e Production for Alternatives B and C (Metric Tons CO_2e)

Emissions Type/Range	**Alternative B**		**Alternative C**	
Direct Emissions				
Construction One-Time Emission (30 years)	16,295		16,295	
Management (Yearly)	292.6		292.6	
Wetland Emissions (yearly)	**Min**	**Max**	**Min**	**Max**
Carbon Sequestration				
Low	-156	-312	-467	-701
High	-1,632	-3,264	-4,897	-7,345
Methane Production				
Low	773	1,547	2,320	3,480
High	952	1,904	2,855	4,283
Peat Soil Oxidation				
Low	-816	-1,633	-2,449	-3,674
High	-1,889	-3,778	-5,668	-8,501
Net CO_2e Change for Wetlands[1]				
Low	-20	-41	-61	-92
Mid[2]	-848	-1,696	-2,543	-3,815
High	-2,748	-5,496	-8,244	-12,366

Emissions Type/Range	Alternative B		Alternative C	
NET CO_2e Change (Yearly)[3]	Min	Max	Min	Max
Low	272	252	232	201
Mid[2]	-555	-1,403	-2,251	-3,522
High	-2,455	-5,204	-7,952	-12,074

Notes: Net CO_2e includes only carbon sequestration and CH_4production because of limited information regarding other GHGs such as N_2O.

[1]Represents net CO_2e production; represents *low* carbon sequestration plus *high* CH_4 emissions plus *low* peat soil oxidation to estimate the widest possible range of GHG emissions.

[2] Represents mid range of carbon sequestration and CH_4 production combined with the low range of peat soil oxidation.

[3] Represents the net change from direct emissions from maintenance activities and wetland emissions. Direct emissions from construction were not included in the net CO_2e because these emissions occur on a different time scale. The plan's overall benefit is equivalent to the yearly accumulation of the net CO_2e change minus the one-time construction emissions.

See limitations and discussion of uncertainty in text.

Although the low range of values presented in Table 5.9-7 above for net CO_2e change over baseline resulting from Alternative A are positive, it is likely that the mid values presented for the net CO_2e change would more closely represent actual project conditions. Using this mid value, as stated above, Alternative B would offset one-time construction emissions within about 12–24 years, and Alternative C would offset one-time construction emissions within about 5–7 years, such that the proposed project would result in a net GHG benefit.

Conclusion: Beneficial. No mitigation required.

Environmental Impacts in the Context of Climate Change

No Action Alternative

Impact CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated with Sea Level Rise

Global climate change has resulted and will continue to result in global mean sea level rise. Local mean sea level rise predictions for San Francisco Bay include up to 16 inches by 2050 and up to 55 inches by 2099 (San Francisco Bay Conservation and Development Commission 2009b). In addition, global sea level rise predictions include up to 78.7 inches by 2100 (Allison et al. 2009). The largest 2009 high-tide differential documented within Suisun Bay is 1.7 inches (National Oceanic and Atmospheric Administration 2009). Thus, sea level rise for the Suisun Bay area would equate to up to 17.7 inches at high tide in 2050 and up to 80.4 inches at high tide in 2099.

Under the No Action Alternative, major restoration would not occur in Suisun Marsh, and managed wetland activities would be substantially limited or suspended. As a result, levee integrity would continue to degrade. As the No Action Alternative would not result in levee improvements to protect against flood events, this analysis conservatively assumes that the existing, degraded levees would fail under the water force associated with predicted sea level rise. Based on the aforementioned sea level rise predictions and assuming the absence (because of failure) of existing levees and other shoreline protection, Suisun Marsh (including the sloping wetland/upland transition zone surfaces that would typically allow tidal wetland to shift upslope when floodwaters rise) would be inundated by the year 2050. Only the Potrero Hills and Kirby Hill areas of Suisun Marsh would not be inundated, because of their higher elevations.

The flood vulnerability of this area as a result of sea level rise and substandard levees is compounded by ongoing subsidence, the El Niño–Southern Oscillation effect, higher winter flows, and greater than 1-year tide or tributary flood events. The aforementioned BCDC local mean sea level rise predictions for San Francisco Bay, which are based on DWR 2006 to 2007 elevation data, do not take into account ongoing subsidence (Parris 2009). There is an ongoing 1 to 3 inches per year of subsidence in the region (U.S. Geological Survey 2000). However, it should be noted that if the levees fail in 2050 as predicted above, subsidence would cease. Based on this range of annual subsidence, relative sea level rise, which considers sea level rise and tidal and subsidence factors, in the Suisun Bay portion of the Bay-Delta is anticipated to be up to 140.7 inches (11.73 feet) at high tide in 2050 and up to 353.4 inches (29.45 feet) at high tide in 2099. El Niño–Southern Oscillation is a large, regional ocean current that moves water from one side of the Pacific to the other every 3 or 4 years, and during El Niño years warm water is pushed over to the eastern Pacific (and thus Suisun Bay), resulting in the ocean being up to 24 inches higher there. Thus, during El Niño years, relative sea level rise in the Suisun Bay portion of the Bay-Delta is anticipated to be up to 164.7 inches (13.73 feet) at high tide in 2050 and up to 377.4 inches (31.45 feet) at high tide in 2099. In addition, the anticipated 50% loss of the Sierra snowpack would lead to earlier runoff and increased winter storm peaks, resulting in temporary surges in Delta (and thus Suisun Bay) water volume even farther above this anticipated relative sea level rise (Knowles and Cayan 2002). Finally, the BCDC local mean sea level rise predictions for San Francisco Bay do not take into account greater than 1-year tide events[6] stacking on top of Bay water levels (Parris 2009). Thus, not only is the Suisun Marsh area susceptible to inundation as a result of large storm events, but under the No Project Alternative the Marsh also likely would become consistently inundated from the combined effect of increased sea level rise, levee degradation, subsidence, and loss of Sierra snowpack. This conclusion that coastal habitats,

[6] Refers to the level of high tide with a 100% chance (1 in 1) of occurring any 1 year. Does not account for the more extreme high tide events that are expected to occur on a more regular basis in the future as a result of rising sea levels. For example, these more extreme high tide events could occur10 or more times per year by 2050 instead of just once or twice per year.

such as wetlands, can become permanently inundated with water and eroded if sea level rises faster than these ecosystems can move inland is also reached in the California Climate Action Team 2009 report (the 2009 California Climate Adaptation Strategy) to Governor Schwarzenegger (California Climate Action Team 2009).

As previously mentioned, sea level rise associated with climate change could overwhelm levees to the point of breach, resulting in Marsh inundation. In addition, because Suisun Marsh primarily is surrounded by urban development and areas of greater elevation (specifically, the Montezuma Hills on the east, Suisun City and Travis Air Force Base on the north, and Benicia Hills on the west), there are no adequate areas for Suisun Marsh to retreat to if it were inundated. Thus, Marsh inundation would result in erosion and loss of wetland habitat, changing sediment demand, altered species composition, changing freshwater inflow and salinity, altered food web, and impaired water quality, all of which may overwhelm the system’s ability to rebound and continue functioning (San Francisco Bay Conservation and Development Commission 2009a). Thus, Suisun Marsh habitat and ecosystem health would be adversely affected by climate change–induced sea level rise. Moreover, this loss of wetlands would increase the risk of shoreline flooding in the Suisun Bay area.

Alternative A, Proposed Project: Restore 5,000–7,000 Acres

Impact CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated with Sea Level Rise

Within 30-Year Planning Horizon

Because Alternative A includes restoring 5,000 to 7,000 acres in Suisun Marsh to fully functioning, self-sustaining tidal wetland and improving the levee stability and flood and drain capabilities of the remaining 44,000 to 46,000 acres of managed wetland areas, this analysis assumes that, for at least 30 years, the improved levees would hold under the water force associated with predicted sea level rise. Based on the fact that sea level rise associated with climate change would be addressed throughout implementation of the SMP, sustainable vegetated tidal marshes are expected to develop in some of the tidally restored ponds within the plan’s 30-year planning horizon.

As described under the No Action Alternative analysis, the flood vulnerability of this area as a result of sea level rise is compounded by ongoing subsidence, the El Niño-Southern Oscillation effect, and higher winter flows. Thus, the Suisun Marsh area is susceptible to inundation as a result of 100-year storm events, but under Alternative A, the Marsh would not likely become consistently inundated because of the proposed levee improvements and the ability of the tidally restored wetlands still to accrete sediment and eventually support vegetated tidal marsh, even if at a slower rate. In addition, under the proposed project, gradually sloping wetland/upland transition zone surfaces would provide an elevation gradient over which tidal wetland could shift upslope when floodwaters rise.

As a result, the system's ability to continue functioning and thrive would increase (San Francisco Bay Conservation and Development Commission 2009a). Thus, Suisun Marsh habitat and ecosystem health would not be adversely affected by climate change–induced sea level rise. Moreover, this restoration of wetland function would decrease the risk of shoreline flooding in the Suisun Bay area.

Alternative A would help maintain and restore natural wetland processes that enhance ecosystem function and protect marsh biodiversity. This would increase the capacity of Suisun Marsh to deal with uncertainty regarding climate change, and reduce stress on species resulting from events associated with climate change (i.e., increased sedimentation from flooding events). Alternative A therefore has the potential to increase the Marsh's ability to adapt to changes induced by climate change (i.e., by reducing subsidence, increasing biomass accumulation, and allowing natural tidal marsh functions to resume, etc.). Refer to the *Plan Response to Predicted Sea-Level Rise* section of Chapter 2 for more discussion regarding restoration efforts associated with Alternative A that support achieving long-term ecological functions and reduce impacts associated with climate change.

Within the 30-year planning horizon, the proposed project would result in a beneficial impact compared to the No Action Alternative related to loss of wetland habitat, ecosystem health, and flood risk associated with climate change–induced sea level rise.

Conclusion: Beneficial Impact. No mitigation required.

Beyond 30-Year Planning Horizon

The proposed project would result in some levee improvements, but beyond the 30-year planning horizon the improved levees could fail under the water force associated with predicted sea level rise. Based on the sea level rise predictions described under the No Action Alternative analysis and assuming the absence (because of failure) of existing levees and other shoreline protection, Suisun Marsh would be inundated by the year 2050. Only the Potrero Hills and Kirby Hill areas of Suisun Marsh would not be inundated, because of their higher elevations.

As described under the No Action Alternative analysis, the flood vulnerability of this area as a result of sea level rise and substandard levees is compounded by ongoing subsidence, the El Niño-Southern Oscillation effect, and higher winter flows. Thus, the Suisun Marsh area is not only susceptible to inundation as a result of 100-year storm events, but under Alternative A, the Marsh (including the sloping wetland/upland transition zone surfaces that would typically allow tidal wetland to shift upslope when floodwaters rise) likely would become consistently inundated from the combined effect of increased sea level rise, levee degradation, subsidence, and loss of Sierra snowpack. This outcome is likely even though some wetland restoration would occur, some new exterior levees would be built, and some levees would be maintained with dredging material, because there is not enough material authorized in the dredging program to improve all levees in the Marsh.

As a result, beyond the 30-year planning horizon, sea level rise associated with climate change could overwhelm levees to the point of breach, resulting in Marsh inundation. In addition, because Suisun Marsh primarily is surrounded by urban development and areas of greater elevation (specifically, the Montezuma Hills on the east, Suisun City and Travis Air Force Base on the north, and Benicia Hills on the west), there are no adequate areas for Suisun Marsh to retreat to if it were inundated. Thus, Marsh inundation would result in erosion and loss of wetland habitat, changing sediment demand, altered species composition, changing freshwater inflow and salinity, altered food web, and impaired water quality, all of which may overwhelm the system's ability to rebound and continue functioning (San Francisco Bay Conservation and Development Commission 2009a). Thus, Suisun Marsh habitat and ecosystem health would be adversely affected by climate change–induced sea level rise. Moreover, this loss of wetlands would increase the risk of shoreline flooding in the Suisun Bay area.

Alternative B: Restore 2,000–4,000 Acres, and Alternative C: Restore 7,000–9,000 Acres

Impact CC-3: Degradation of Wetland Habitat and Ecosystem Health as a Result of Inundation Associated with Sea Level Rise

Within 30-Year Planning Horizon

Alternatives B and C would have the same restoration and managed wetland activities, only over a different acreage of land. However, Alternative B has less restoration and more levee stability improvements, so the potential for habitat loss and degradation of ecosystem health associated with climate change–induced sea level rise would be lower. Thus, within the 30-year planning horizon, Alternatives B and C would result in a beneficial impact compared to the No Action Alternative related to loss of wetland habitat, ecosystem health, and flood risk associated with climate change–induced sea level rise, and with the incorporation of measures to improve levees to withstand sea level rise, this impact would be beneficial.

Conclusion: Beneficial Impact. No mitigation required.

Beyond 30-Year Planning Horizon

Alternatives B and C would have the same restoration and managed wetland activities, only over a different acreage of land. Alternatives B and C would result in some levee improvements (B more than C), but beyond the 30-year planning horizon the improved levees could fail under the water force associated with predicted sea level rise. Based on the sea level rise predictions described under the No Action Alternative analysis and assuming the absence (because of failure) of existing levees and other shoreline protection, Suisun Marsh would be inundated by the year 2050. This is likely even though some new exterior levees would be designed to protect against sea level rise and the dredging program would provide source materials for levee maintenance, because there is not enough material authorized in the dredging program to improve all levees in the Marsh.

Appendix B

Emission Calculations Spreadsheets

Appendix B. Tug Emissions Calculations

Based on Puget Sound methodology

Emissions (g/year)=kW*Activity (hours/year)*load factor*Emission Factor (g/kW-hr)*fuel correction factor

Avg Tug HP	86
kW=HP/1.341	64.13124534
Activity (90 days, 10 hours day)	900
load factor for tugs	0.31
fuel correction factor	1
grams to pounds	0.002204623

Emission Factor			grams/year	grams/day	pounds/day
ROG	0.27		4831.006711	53.68	0.12
NOx	11		196818.7919	2186.88	4.82
CO	2		35785.2349	397.61	0.88
PM	0.9		16103.3557	178.93	0.39
CO2	690		12345906.04	137176.73	302.42

Source: Starcrest Consulting Group, 2007. Puget Sound Maritime Air Emissions Inventory. Prepared April 2007.

Finding PM 10 and PM2.5

Offroad Equipment	PM2.5 fraction of total PM	0.92	0.36
	PM10 fraction of total PM	1	0.39

Source: SCAQMD Final Methodology to Calculate Particulate Matter (PM)2.5 and PM2.5 Significance Thresholds. October 2006.

Appendix C

USFWS Special-Status Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

August 25, 2010

Document Number: 100825030324

Harry Oakes
ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Subject: Species List for Suisun Marsh Habitat Management, Preservation, and Restoration Plan

Dear: Interested party

We are sending this official species list in response to your August 25, 2010 request for information about endangered and threatened species. The list covers the California counties and/or U.S. Geological Survey 7½ minute quad or quads you requested.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

Please read Important Information About Your Species List (below). It explains how we made the list and describes your responsibilities under the Endangered Species Act.

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be November 23, 2010.

Please contact us if your project may affect endangered or threatened species or if you have any questions about the attached list or your responsibilities under the Endangered Species Act. A list of Endangered Species Program contacts can be found at www.fws.gov/sacramento/es/branches.htm.

Endangered Species Division

TAKE PRIDE IN AMERICA

U.S. Fish & Wildlife Service
Sacramento Fish & Wildlife Office
Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 100825030324

Database Last Updated: April 29, 2010

Quad Lists

BIRDS LANDING (481A)
Listed Species

Invertebrates

Branchinecta conservatio
- Conservancy fairy shrimp (E)

Branchinecta lynchi
- vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
- valley elderberry longhorn beetle (T)

Elaphrus viridis
- Critical habitat, delta green ground beetle (X)
- delta green ground beetle (T)

Lepidurus packardi
- vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus
- Critical habitat, delta smelt (X)
- delta smelt (T)

Oncorhynchus mykiss
- Central Valley steelhead (T) (NMFS)

Oncorhynchus tshawytscha
- Central Valley spring-run chinook salmon (T) (NMFS)
- winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
- California tiger salamander, central population (T)
- Critical habitat, CA tiger salamander, central population (X)

Rana draytonii
- California red-legged frog (T)

Reptiles

Thamnophis gigas
- giant garter snake (T)

Birds

Rallus longirostris obsoletus

California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni

California least tern (E)

Mammals

Reithrodontomys raviventris

salt marsh harvest mouse (E)

Plants

Sidalcea keckii

Keck's checker-mallow (=checkerbloom) (E)

DENVERTON (481B)

Listed Species

Invertebrates

Branchinecta conservatio

Conservancy fairy shrimp (E)

Critical habitat, Conservancy fairy shrimp (X)

Branchinecta lynchi

Critical habitat, vernal pool fairy shrimp (X)

vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus

valley elderberry longhorn beetle (T)

Elaphrus viridis

Critical habitat, delta green ground beetle (X)

delta green ground beetle (T)

Lepidurus packardi

Critical habitat, vernal pool tadpole shrimp (X)

vernal pool tadpole shrimp (E)

Fish

Acipenser medirostris

green sturgeon (T) (NMFS)

Hypomesus transpacificus

Critical habitat, delta smelt (X)

delta smelt (T)

Oncorhynchus mykiss

Central Valley steelhead (T) (NMFS)

Oncorhynchus tshawytscha

Central Valley spring-run chinook salmon (T) (NMFS)

winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense

California tiger salamander, central population (T)

Rana draytonii

California red-legged frog (T)

Reptiles

Thamnophis gigas

giant garter snake (T)

Birds

Rallus longirostris obsoletus

California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni

California least tern (E)

Mammals

Reithrodontomys raviventris

salt marsh harvest mouse (E)

Plants

Cirsium hydrophilum var. hydrophilum

Suisun thistle (E)

Cordylanthus mollis ssp. mollis

soft bird's-beak (E)

Lasthenia conjugens

Contra Costa goldfields (E)

Critical habitat, Contra Costa goldfields (X)

Proposed Species

Plants

Cirsium hydrophilum var. hydrophilum

Critical habitat, Suisun thistle (PX)

Cordylanthus mollis ssp. mollis

Critical habitat, soft bird's-beak (PX)

HONKER BAY (481C)

Listed Species

Invertebrates

Branchinecta lynchi

vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus

valley elderberry longhorn beetle (T)

Elaphrus viridis

delta green ground beetle (T)

Fish

Acipenser medirostris

green sturgeon (T) (NMFS)

Hypomesus transpacificus

Critical habitat, delta smelt (X)

delta smelt (T)

Oncorhynchus mykiss

Central Valley steelhead (T) (NMFS)

Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha

Central Valley spring-run chinook salmon (T) (NMFS)

Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
California tiger salamander, central population (T)

Rana draytonii
California red-legged frog (T)

Reptiles

Masticophis lateralis euryxanthus
Alameda whipsnake [=striped racer] (T)

Thamnophis gigas
giant garter snake (T)

Birds

Rallus longirostris obsoletus
California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni
California least tern (E)

Mammals

Reithrodontomys raviventris
salt marsh harvest mouse (E)

Plants

Cordylanthus mollis ssp. mollis
soft bird's-beak (E)

Oenothera deltoides ssp. howellii
Antioch Dunes evening-primrose (E)

Proposed Species

Amphibians

Rana draytonii
Critical habitat, California red-legged frog (PX)

ANTIOCH NORTH (481D)
Listed Species

Invertebrates

Apodemia mormo langei
Lange's metalmark butterfly (E)

Branchinecta lynchi
vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

Elaphrus viridis
delta green ground beetle (T)

Lepidurus packardi
vernal pool tadpole shrimp (E)

Fish

Acipenser medirostris
green sturgeon (T) (NMFS)

Hypomesus transpacificus
Critical habitat, delta smelt (X)
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
California tiger salamander, central population (T)

Rana draytonii
California red-legged frog (T)

Reptiles

Thamnophis gigas
giant garter snake (T)

Birds

Rallus longirostris obsoletus
California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni
California least tern (E)

Mammals

Reithrodontomys raviventris
salt marsh harvest mouse (E)

Vulpes macrotis mutica
San Joaquin kit fox (E)

Plants

Cordylanthus mollis ssp. mollis
soft bird's-beak (E)

Erysimum capitatum ssp. angustatum
Contra Costa wallflower (E)
Critical Habitat, Contra Costa wallflower (X)

Lasthenia conjugens
Contra Costa goldfields (E)

Neostapfia colusana
Colusa grass (T)

Oenothera deltoides ssp. howellii
Antioch Dunes evening-primrose (E)
Critical habitat, Antioch Dunes evening-primrose (X)

Sidalcea keckii

Keck's checker-mallow (=checkerbloom) (E)

FAIRFIELD SOUTH (482A)
Listed Species

Invertebrates

Branchinecta conservatio
Conservancy fairy shrimp (E)

Branchinecta lynchi
Critical habitat, vernal pool fairy shrimp (X)
vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

Elaphrus viridis
delta green ground beetle (T)

Lepidurus packardi
Critical habitat, vernal pool tadpole shrimp (X)

Speyeria callippe callippe
callippe silverspot butterfly (E)

Syncaris pacifica
California freshwater shrimp (E)

Fish

Acipenser medirostris
green sturgeon (T) (NMFS)

Hypomesus transpacificus
Critical habitat, delta smelt (X)
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
California tiger salamander, central population (T)

Rana draytonii
California red-legged frog (T)
Critical habitat, California red-legged frog (X)

Reptiles

Thamnophis gigas
giant garter snake (T)

Birds

Pelecanus occidentalis californicus
California brown pelican (E)

Rallus longirostris obsoletus

California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni

California least tern (E)

Mammals

Reithrodontomys raviventris

salt marsh harvest mouse (E)

Plants

Cirsium hydrophilum var. hydrophilum

Suisun thistle (E)

Cordylanthus mollis ssp. mollis

soft bird's-beak (E)

Lasthenia conjugens

Contra Costa goldfields (E)

Critical habitat, Contra Costa goldfields (X)

Proposed Species

Amphibians

Rana draytonii

Critical habitat, California red-legged frog (PX)

Plants

Cirsium hydrophilum var. hydrophilum

Critical habitat, Suisun thistle (PX)

Cordylanthus mollis ssp. mollis

Critical habitat, soft bird's-beak (PX)

VINE HILL (482D)

Listed Species

Invertebrates

Branchinecta lynchi

vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus

valley elderberry longhorn beetle (T)

Elaphrus viridis

delta green ground beetle (T)

Speyeria callippe callippe

callippe silverspot butterfly (E)

Syncaris pacifica

California freshwater shrimp (E)

Fish

Acipenser medirostris

green sturgeon (T) (NMFS)

Hypomesus transpacificus

Critical habitat, delta smelt (X)

delta smelt (T)

Oncorhynchus mykiss

Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha

Central Valley spring-run chinook salmon (T) (NMFS)
Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense

California tiger salamander, central population (T)

Rana draytonii

California red-legged frog (T)
Critical habitat, California red-legged frog (X)

Reptiles

Masticophis lateralis euryxanthus

Alameda whipsnake [=striped racer] (T)

Thamnophis gigas

giant garter snake (T)

Birds

Rallus longirostris obsoletus

California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni

California least tern (E)

Mammals

Reithrodontomys raviventris

salt marsh harvest mouse (E)

Plants

Cordylanthus mollis ssp. mollis

soft bird's-beak (E)

Proposed Species

Amphibians

Rana draytonii

Critical habitat, California red-legged frog (PX)

County Lists

No county species lists requested.

Key:

(E) *Endangered* - Listed as being in danger of extinction.

(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.

Critical Habitat - Area essential to the conservation of a species.

(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.

(C) *Candidate* - Candidate to become a proposed species.

(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.

(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. More info

Wetlands

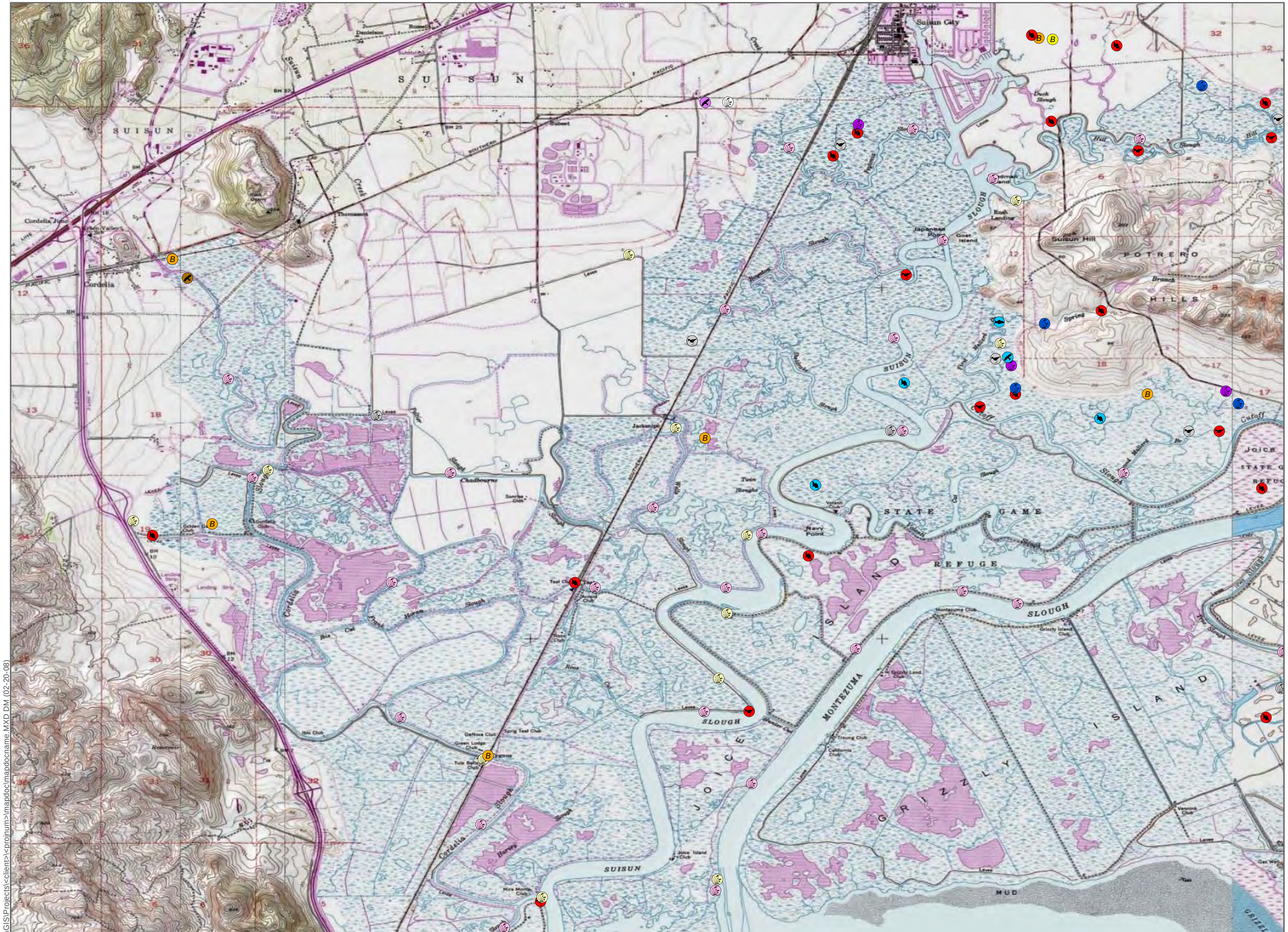
If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6580.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be November 23, 2010.

Appendix D

California Natural Diversity Database Occurrences of Special-Status Plant and Wildlife Species in Suisun Marsh



Appendix G
CNDDB Occurrences of Special-Status Plant and Wildlife Species in Suisun Marsh
Region1

Legend

- alkali milk-vetch
- burrowing owl
- California black rail
- California clapper rail
- California least tern
- Delta mudwort
- Delta tule pea
- Mason's lilaeopsis
- northern harrier
- Sacramento splittail
- salt-marsh harvest mouse
- saltmarsh common yellowthroat
- short-eared owl
- soft bird's-beak
- Suisun Marsh aster
- Suisun shrew
- Suisun song sparrow
- Suisun thistle
- Swainson's hawk
- tricolored blackbird
- western pond turtle

N

0 0.5 1 Miles

ICF Jones & Stokes
an ICF International Company

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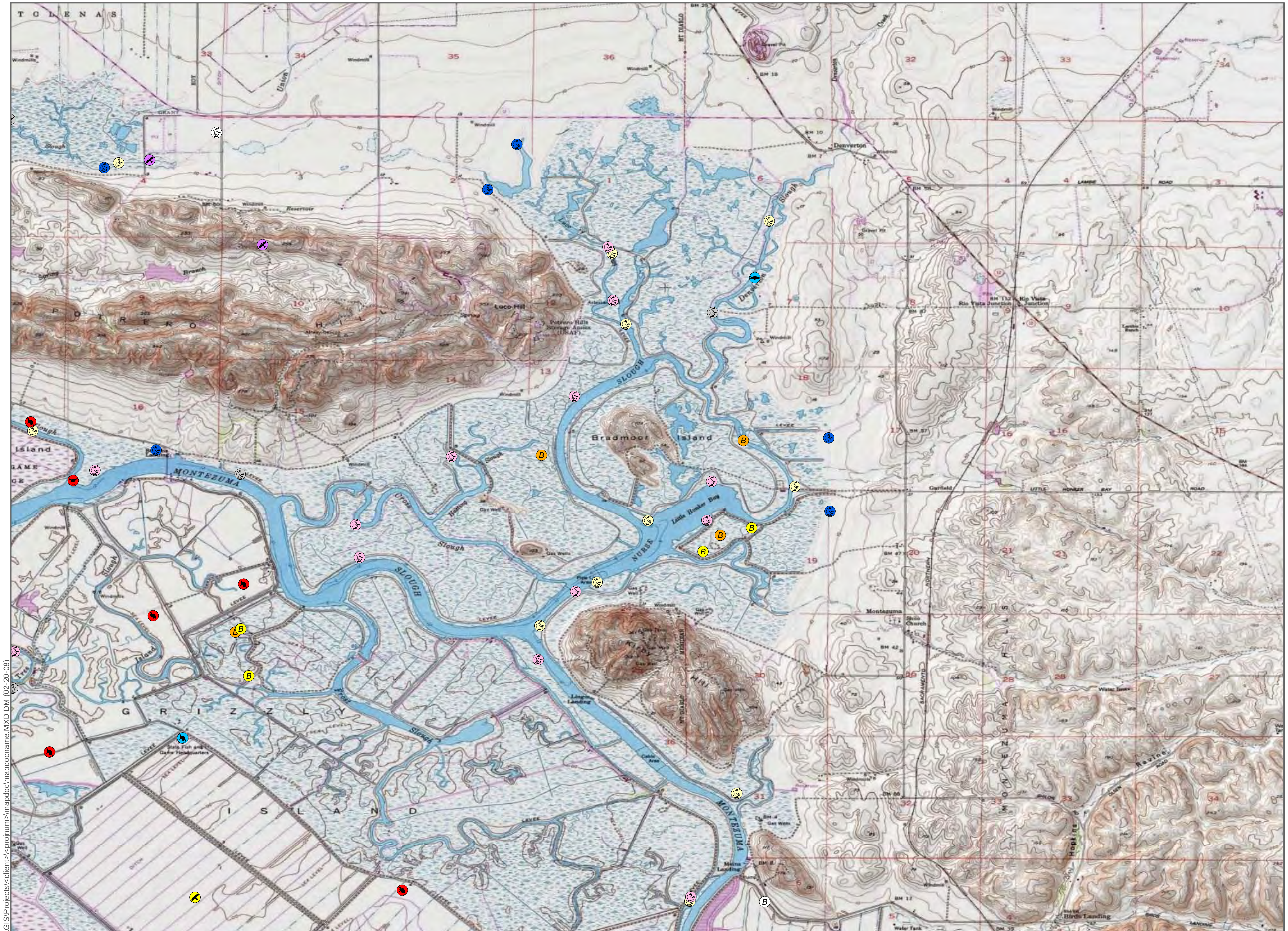

Appendix G
CNDDB Occurrences of Special-Status Plant and Wildlife Species in Suisun Marsh
Region 2

Legend

- alkali milk-vetch
- burrowing owl
- California black rail
- California clapper rail
- California least tern
- Delta mudwort
- Delta tule pea
- Mason's lilaeopsis
- northern harrier
- Sacramento splittail
- salt-marsh harvest mouse
- saltmarsh common yellowthroat
- short-eared owl
- soft bird's-beak
- Suisun Marsh aster
- Suisun shrew
- Suisun song sparrow
- Suisun thistle
- Swainson's hawk
- tricolored blackbird
- western pond turtle

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Appendix G
CNDDB Occurrences of Special-Status Plant and Wildlife Species in Suisun Marsh Region 3

Legend

- alkali milk-vetch
- burrowing owl
- California black rail
- California clapper rail
- California least tern
- Delta mudwort
- Delta tule pea
- Mason's lilaeopsis
- northern harrier
- Sacramento splittail
- salt-marsh harvest mouse
- saltmarsh common yellowthroat
- short-eared owl
- soft bird's-beak
- Suisun Marsh aster
- Suisun shrew
- Suisun song sparrow
- Suisun thistle
- Swainson's hawk
- tricolored blackbird
- western pond turtle

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ICF Jones & Stokes
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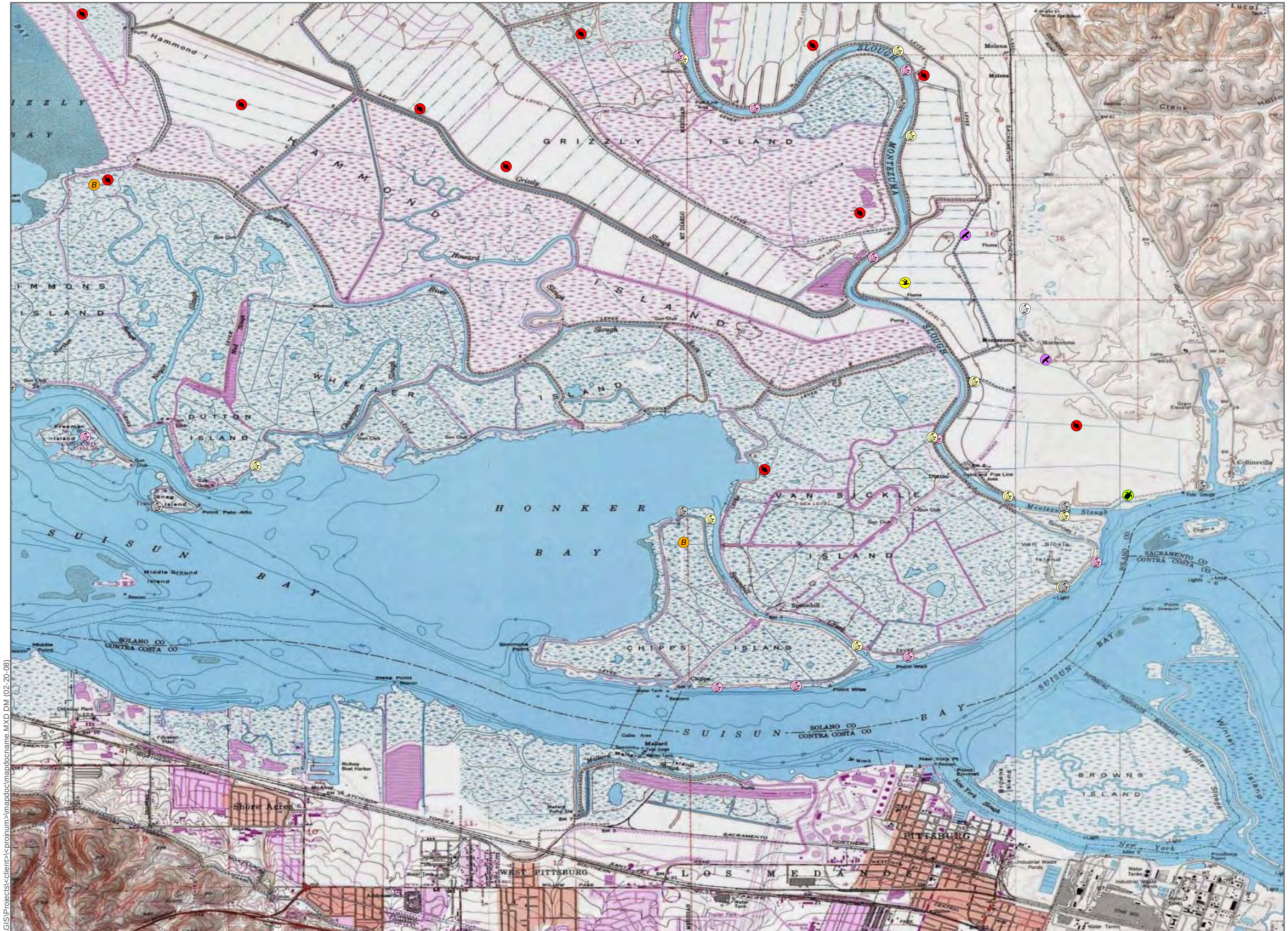
Appendix G
CNDDB Occurrences of Special-Status Plant and Wildlife Species in Suisun Marsh
Region 4



Legend

- alkali milk-vetch
- burrowing owl
- California black rail
- California clapper rail
- California least tern
- Delta mudwort
- Delta tule pea
- Mason's lilaeopsis
- northern harrier
- Sacramento splittail
- salt-marsh harvest mouse
- saltmarsh common yellowthroat
- short-eared owl
- soft bird's-beak
- Suisun Marsh aster
- Suisun shrew
- Suisun song sparrow
- Suisun thistle
- Swainson's hawk
- tricolored blackbird
- western pond turtle

N

0 0.5 1 Miles

ICF Jones & Stokes
an ICF International Company

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Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Air Quality Best Management Practices and Mitigation Measures				
A.1 Air Quality Best Management Practices: Enhanced Control Measures and Additional Air Quality Best Management Practices The following control practices will be used to offset any air quality issues that may arise. i. Hydroseed with native or noninvasive species appropriate to that specific location or apply (nontoxic) soil stabilizers to inactive construction areas (previously graded areas inactive for 10 days or more).	During construction		X	
ii. Limit traffic speeds on unpaved roads to 15 mph.			X	
iii. Install sandbags or other erosion control measures to prevent silt runoff to public roadways.			X	
iv. Replant vegetation with native or noninvasive species appropriate to that specific location in disturbed areas as quickly as possible.			X	
v. Maintain properly tuned engines.			X	
vi. Minimize the idling time of diesel-powered construction equipment to 2 minutes.			X	
vii. Use alternative-powered (e.g., hybrid, compressed natural gas, biodiesel, electric) construction equipment.			X	
viii. Use add-on control devices such as diesel oxidation catalysts or particulate filters.			X	
ix. All scrapers, dozers, and excavators (e.g., the high horsepower equipment) used during Phase 2 would have a Tier 3 engine or greater			X	
All scrapers, dozers, and excavators (e.g., the high horsepower equipment) used during Phase 1 would have a Tier 3 engine or greater			X	
A.2 Air Quality Best Management Practices: Require all contractors to use equipment that meets California Air Resources Board’s most recent certification standard for off-road heavy-duty diesel engines.	During construction	X	X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
A.3 Reduce Construction NOX Emissions: Construction activity will be limited so that construction emissions do not exceed the BAAQMD's construction threshold for NO_X. Such measures include, but are not limited to, implementing off road equipment mitigation, including installing 1st tier diesel particulate filters (DPFs), and installing diesel oxidation catalysts to reduce NOx emissions by 40%.	During construction		X	
A.4 Implement All Appropriate BAAQMD Mitigation Measures: The following BAAQMD standard mitigation measures will be implemented where appropriate and feasible. These measures include: 1. Cover all haul trucks transporting soil, sand, or other loose material off-site.	During construction		X	
2. Remove all visible mud or dirt track-out onto adjacent public roads.	During construction		X	
3. Minimize idling times either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.	During construction		X	
4. Maintain all construction equipment in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.	During construction		X	
5. Post a publicly visible sign with the telephone number and person to contact regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations	During construction	X		
A.5 Limit Restoration and Management Activity: The overlap of restoration and management activities will be limited to the extent feasible and the equipment being used for restoration and management activities will not exceed the equipment described in Tables 3-4a-d of Chapter 3 of the Tule Red Addendum and 5.7-10 of the SMP EIS/EIR. This will ensure that construction emissions do not exceed the draft BAAQMD threshold for NOx	During construction		X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Standard Design Features and Construction Practices				
B.1 Stop work immediately if a conflict with a utility facility occurs and contacting the affected utility to (1) notify it of the conflict, (2) aid in coordinating repairs to the utility, and (3) coordinate to avoid additional conflicts in the field.	During construction		X	
B.2 Implement BMPs to minimize any disease-carrying mosquitoes and threats to public health if it is found that project components pose a threat to public health	During construction/		X	
	Post construction	X		
B.3 Control construction equipment access and placement of fill to maintain acceptable loading based on the shear strength of the foundation material.	During construction	??	X	
B.4 Minimize degradation of wetland habitats where feasible by minimizing the disturbance footprint.	During construction	??	X	
B.5 Implement BMPs and minimization measures to minimize water quality impacts such as temporary turbidity increases. See Erosion and Sediment Control Plan below.	During construction		X	
B.6 Inspect all equipment for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks will not be used within 100 feet of wetlands.	During construction		X	
B.7 Require the construction contractor to remove all trash and construction debris after construction and to implement a revegetation plan for temporarily disturbed vegetation in the construction zones.	During construction		X	
	Post construction	X		
B.8 Maintain waste facilities. Waste facilities include concrete wash-out facilities, chemical toilets, and hydraulic fluid containers. Waste will be removed to a proper disposal site.	During construction		X	
Access Point/Staging Areas				
C.1 Establish staging areas for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with resource agencies.	Prior to construction	X		
	During construction		X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
C.2 Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in which case the maximum setback possible will be used.	Prior to construction	X		
If an off-road site is chosen, qualified biological and cultural resources personnel will survey the selected site to verify that no sensitive resources would be disturbed by staging activities. If sensitive resources are found, an appropriate buffer zone will be staked and flagged to avoid impacts. If impacts on sensitive resources cannot be avoided, the site will not be used. An alternate site will be selected.	During construction		X	
C.3 Where possible, no equipment refueling or fuel storage will take place within 100 feet of a body of water. Vehicle traffic will be confined to existing roads and the proposed access route. Ingress and egress points will be clearly identified in the field using orange construction fence. Work will not be conducted outside the designated work area.	During construction		X	
Erosion and Sediment Control Plan				
D.1 Prepare and implement an erosion and sediment control plan to control short-term and long-term erosion and sedimentation effects and to restore soils and vegetation in areas affected by construction activities. The plan will include all the necessary local jurisdiction requirements regarding erosion control and will implement BMPs for erosion and sediment control as required.	Prior to construction/	X		
	During construction		X	
D.2 Develop an erosion control plan to ensure that during rain events construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion control materials (baffles, fiber rolls, or hay bales; temporary containment berms) and erosion control measures such as straw application or hydroseeding with native grasses on disturbed slopes, and floating sediment booms and/or curtains to minimize any impacts that may occur from increased mobilization of sediments.	Prior to construction/	X		
	During construction		X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Stormwater Pollution Prevention Plan (SWPPP)				
E.1 Develop a stormwater pollution prevention plan (SWPPP) prior to construction. The objectives of the SWPPP will be to (1) identify pollutant sources associated with construction activity and project operations that may affect the quality of stormwater and (2) identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. The project proponents and/or their contractor(s) will develop and implement a spill prevention and control plan as part of the SWPPP to minimize effects of spills of hazardous, toxic, or petroleum substances during construction of the project.	Prior to construction	X		
Implementation of this measure will comply with state and federal water quality regulations. The SWPPP will be kept on site during construction activity and during operation of the project and will be made available upon request to representatives of the Regional Water Quality Control Board (Regional Water Board).	During construction		X	
The SWPPP will include but is not limited to: 1. A description of potential pollutants to stormwater from erosion.	Prior to construction	X		
2. Management of dredged sediments and hazardous materials present on site during construction (including vehicle and equipment fuels).		X		
3. Details of how the sediment and erosion control practices comply with state and federal water quality regulations.		X		
4. A description of potential pollutants to stormwater resulting from operation of the project (from Contractor).			X	
Hazardous Materials Management Plan				
F.1 The SWPPP will include a hazardous materials spill plan. The plan will describe the actions that will be taken in the event of a spill. The plan also will incorporate preventive measures to be implemented (such as vehicle and equipment staging, cleaning, maintenance, and refueling) and contaminant (including fuel) management and storage.	Prior to construction	X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
In the event of a contaminant spill, work at the site immediately will cease until the contractor has contained and mitigated the spill. The contractor will immediately prevent further contamination, notify appropriate authorities, and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, will be available on site at all times. Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site.	During construction		X	
Do not use any hazardous material in excess of reportable quantities, as specified in Title 40 Code of Federal Regulations (CFR) Part 355, Subpart J, Section 355.50, unless approved in advance by the Office of Emergency Services (OES), and will provide to the OES in the annual compliance report a list of hazardous materials contained at a project site in reportable quantities. The reporting of hazardous materials in excess of reportable quantities of Title 40 CFR Part 355 is required annually to Solano County Environmental Health Services Division as the Solano County Certified Unified Program Agency (CUPA).	During construction		X	
Mosquito Abatement Best Management Practices				
Develop a management program consistent with Marsh-wide management actions for the control of mosquitoes. If necessary, implement a sampling and treatment program for any depressions that would retain tidal water.	During construction	X		
	Post construction	X SFCWA/ CDFW		
Cultural Resources				
H.1 Prior to ground-disturbing activities in restoration areas, SFCWA will conduct a cultural resources inventory of the restoration area, according to the standards cited in the SMP EIS/EIR (CUL-MM-1 and CUL-MM-5), including: 1. The implementing regulations for Section 106 of the NHPA (36 CFR 800.4). 2. The State CEQA Guidelines (14 CCR 15064.5[a]). 3. Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines (48 Federal Register [FR] 44716-44742)	Prior to construction	Cultural resources survey is complete		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
4. The Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation Programs Pursuant to the National Historic Preservation Act (including the Guidelines for the Treatment of Cultural Landscapes). 5. Applicable NRHP bulletins and National Park Service technical briefs (Andrus and Shrimpton 1997; Birnbaum 1994; McClellan et al. 1995). If any cultural resources are determined to be historic properties and ground-disturbing activities are found to result in adverse effects, the Corps or SFCWA will resolve the effects in accordance with Section 106 of the NHPA or CEQA, as applicable. If no cultural resources are identified in specific restoration areas, or identified resources are not determined to be significant, no additional cultural work is required.		No cultural resources were determined to be historic properties		
If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work within 100 feet of the find immediately and notify Westervelt, the Contractor, SFCWA and the Corps. All construction personnel will leave the area. Vehicles and equipment will be left in place until a qualified archaeologist identifies a safe path out of the area. The on-site supervisor will flag or otherwise mark the location of the find and keep all traffic away from the resource. The on-site supervisor immediately will notify the lead state or federal agency of the find. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.	During construction		X	
H.2 If human remains of Native American origin are discovered during ground disturbing activities on non-federal land, SFCWA or the Corps must comply with state laws relating to the disposition of Native American burials, which fall within the jurisdiction of the Native American Heritage Commission (NAHC) (PRC 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, SFCWA or the Corps will not allow further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:	During construction	X	X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
a. the Solano County coroner has been informed and has determined that no investigation of the cause of death is required; and b. if the remains are of Native American origin, the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in PRC 5097.98; or 1. The NAHC was unable to identify a descendant or the descendant failed to make a recommendation within 48 hours after being notified by the NAHC. 2. If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied				
Biological Resources: General				
I.1 Implement General Biological Best Management Practices: 1. No firearms (except for federal, state, or local law enforcement officers and security personnel) will be permitted at the project site to avoid harassment, killing, or injuring of wildlife.	Prior to, during, and post construction	X	X	
2. No pets will be permitted at the project site to avoid harassment, killing, or injuring of wildlife.		X	X	
3. Native vegetation trimmed or removed on the project site will be stockpiled during work. After construction activities, removal of temporary mats and construction-related materials, and application of native and naturalized species seed mix have been completed, stockpiled native vegetation will be reapplied over temporarily disturbed wetlands to provide temporary soil protection and as a seed source.		X	X	
4. Vegetation shall be removed under the supervision of a qualified biologist approved by DFW and USFWS. If a mouse of any species is observed within the areas being removed of vegetation, DFW and USFWS shall be notified. Vegetation removal may begin when no mice are observed and shall start at the edge farthest from the salt marsh or the poorest habitat and work its way toward the salt marsh or the better salt marsh habitat.		X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
5. Removal of vegetation in wetland habitat will be conducted with a qualified biological monitor present. This monitor will watch for special-status wildlife species and temporarily stop work if special-status species are encountered. Wildlife will be allowed to escape before work is resumed. Monitors with the appropriate qualifications to handle special-status species will be allowed to move special-status species to safe locations as permitted by their authorizations.		X	X	
6. Temporarily affected wetlands will be restored by removing construction related debris and trash. Affected areas will be seeded with a native and naturalized seed mix.		X	X	
Biological Resources: Worker Training				
J.1 The Service-approved biologist will provide training to field management and construction personnel on the importance of protecting environmental resources. Communication efforts and training will take place during preconstruction meetings so that construction personnel are aware of their responsibilities and the importance of compliance. Construction personnel will be educated on the types of sensitive resources located in the project area and the measures required to avoid impacts on these resources. Materials covered in the training program will include environmental rules and regulations for the specific project and requirements for limiting activities to the construction right-of-way and avoiding demarcated sensitive resources areas. Training seminars will educate construction supervisors and managers on: i. The need for resource avoidance and protection. ii. Construction drawing format and interpretation. iii. Staking methods to protect resources. iv. The construction process. v. Roles and responsibilities. vi. Project management structure and contacts. vii. Environmental commitments. viii. Emergency procedures.	Prior to construction	X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
If new construction personnel are added to the project, the contractor will ensure the personnel receive the mandatory training before starting work. A representative will be appointed during the employee education program to be the contact for any employee or contractor who might inadvertently kill or injure a listed species or who finds a dead, injured, or entrapped individual. The representative's name and telephone number will be provided to the USFWS before the initiation of ground disturbance.	During construction	X	X	
Biological Resources: Special-Status Plant Species Protection				
1. Special-status plant surveys required for project-specific permit compliance will be conducted within 1 year prior to initiating construction. The purpose of these surveys will be to verify the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. The extent of mitigation of direct loss of or indirect impacts on special-status plants will be based on these survey results.	Prior to construction	X		
2. If found, the locations of special-status plants in proposed construction areas will be recorded using a global positioning system (GPS) unit and flagged.		X		
3. Any special-status plant species observed during surveys will be reported to the Service and DFW so the observations can be added to the California Natural Diversity Database (CNDDB)		X		
Biological Resources: Special-Status Wildlife Species Protection				
1. If individuals of listed wildlife species may be present and subject to potential injury or mortality from construction activities, a Service or DFW-approved biologist will conduct a preconstruction survey. If a listed wildlife species is discovered, construction activities will not begin in the immediate vicinity of the individual until the Service or DFW is contacted, depending on the species, and the individual has been allowed to leave the construction area.	Prior to Construction	X		
2. Minimum qualifications for the qualified biologist will be a 4-year college degree in biology or related field and 2 years of professional experience in the application of standard survey, capture, and handling methods for the species of concern. However, in the case of fully protected species, no capture or handling will be done.		X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
3. Any special-status mammal, bird, or other species observed during surveys will be reported to the Service and DFW so the observations can be added to the California Natural Diversity Database (CNDDB).		X		
Biological Resources: Salt Marsh Harvest Mouse and Suisun Shrew				
1. A Service-approved biologist, with previous salt marsh harvest mouse monitoring and surveying experience, will identify suitable salt marsh habitat for the mouse and conduct preconstruction surveys for the mouse prior to project initiation.	Prior to and during construction	X		
2. Vegetation will be removed from all areas (driving roads, action area, or anywhere else that vegetation could be stepped on).			X	
3. If a salt marsh harvest mouse is discovered, construction activities will cease in the immediate vicinity of the individual until the Service is contacted and the individual has been allowed to leave the construction area.			X	
4. A Service-approved biologist with previous salt marsh harvest mouse experience will be on site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The Service-approved biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the Service-approved biologist has requested work stoppage because of take of any of the listed species, the Service and DFW will be notified within 1 day by email or telephone.		X		
5. Disturbance to wetland vegetation (i.e., pickleweed [*Salicornia* spp.]) will be avoided to the extent feasible in order to reduce potential impacts on SMHM habitat. If wetland vegetation (i.e., pickleweed [*Salicornia* spp.]) cannot be avoided, it will be removed by a method approved by the USFWS and DFW. The USFWS-approved biologist will be on site to monitor all wetland vegetation removal activities.			X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Biological Resources: Bats				
Pre-demolition surveys would be required prior to the demolition of existing structures to ensure no bat presence. These pre-demolition surveys would be conducted by a qualified biologist, and would occur up to 3 days prior to demolition. If live bats or indications of bat use, including guano, staining, prey remains, bat carcasses are not found within the existing structures, the structures may be demolished at any time	Prior to demolition	X		
1. If live bats or indications of bat use are found, the demolition of the structures would be limited to the beginning of September to the middle of October, at which time remaining bats would be evicted using appropriate protocols prior to demolition.	Prior to demolition	X		
2. Windows and doors of the structures would be kept closed and sealed prior to demolition to prevent bats from inhabiting or roosting in the structures.	Prior to demolition	X		
3. To the degree feasible, stored material, furnishings, wooden fixtures and debris piles in and around the buildings will be checked for bats and cleared from the area prior to demolition to improve visual survey access to potential roost spaces.	Prior to demolition	X		
Biological Resources: Birds				
1. Preconstruction surveys will be performed to determine whether nesting birds, including migratory birds, raptors, and special-status bird species, are present within or immediately adjacent to the project sites and associated staging and storage areas if activities would occur during active nesting periods. Bird species using the managed wetland habitat include waterfowl, shorebirds, Suisun song sparrow, Suisun common yellowthroat, and several other resident and migratory songbirds.	Prior to, during and post construction	X		
2. All woody and herbaceous vegetation will be removed from construction areas (earthwork areas), during the nonbreeding season (September 1–February 1) to the extent feasible, to minimize effects on nesting birds. If woody and herbaceous vegetation removal occurs during the breeding season, a qualified biologist will survey the construction area for active nests and young migratory birds immediately before removal activities.		X		
3. During the breeding season, all vegetation subject to impact will be maintained to a height of approximately 6 inches to minimize the potential for nesting.		X		
4. If active nests or migratory birds are found within the boundaries of the construction area, an acceptable buffer width and appropriate measures will be developed in coordination with DFW.		X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
5. Inactive migratory bird nests (excluding raptors) located outside the construction areas will be preserved. If an inactive migratory bird nest is located in the area of effect, it will be removed before the start of the breeding season (approximately February 1).		X		
6. Impacts on great blue heron rookeries will be avoided; mature trees will not be removed, and nearby work will occur outside the nesting season.		X		
Biological Resources: Raptors				
1. Preconstruction surveys will be performed before and during the raptor nesting season (bimonthly, i.e., two times per month) to identify existing nests that may be used during the nesting season.	Prior to construction	X		
2. Raptors may nest from later winter through mid-summer; therefore, multiple nesting season surveys will performed.		X		
3. DFW will be notified of all raptor nests located during the preconstruction surveys. If a raptor nest is located within the recommended buffer, the project proponents will coordinate with DFW to determine an acceptable buffer width.		X		
4. If an active raptor nest is found outside the construction areas, a buffer zone will be developed in coordination with DFW. For special-status species, a larger buffer will be required (e.g., 0.5-mile Swainson's hawk buffer). The project proponents will coordinate with DFW prior to project implementation to determine the species-specific buffer widths.		X		
Biological Resources: California Clapper Rail and California Black Rail				
1. If construction activities are necessary during the breeding season, preconstruction surveys for California clapper rail and black rail will be conducted by a Service-approved biologist at and adjacent to areas of potential tidal and managed wetlands habitat for California clapper rail and black rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the California clapper rail or black rail breeding season in areas within or adjacent to California clapper rail breeding habitat with approval of the USFWS and DFW under the supervision of a qualified biologist	Prior to construction	X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Biological Resources: California Least Tern				
1. No activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys). Exception: Only inspection, maintenance, research, or monitoring activities may be performed during the least tern breeding season in areas within or adjacent to least tern breeding habitat with approval of the Service and DFW under the supervision of a qualified biologist.	Prior to construction	X		
Biological Resources Western Pond Turtle				
1. Preconstruction surveys will be performed in all managed wetlands and in adjacent sloughs that provide suitable habitat for western pond turtle. If pond turtles are identified, the area will be surveyed for nesting sites, if construction activities would occur during the nesting season.	Prior to construction	X		
2. If pond turtles are identified in managed wetlands to be breached, the ponds and associated drainages will be dewatered and, to the extent feasible, any turtles observed will be captured and released to other suitable locations within a nearby managed wetland or drainage.		X		
Biological Resources: Fish				
T.1 The NMFS Santa Rosa Area Office must be notified by letter or email message stating the project commencement date, at least 14 days prior to implementation. NMFS employee(s) or any other person(s) designated by NMFS will be allowed access to the work site.	Prior to construction/	X		
	During construction	X		
T.2 A biologist or on-site monitor will evaluate the project site during construction to document any actions or condition that could adversely affect salmonids, green sturgeon, or their habitat. Whenever conditions are identified that could adversely affect salmonids, green sturgeon, or their habitat, in a manner not described in this opinion, NMFS shall be immediately notified by contacting biologist Daniel Logan at (707) 575-6053 or dan.logan@noaa.gov.	During construction	X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
T.3 Draft restoration design plans (65-90 percent design level) will be submitted to NMFS for review and written approval at least 120 days prior to initiation of construction. The draft restoration design plans will be submitted to: NMFS Santa Rosa Area Office Attention: Supervisor of Protected Resources Division 777 Sonoma Avenue, Room 325 Santa Rosa, California, 95404-6528	Prior to construction	X Plans emailed 3/19/16		
In-water construction activities, such as levee construction and levee breaching, will occur during the in-channel work window of September 1 through November 30.	During construction	X		
Biological Resources: Biological Monitoring				
1. A Service-approved biologist/environmental monitor will be responsible for monitoring implementation of the conditions in the state and federal permits (CWA Section 401, 402, and 404; ESA Section 7; Fish and Game Code Section 1602 and/or 2050; project plans [SWPPP]; and EIS/EIR mitigation measures).	Prior to, during, and post construction	X		
2. The Service-approved biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each construction site based on mapping of existing land-cover types and special-status plant species. If such maps are not available, the biologist/environmental monitor will map and quantify the land-cover types and special-status plant populations in the proposed project footprint prior to construction.		X		
3. The biologist/environmental monitor will ensure the avoidance of all sensitive habitat areas outside direct project footprints, including patches of tidal wetland along channel banks, during dredging operations, to the extent practical.		X		
4. Plants for revegetation will come primarily from natural recruitment. Plants imported to the restoration areas will come from local stock, and to the extent possible, local nurseries. Only native or naturalized plants will be used for restoration efforts.		X		
5. To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the action area, the limits of construction will be marked on the construction drawings and identified in the field.		X	X	

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
Biological Resources: Construction Period Restrictions				
V.1 Timing of restoration construction activities will depend on the type of activity, presence or absence of sensitive resources, tides, and/or water management in wetlands. In general, landside work will occur between July and September. In-water activities will be conducted during the months of August through November. Working outside this window will require additional approvals from the resource agencies. Other timing restrictions may be necessary during the hunting season, such as limiting work to days other than Saturday, Sunday, and Wednesday.	Prior to construction	X		
	During construction		X	
Nonnative Plant Control				
W.1 The following measures will be included in the project construction specifications to minimize the potential for the introduction of new noxious weeds and the spread of weeds previously documented in the project area.				
1. Use certified, weed-free, imported erosion control materials (or rice straw in upland areas).	During construction	X		
	Post construction	X		
2. Coordinate with the county agricultural commissioner and land management agencies to ensure that the appropriate BMPs are implemented.	During construction	X		
3. Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds.	During construction	X	X	
4. Clean equipment at designated wash stations after leaving noxious weed infestation areas.	During construction		X	
5. As feasible, treat isolated infestations of noxious weeds identified in the project area with approved eradication methods at an appropriate time to prevent further formation of seed, and destroy viable plant parts and seed.	During construction	X		
	Post construction	X		
6. Minimize surface disturbance to the greatest extent possible.	During construction	X	X	
7. Seed all disturbed areas with native and naturalized seed mixes, as provided in the revegetation plan developed in cooperation with DFW. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.	During construction		X	
	Post construction	X		

Mitigation Measures and Environmental Commitments	Implementation Schedule	Responsible Party		Specification Location
		Client	Contractor	
8. Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.	During construction		X	
	Post construction	X		
9. Restore or enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.	Post construction	X		

A California Corporation
Specializing in Geotechnical Engineering

Hultgren-Tillis Engineers

February 29, 2016
File No. 816.01

Westervelt Ecological Services, LLC
600 North Market Boulevard, Suite 3
Sacramento, California 95834

Attention: Mr. Mark Young

Geotechnical Engineering Evaluation
Cross Levee
Tule Red Restoration Project
Solano County, California

Dear Mr. Young:

INTRODUCTION

This letter presents our conclusions and recommendations for the geotechnical aspects of the planned new levee crossing between the north and south habitat berms as part of the Tule Red project. This letter supplements our report dated December 22, 2015 for the Tule Red project. Since our December 22, 2015 report, the plans for the project have been developed, including the plans for the construction access crossing.

The construction access crossing is an approximately 120-foot long berm that spans between the north and south habitat berms. The current berm concept has a 24-foot wide crown at Elevation 9 feet above the North American Vertical Datum of 1988 (NAVD 88) which slopes up to Elevations 9.5 and 12 feet where it abuts the north and south habitat berm, respectively. The crossing berm will have 3:1 (horizontal to vertical) side slopes and be founded on native marsh soils. At approximately the midpoint of the berm alignment, a 36-inch culvert is planned to run transverse to the crossing, with an invert elevation at approximately the elevation of the existing marsh grade. The culvert will contain a screw gate on both ends. The north end of the culvert will outlet into a rerouted drainage channel and the south end will outlet into a third order channel in the Tule Red project.

DISCUSSION

We reviewed the preliminary plans for the crossing in the plan set dated February 2, 2016. The primary geotechnical engineering concerns for the crossing include settlement, seepage, and stability of the slopes. These concerns and other consideration for design and construction of the crossing are discussed below.

1. Settlement

The levee will be constructed on the soft compressible marsh soils. The weight of the fill will cause consolidation of the marsh soils and settlement of the levee and culvert pipe. The settlement will be highest below the crown. The levee will settle differentially, both longitudinally and transversely along the alignment of the crossing. We estimate that settlement will be 1 to 1.5 feet along the centerline for the embankment between the two existing levees. As the new crossing berm meets the existing levees and the amount of fill placed for the crossing becomes thinner, we estimate that the amount of ground settlement will decrease to between 0.1 to 0.2 feet. Likewise, as the fill thickness decreases along the 3:1 slopes of the crossing, the settlement will also decrease. We estimate that the settlement beneath the toe of the embankment slopes will be small. The settlement can lead to transverse cracking in the construction access crossing embankment and in the existing levees. Cracks are prevalent throughout the Suisun Marsh and Delta levee system. The cracking is undesirable and, coupled with an inadequate seepage barrier within the levee, will be a continuing concern for the levee. Deformation cannot be avoided and cracking should be expected.

The levee and culvert should be designed to accommodate these levels of settlement. It is desirable to place as much embankment fill as possible prior to constructing the culvert.

2. Seepage

Seepage is a concern through and below the levee and particularly along the conduit. Potential measures to reduce the risk of seepage are discussed below.

- Place a graded filter around the northern third of the culvert.
- Strip vegetation within the footprint of the levee, carefully dewater and fill the existing ditches.
- Construct the embankment with the least expansive material available from the borrow areas.

3. Stability

The marsh soils beneath the levee embankment are weak and deformable. Rapid placement of fill could cause ground movement below the fill and potentially deform the adjacent existing levees. Typical practice is to limit the thickness of fill to allow the ground to adjust to the load and the marsh soils to gain strength. The fill should be placed in phases to avoid overstressing the ground.

RECOMMENDATIONS

1. Site Preparation

The footprint of the crossing levee should be cleared and grubbed of surface and subsurface deleterious matter including trees, grasses, other vegetation and debris designated for removal. The site should be stripped to sufficient depth to remove vegetation and soil containing roots. The ditches should be cleared of vegetation and dewatered. Soft or loose soil at the base of the ditches should be removed. Stripped and grubbed materials should be removed from the fill site and should not be used as fill. We should observe the footprint of the site after it has been prepared to receive fill.

2. Fill Materials

Fill placed at the crossing site for the embankment should be a soil or soil/rock mixture free of deleterious matter and contain no rocks or hard fragments larger than 4-inches in maximum dimension with less than 15 percent larger than 1-inch in maximum dimension. The fill for the crossing should be selected from the least expansive soils on site. Based on our test pits, the most appropriate material for the crossing fill was found in the northern portion of the site (Test Pits 1 through 4) approximately 2.5 feet below the ground surface and deeper. We should observe the materials to be placed at the crossing site before they are placed and perform laboratory testing as necessary to confirm the acceptability of the materials for the crossing.

3. Compaction

Surfaces in areas to be filled should be scarified to a depth of at least 8-inches. The scarified soil should be moisture conditioned to at least optimum moisture content and compacted to at least 90 percent relative compaction. ASTM test D-1557 should be used to establish the reference values for computing optimum moisture content and relative compaction.

If soft or yielding soils are present during subgrade preparation or fill compaction, they should be scarified, moisture conditioned and compacted or removed by excavating to expose firm soil.

Fill should be placed in lifts 8-inches or less in loose thickness and moisture conditioned to at least optimum moisture content. Moisture conditioning should be performed before compaction. Each lift should be methodically compacted to at least 90 percent relative compaction. A sheepsfoot compactor or equivalent equipment should be used for compacting clay soils. Material that fails to meet the moisture or compaction criteria should be loosened by ripping or scarifying, moisture conditioned, and then recompacted.

Fill should be placed on horizontal surfaces. The fill should be benched into the existing levee slope to bond the existing levee and new fill. The horizontal bench width into the existing slopes should not exceed 5 feet.

4. Filter Drainage Material

Filter drainage material should be placed around the northern one-third (1/3) of the culvert crossing and should be at least 1.5 feet thick around the pipe. The filter material should meet the following gradations.

Drainage Material Gradation

Sieve	Percent Passing by Weight
3/4-inch	100
#4	78-100
#16	56-100
#30	10-52
#50	0-30

5. Staged Construction

The cross levee fill should be placed in multiple stages. Fill should be placed before the rest of the fill for the project in order to maximize the amount of time the fill can settle before placing the culvert pipe. The initial phase should include filling the ditch and placing up to 3 feet of fill above the ditch. After a waiting period of approximately 30 days, another 1-foot of fill should be added. Fill should be added in 1-foot phases, with a 30 day waiting period between phases. This schedule may need to be adjusted based upon the observed deformation of the levee during construction.

If you have any questions, please call.

Sincerely,

Hultgren – Tillis Engineers

Gregory R. Olsen
Civil Engineer

R. Kevin Tillis
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
GREGORY ROBERT OLSEN
No. C 82690
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
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NO. GE 2160
GEOTECHNICAL
STATE OF CALIFORNIA

GRO:RKT:lm:la

Filename: 81601L01 Cross Levee.docx

California Department of Fish and Wildlife Temporary Entry Permit Grizzly Island Wildlife Area	Project:	Tule Red Tidal Restoration
	Westervelt Ecological Parcel No:	0046-260-110
	County:	Solano
	APN:	0046-260-070

TEMPORARY ENTRY PERMIT

This Temporary Entry Permit ("Permit") is made as of __________________, 2016, by and among the California Department of Fish and Wildlife ("CDFW") and The State and Federal Contractors Water Agency (SFCWA) and SFCWA's authorized agent, Westervelt Ecological Services ("WES"). SFCWA and WES are collectively referred to herein as "SFCWA/WES." This Permit gives permission to SFCWA/WES, its officers, employees, agents, and contractors, as specified below, to enter onto that portion of CDFW's Grizzly Island Wildlife Area ("GIWA") being that certain 60 acres labeled "DFW" and the "Staging Area" each as specified on the attached Exhibit A attached hereto and incorporated herein by this reference (the "Property"). The Property is located in Solano County, State of California.

A. Whereas SFCWA requests that SFCWA/WES have access to this Property for the purposes of implementing the portion of the project described on attached Exhibit B (the "Project") that is located on the Property. Specifically, access to the Property will be to/for:

    1. Investigate and collect data on existing conditions including, but not limited to, testing and sampling of soil, surface water, sediments, etc. necessary to implement the design of the Project.

    2. Survey biological resources including vegetation, wildlife and wetland resources. Topographic, bathymetric, and other surveys as may be necessary to evaluate existing conditions associated with the Property.

    3. Water and vegetation management activities related to construction of the Project during 2015-2018.

    4. Earthwork and planting activities related to construction of the Project during 2015-2018.

    5. Construction activities related to possible modification of the CDFW drain to increase dissolved oxygen levels in the drain water. Such activities may include installation of a diffuser, and/or installation of an aerator, construction of a habitat berm and installation of a culvert with a screw gate and possible aerator/spillway, and/or other measures that may be identified to improve dissolved oxygen levels.

    6. Monitoring activities related to the Project including, but not limited to, the monitoring of vegetation, hydrology, topography, water quality, water velocity and hydrology, etc.

    7. Maintenance and management activities related to the Project including, but not limited to, earthwork and vegetation management.

This Permit is subject to the following terms and conditions:

1. **Project Description:** Subject to the terms and conditions of this Permit, CDFW hereby gives permission to SFCWA/WES to enter upon that portion of CDFW's GIWA specified on the attached Exhibits each year during the Term (Section 3) of this Permit solely for the purposes described in Exhibit B.

2. **Procedures For Entry Onto Property:**

a. SFCWA/WES shall submit protocols in writing to CDFW at least sixty (60) days in advance of the proposed date of the surveys and construction for review and approval by the Regional Manager or the Regional Manager's designee. SFCWA/WES shall not enter the Property until CDFW has approved survey and construction protocols in writing.

i. Survey protocols shall consist of detailed descriptions of the specific activity(ies) SFCWA/WES proposes to conduct on the Property, including but not limited to the species or habitats to be surveyed, location and duration of the activity(ies), types of equipment and survey methods which will be used, means and route(s) of access to the survey site(s), names of the individuals who will be conducting the Survey(s), the organization(s) with whom they are directly employed, and identity of the WES Project Manager who will be directing the activity(ies). Survey protocols should be limited to those activities reasonably certain to occur within six months following the date of the request and should not be a general list of all activities which could occur within the Permit Term.

ii. Construction details shall consist of detailed descriptions and drawings of the specific activitity(ies) SFCWA/WES proposes on the Property methods which will be used, means and route(s) of access to the construction site(s), names of the individuals who will be conducting the construction activity(ies), the organization(s) with whom they are directly employed, and identity of the WES Project Manager who will be directing the activity(ies)

iii. Protocols shall be submitted to CDFW in accordance with the Notice requirements (Section 11), and a copy shall be transmitted simultaneously via email to Patrick Graham (patrick.graham@wildlife.ca.gov), Larry Wyckoff larry.wyckoff@wildlife.ca.gov) and Greg Martinelli (greg.martinelli@wildlife.ca.gov) (or another CDFW representative as designated by the Regional Manager).

b. WES shall notify CDFW at least forty-eight (48) hours in advance of entry and beginning of work on the Property, a change in the project schedule, or cessation of work. Notice shall be submitted to CDFW in accordance with the Notice requirements (Section 11) and a copy shall be transmitted simultaneously via email to Patrick Graham, Larry Wyckoff, and Greg Martinelli (or another CDFW representative as designated by the Regional Manager).

c. WES shall coordinate with the CDFW and Suisun Resource Conservation District (SRCD) to identify, prepare, and confirm protocols for alternative access routes during closures for CDFW and private landowner ingress and egress to their respective properties. WES shall work with CDFW to alter existing route gates and locking procedures which will maintain security at CDFW's equipment compound.

d. WES shall notify CDFW and SRCD at least forty-eight (48) hours in advance of all proposed road closures and temporary access closures. Notice shall be submitted to CDFW in accordance with the Notice requirements (Section 11) and a copy shall be transmitted simultaneously via email to Patrick Graham, Larry Wyckoff, and Greg Martinelli (or another CDFW representative as designated by the Regional Manager) and Steve Chappell at the SRCD (Schappell@suisunrcd.org) for coordination and notifications to the private parcel landowners.

i. Access details shall consist of detailed descriptions and drawings of the specific alternative routes required, methods which will be used, means and route(s) of access to the construction site(s) and private parcels, names of the individuals who will be conducting the construction activitiy(ies), the organization(s) with whom they are directly employed, and identity of the WES Project Manager who will be directing the activity(ies)

3. **Permit Term:** The Term of this Permit shall only be for the period beginning on July 1, 2016 and ending on December 31, 2021.

4. **CDFW Covenants**:

   a. To facilitate the Project, CDFW agrees to utilize an alternative drain pump during the construction periods of 2016 through 2018 (May through October), so that during such construction periods water will not drain from the Property onto the adjacent Tule Red property owned by WES (as shown on attached Exhibit A). SFCWA/WES and CDFW will work together to implement an alternative to utilizing the drain pump during construction periods, the cost of which will be paid by SFCWA.

5. **Access Limits and Conditions:** Access to the Property shall be only through existing roads to the Property and/or through the adjacent Tule Red property owned by WES (each as shown on attached Exhibit A) ("Access Route"). WES shall not access the portion(s) of the Property open to hunting ("Hunt Zone") from October 15—February 10. Parking is only allowed in designated areas agreed upon by CDFW. No equipment shall be left on-site without prior written approval of the CDFW Regional Manager or the Regional Manager's designee, which may be withheld. Staging of materials or equipment shall not occur on CDFW land between August 1 and February 15.

6. **Permit Subject to Laws and Authorities:**

   a. SFCWA/WES shall, at SFCWA/WES's sole cost and expense, comply and cause its officers, employees, agents and contractors to comply with the requirements of all municipal, state (including CDFW acting in its regulatory capacity), and federal authorities now in force or which may hereafter be in force pertaining to the Project and use of the Property as provided by this Permit. This Permit is expressly made subject to any and all laws, statutes, regulations, ordinances, codes, orders and regulatory permits, authorizations or approvals, including any conditions of such permits, authorizations and approvals issued or required to be obtained from or issued by such authorities.

   b. SFCWA/WES's obligations include, but are not limited to, compliance with California Code of Regulations, §550. General Regulations for Public Use on All Department of Fish and Wildlife Lands, and Title 14, § 551. Additional Visitor Use Regulations on Department Lands Designated as Wildlife Areas as they pertain to the Grizzly Island Wildlife Area. Regulations may be found at http://www.fgc.ca.gov/regulations/2013/index.aspx#550

   c. Prior to commencement of any work on the Property, SFCWA/WES shall obtain all legally required permits or approvals, including scientific collecting permits, and submit to CDFW full and complete copies of all permits and approvals, including documentation related to or referenced in such permits and approvals, along with the corresponding agency contact and telephone numbers.

7. **Permit Subject to Existing Claims:** This Permit is subject to existing rights, interests, contracts, permits, licenses, easements, including conservation easements, and any other encumbrances and claims which may affect the Property, whether or not of record.

8. **Waiver of Claims and Indemnity:** Consistent with Government Code section 14662.5, SFCWA/WES waives all claims against CDFW, its officers, agents, employees and contractors,

for loss or damage caused by, arising out of, or in any way connected with the exercise of this Permit, and (a) WES agrees to protect, save harmless and indemnify CDFW, its officers, agents, employees and contractors of and from any and all claims, losses, costs, expenses, damage or liability which may be suffered or incurred by CDFW, its officers, agents, employees and contractors, caused by, arising out of, or in any way connected with WES's exercise of the permission hereby granted, and the project for which this Permit is granted, except only those caused by the sole active negligence of CDFW, and (b) SFCWA agrees to protect, save harmless and indemnify CDFW, its officers, agents, employees and contractors of and from any and all claims, losses, costs, expenses, damage or liability which may be suffered or incurred by CDFW, its officers, agents, employees and contractors, caused by, arising out of, or in any way connected with SFCWA's exercise of the permission hereby granted, and the project for which this Permit is granted, except only those caused by the sole active negligence of CDFW. SFCWA/WES agrees that CDFW shall not be considered negligent and CDFW shall not be held liable for any loss, damage, or theft of property belonging to, or in the custody of SFCWA/WES, its officers, employees, agents or contractors if such loss, damage, or theft occurs on land owned by, or under the control or management of, CDFW unless caused by the sole active negligence of CDFW. SFCWA/WES will further cause each contractor providing services in connection with the project for which this Permit is issued to include such indemnification and waiver of claims by the contractor in favor of CDFW.

9. **Insurance:** At no cost to CDFW and in connection with its indemnification and waiver of claims for the Project, SFCWA/WES shall provide and/or cause its contractors/subcontractors to insure their activities in connection with this Permit and obtain, keep in force, and maintain insurance as follows:

   a. COMMERCIAL GENERAL LIABILITY. Commercial General Liability insurance with limits of not less than ONE MILLION AND NO/100 DOLLARS ($1,000,000.00) per occurrence and THREE MILLION AND NO/100 DOLLARS ($3,000,000.00) aggregate, as well as Fire Legal Liability of not less than THREE HUNDRED THOUSAND AND NO/100 DOLLARS ($300,000.00).

      The policy shall include coverage for liabilities arising out of premises, operations, independent contractors, products, completed operations, personal and advertising injury, and liability assumed under this Permit as an insured contract. This insurance shall apply separately to each insured against whom claim is made or suit is brought subject to the limits of liability of the policy.

      The policy must include State of California, Department of Fish and Wildlife, and its officers, agents, and employees as additional insureds by endorsement, but only insofar as the operations under this Permit are concerned.

      If the above insurance is written on a claims-made form, it shall continue for not less than three (3) years following termination of this Permit. The insurance shall have a retroactive date of placement prior to or coinciding with the commencement of the Term of this Permit (Section 3).

   b. PROPERTY INSURANCE. SFCWA/WES shall also procure property insurance at least as broad as the most commonly available special form policy with a limit of not less than FIVE HUNDRED THOUSAND DOLLARS ($500,000). Said policy shall contain an endorsement naming CDFW as loss payable and provide that payments for any losses be made to CDFW and SFCWA/WES as co-payees and shall be used to repair, rebuild, restore or replace the insured property at CDFW's direction for any damage resulting from the installation or operation of SFCWA/WES's facilities. If payments are not used, they shall be made payable directly to CDFW for rebuilding or repair as necessary in the discretion of the CDFW.

c. AUTOMOBILE LIABILITY. Motor vehicle liability with limits of not less than ONE MILLION DOLLARS ($1,000,000.00) combined single limit per accident. The policy must include the State of California, Department of Fish and Wildlife, and its officers, agents, and employees as additional insureds by endorsement with respect to liability arising out of all vehicles owned, hired and non-owned.

d. WORKERS' COMPENSATION. Statutory workers' compensation and employer's liability coverage for all employees who will be engaged in the performance of activities under this Permit, including special coverage extensions where applicable. Employer's liability limits of ONE MILLION DOLLARS ($1,000,000.00) shall be required, and the policy shall include a waiver of subrogation in favor of CDFW.

e. OTHER RISKS. Such other insurance in such amounts which from time to time may be reasonably required by the mutual consent of CDFW and SFCWA/WES against other insurable risks relating to performance.

f. GENERAL REQUIREMENTS. Each policy of insurance must meet the following general requirements:

i. Insurance Companies must be rated at least A-/FSC Class VII by A.M. Best Key Rating Guide Company licensed to do business in California.

ii. All policies shall contain an endorsement naming CDFW as an additionally named insured at no cost to CDFW.

iii. Upon request by CDFW, SFCWA/WES shall provide CDFW with true copies of the policies and certificates of all required insurance satisfactory to CDFW.

iv. Coverage must be in force for the complete Term of this Permit. If an insurance policy expires or is non-renewed during the Term, then CDFW must receive true copies of new policies and new certificates of insurance within ten (10) days following the expiration date of the existing policy. This new insurance must still meet the original requirements of this Permit.

v. Insurance policies shall contain a provision that coverage will not be cancelled, non-renewed or materially modified without at least thirty (30) days prior written notice to CDFW.

vi. SFCWA/WES shall provide CDFW a copy of any notice of cancellation, material modification or non-renewal of insurance within five (5) business days following receipt.

vii. CDFW is not responsible for any deductible or self-insured retention contained within the insurance program.

viii. SFCWA/WES is required to ensure all contractors and subcontractors have adequate insurance meeting the coverage requirements in this provision.

ix. In the event any contractor/subcontractor fails to keep in effect at all times the specified insurance coverage, CDFW may, in addition to any other remedies it may have, terminate this Permit upon the occurrence of such event, subject to the provisions of this Permit.

x. Any required insurance shall be primary, and not excess, to any insurance carried by CDFW, as it relates to the Property and activities under this Permit.

xi. CDFW shall not be liable for the payment of any premiums or assessments on the required insurance coverage.

10. **Contractors:** SFCWA/WES shall incorporate the terms, conditions, and requirements contained herein when contracting out all or any portion of the activities permitted hereunder. SFCWA/WES shall be responsible for ensuring contractor/subcontractor compliance with terms and conditions contained herein. Failure of contractors to abide by CDFW's terms and conditions shall constitute default by SFCWA/WES (see "Section 19. Breach and Cure" below) allowing CDFW to terminate this Permit and seek all legal remedies.

11. **Notice:** Any notice required or permitted herein shall be in writing and shall be addressed as follows, unless otherwise specified in this Permit:

CDFW: **Scott Wilson**
Regional Manager
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
Email: scott.wilson@wildlife.ca.gov
Telephone: (707) 944-5517
Fax: (707) 944-5563

with copies (by email) to:

Patrick Graham
Email: Patrick.graham@wildlife.ca.gov

Larry Wyckoff
Email: Larry.wyckoff@wildlife.ca.gov

Greg Martinelli
Email: Greg.martinellie@wildlife.ca.gov

And with a copy (by email) to: **Steve Chappell**
Suisun Resource Conservation District
Email: schapell@suisunrcd.org

SFCWA: The State and Federal Contractors Water Agency
1121 L Street, Suite 806
Sacramento, Ca 95814
Attention: Byron Buck, Executive Director
Phone: (916) 476-5056
Fax: (916) 476-5057
Email: bbuck@sfcwa.org

WES: Westervelt Ecological Services
600 North Market Boulevard, Suite 3

Sacramento, CA 95834
Attention: Gregory E. Sutter
Email: gsutter@westervelt.com
Telephone: (916) 646-3644
Fax: (916) 646-3675

or to such other address(es) as either party may indicate in written notice to the other. All notices and communications given under this Permit shall be deemed to have been duly given and received: (i) upon personal delivery, or (ii) as of the third business day after mailing by United States certified mail, return receipt requested, postage prepaid, addressed as set forth above, or (iii) the immediately succeeding business day after deposit (for next day delivery) with Federal Express or other similar overnight courier system, or (iv) 24 hours after email/.pdf or facsimile transmittal with confirmation of receipt followed by personal delivery, United States mail, or overnight delivery as specified in this Section.

12. **Limits of Work:** In no event shall this Permit authorize work in excess or contrary to the terms and conditions of any law or regulatory agency requirement, permit, or approval, including that of CDFW acting in its regulatory capacity. Under no circumstances, whether or not permitted or authorized by any law or regulatory agency, permit, or approval, shall work exceed that which is reasonably necessary to carry out the survey and other activities set forth in Exhibit B in connection with Tule Red Tidal Restoration unless first approved in writing by CDFW, which approval CDFW may withhold.

13. **Compliance with Monitoring and Mitigation Measures:**

a. SFCWA/WES shall consult with CDFW Senior Environmental Scientist Larry Wyckoff and Environmental Program Manager Greg Martinelli to determine site-specific conditions and avoidance measures for the protection of natural and cultural resources. If any natural resource mitigation measures are identified by CDFW, they shall be completed by SFCWA/WES at its cost in consultation with and to the satisfaction of the Regional Manager within one year after the completion of the Project or such earlier time as CDFW may specify. SFCWA/WES shall complete monitoring in accordance with regulatory requirements, permits and approvals.

b. Within thirty (30) days of completing the Project, SFCWA/WES shall provide to CDFW a copy of any data gathered and results or reports generated.

c. SFCWA/WES shall ensure that all activities conducted pursuant to this Permit comply with all state and Federal environmental laws, including but not limited to the Federal Endangered Species Act, California Endangered Species Act, and California Environmental Quality Act.

d. SFCWA/WES will notify CDFW if any previously undocumented historical resources (including archaeological sites), special-status species, threatened/endangered species, or other resources are identified on the Property. SFCWA/ WES will consult with CDFW Senior Environmental Scientist Larry Wyckoff and Environmental Program Manager Greg Martinelli to determine the appropriate avoidance and mitigation measures necessary to protect the resources during future Surveys.

e. In the event that previously undocumented cultural resources are encountered during the Project (including but not limited to dark soil containing shellfish, bone, flaked stone, ground stone, or deposits of historic trash), work within the immediate vicinity of the find shall be temporarily halted or diverted until a qualified cultural resource specialist has evaluated the find and implemented appropriate treatment and disposition of the artifact(s) at the expense of SFCWA/WES. Once any significant cultural resources are found in a Project location, a qualified historian and/or archaeologist must be brought on-site at the expense of SFCWA/WES to monitor any ground-disturbing work in that area from that point forward.

f. Should SFCWA/WES's contractors or any subcontractors find any cultural or historical resources, SFCWA/WES agrees to halt all work within thirty feet (30') of the find and immediately notify CDFW's Larry Wyckoff and Greg Martinelli. SFCWA/WES further covenants that work shall not resume in the area of the find until authorized in writing by the Regional Manager or the Regional Manager's designee.

g. In the event that human remains are discovered, work shall immediately cease in the area of the find and the WES project manager/site supervisor will immediately notify CDFW's Larry Wyckoff and Greg Martinelli. Any human remains and/or funerary objects will be left in place or returned to the point of discovery and covered with soil. The CDFW Regional Manager or authorized representative will notify the County Coroner, in accordance with California Health and Safety Code §7050.5 and the Native American Heritage Commission (NAHC) or Tribal Representative. If a Native American monitor is on-site at the time of the discovery, the monitor will be responsible for notifying the appropriate Native American authorities.

h. If the coroner or tribal representative determines the remains represent Native American interment, the NAHC in Sacramento and/or tribe will be consulted to identify the most likely descendants and appropriate disposition of the remains. Work will not resume in the area of the find until proper disposition is complete (Public Resources Code §5097.98). SFCWA/WES will be responsible for all costs related to any such disposition, including legal fees and costs, if any. No human remains or funerary objects will be cleaned, photographed, analyzed, or removed from the site prior to disposition. If it is determined that the find indicates a sacred or religious site, the site will be avoided. Formal consultation with the California Office of Historic Preservation and review by the Native American Heritage Commission/Tribal Cultural representatives shall also occur as necessary to define additional site mitigation or future restrictions.

14. **Repair and Restoration of Property:** If SFCWA/WES, its agents or contractors cause any damage to the Property, or any fixtures, improvements, machinery, equipment or other property of CDFW or that of third parties resulting from any exercise of the rights granted by this Permit, SFCWA/WES shall repair and restore such property to its original condition or replace the same prior to further use of the Property pursuant to this Permit and in no event later than the expiration of this Permit, or within ten (10) days of its earlier termination. In the event that repair and restoration is performed following termination of this Permit, SFCWA/WES's obligations (including Indemnity and Insurance obligations) under this Temporary Entry Permit shall continue until repair and restoration is completed to the satisfaction of the Regional Manager.

15. **Right to Halt Work:** CDFW reserves the right to halt work and demand mitigation measures at any time, with or without prior notice to SFCWA/WES, in the event CDFW determines that any provision of this Permit is violated, or any threat to the health and safety of visitors, users of the Property, or the environment arises.

Use Restrictions: The use of the Property by SFCWA/WES shall be restricted to the daytime hours between sunrise and sunset on a day-by-day basis, unless otherwise approved in advance in writing by CDFW. No person may use or occupy the Property overnight. Activities on the Property shall be conducted only in a manner which will not interfere with the orderly operation of and activities on the Property. SFCWA/WES shall not use or allow the Property to be used, either in whole or in part, for any purpose other than as herein set forth, without the prior written consent of CDFW (which CDFW may withhold).

16. **CDFW's Right to Enter:** At all times during the term of this Permit, there shall be and is hereby expressly reserved to CDFW and to any of its contractors, agents, employees, representatives, licensees, invitees and guests the right at any and all times, and any and all places, to enter upon and use said Property to survey, inspect, or perform any and all other lawful activities. SFCWA/WES shall not interfere with CDFW's activities on or uses of the Property.

17. **Protection of Property:** SFCWA/WES shall protect the Property, including all improvements and the natural resources thereon, at all times at SFCWA/WES's sole cost and expense, and SFCWA/WES shall strictly adhere to the following restrictions:

    a. SFCWA/WES may not place or dump garbage, trash or refuse anywhere upon or within the Property.

    b. SFCWA/WES may not commit or create, or suffer to be committed or created, or allow to occur any waste, hazardous condition and/or nuisance upon the Property.

    c. SFCWA/WES may not bait, poison, trap, hunt or engage in any other activity which results in the killing, maiming or injury of animals or wildlife upon the Property without first obtaining written permission from the Regional Manager or his or her designee.

    d. SFCWA/WES may not transport, generate, use, store, release, or dispose of hazardous or toxic substances, materials, or waste (including petroleum and products, byproducts and fractions thereof) on, under, about or from the Property.

    e. SFCWA/WES shall exercise due diligence in the protection of the Property against damage or destruction by fire, vandalism or other cause.

    f. SFCWA/WES shall ensure all gates are secured and locked as agreed upon by SFCWA/WES and CDFW.

18. **Breach and Cure:** In the event of a default or breach by SFCWA/WES of any of the terms or conditions set forth in this Permit, CDFW shall send SFCWA/WES written notice specifying the nature of such breach. SFCWA/WES shall have ten (10) business days from the receipt of such notice within which to cure such breach. If more time is reasonably required for SFCWA/WES performance, then SFCWA/WES shall notify CDFW in writing of its proposed schedule for performance and commence performance within such ten (10) business day period; thereafter, SFCWA/WES shall diligently proceed to completion. If SFCWA/WES fails to cure or to commence to cure within such ten (10) business day period, then CDFW may at any time thereafter, without limiting CDFW in the exercise of any right of remedy at law or in equity which CDFW may have by reason of such default or breach:

    a. Maintain this Permit in full force and effect and cure such default or breach at SFCWA/WES's cost. If CDFW at any time, by reason of such default or breach, pays any sum or does any act that requires the payment of any sum, the sum paid by CDFW shall be due immediately from SFCWA/WES to CDFW at the time the sum is paid, and if paid at a late date shall bear the maximum interest allowed by California law from the date the sum is paid by CDFW until CDFW is reimbursed by SFCWA/WES.

    b. Terminate this Permit by giving SFCWA/WES written notice of termination. In such event, CDFW shall be entitled to recover from SFCWA/WES all damages incurred by CDFW by reason of SFCWA/WES's default including, but not limited to, the following:

        i. any amount reasonably necessary to compensate CDFW for all the detriment proximately caused by SFCWA/WES's default or breach of this Permit or which in the ordinary course of events would be likely to result therefrom; plus,

ii. at CDFW's election, such other amounts in addition to or in lieu of the foregoing as may be permitted from time to time by applicable law. Upon termination of this Permit, CDFW shall have the right to make any reasonable repairs, alterations or modifications to the Property, which CDFW, in its sole discretion, deems reasonable and necessary for CDFW's use of the Property.

19. **Revocation of Permit:** CDFW shall have the absolute right to revoke this Permit at any time and for any reason upon ten (10) days written notice to SFCWA/WES. Written notice to SFCWA/WES may be accomplished by electronic or facsimile transmission, and the notice period set forth in this section shall begin on the date of the written notice. If SFCWA/WES is in breach of the Permit or owes money to CDFW pursuant to this Permit, and prepaid monies paid by CDFW shall be held and applied by CDFW as an offset toward damages and/or amounts owed. Nothing stated herein shall limit CDFW's exercise of its legal and equitable remedies.

20. **Voluntary Execution and Independence of Counsel:** By their respective signatures below each party affirms that they have read and understood this Permit and have received independent counsel and advice from their attorneys with respect to the advisability of executing this Permit.

21. **Reliance on Investigations:** SFCWA/WES accepts this Permit, and access to the Property to which it pertains, in its AS-IS condition and has made such investigation of the facts pertaining to this Permit, the Property and all the matters relating to the Project as SFCWA/WES deems necessary.

22. **Entire Agreement:** The parties further declare and represent that no inducement, promise or agreement not herein expressed has been made to them and this Permit contains the entire agreement of the parties, and that the terms of this agreement are contractual and not a mere recital.

23. **Alteration in Writing:** This Permit supersedes any and all prior understandings and agreements, whether written or oral, between the parties with respect to the subject matter of the Permit. No alteration or variation of this Permit shall be valid unless made in writing and signed by CDFW, SFCWA and WES.

24. **Warranty of Authority:** The undersigned represents that they have the authority to, and does, bind the person or entity on whose behalf and for whom they are signing this Permit and the attendant documents provided for herein, and this Permit and said additional documents are, accordingly, binding on said person or entity.

25. **Binding on Successors:** This Permit is binding upon and shall inure to the benefit of each party hereto, their respective agents, attorneys, employees, representatives, assigns and heirs, subject to the limitations in Section 27.

26. **Assignment:** This Permit shall not, nor shall any interest herein be assigned, mortgaged, hypothecated, or transferred by SFCWA/WES, whether voluntary or involuntary or by operation of law, nor shall SFCWA/WES let or sublet or grant any license of permit with respect to the use and occupancy of the Property or any portion thereof, without the written consent of CDFW being first had and obtained and which CDFW may withhold.

27. **Choice of Law:** This Permit will be governed and construed by the laws of the State of California.

28. **Counterparts/Electronic Signatures**. This Permit may be executed in multiple counterparts, each of which shall be deemed an original, but all of which, together, shall constitute one and the same instrument. An electronic email copy or facsimile of a duly executed copy of this Permit shall be deemed for all purposes as receipt of an originally signed document, and any

such copy bearing an electronic email copy or facsimile signature shall be binding upon, and enforceable against, the party to be charged thereby.

29. **Labor Code Requirements; Prevailing Wage**: SFCWA/WES understands and agrees that work performed on the Project may be subject to California Labor Code requirements, which include prevailing wage provisions. For more details, please refer to the Department of Industrial Relations (DIR) website at http://www.dir.ca.gov. SFCWA/WES shall pay prevailing wage to all persons employed in the performance of any part of the Project if required by law to do so.

30. **Recovery of Legal Fees**: If any action including actions or proceedings under Title II of the United States Code is brought by CDFW to enforce or interpret any provisions of this Permit or to restrain the breach of any agreement contained herein, or for the recovery of possession of the Property, or to protect any rights given to CDFW against SFCWA/WES, and if CDFW shall prevail in such action on trial or appeal, the SFCWA/WES shall pay to CDFW such amount in attorney's fees in said action as the court shall determine to be reasonable, which shall be fixed by the court as part of the costs of said action.

IN WITNESS WHEREOF, the parties hereto have caused this Permit to be duly executed as of the day and year set forth below

CDFW:

California Department of Fish and Wildlife

Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
Information: (707) 944-5500
FAX: (707) 944-5563

► ______________________________________
Scott Wilson, Regional Manager Date

SFWCA:

The State and Federal Contractors Water Agency

By: ______________________________
Name: ______________________________
Title: ______________________________

Date: ______________________________

WES:

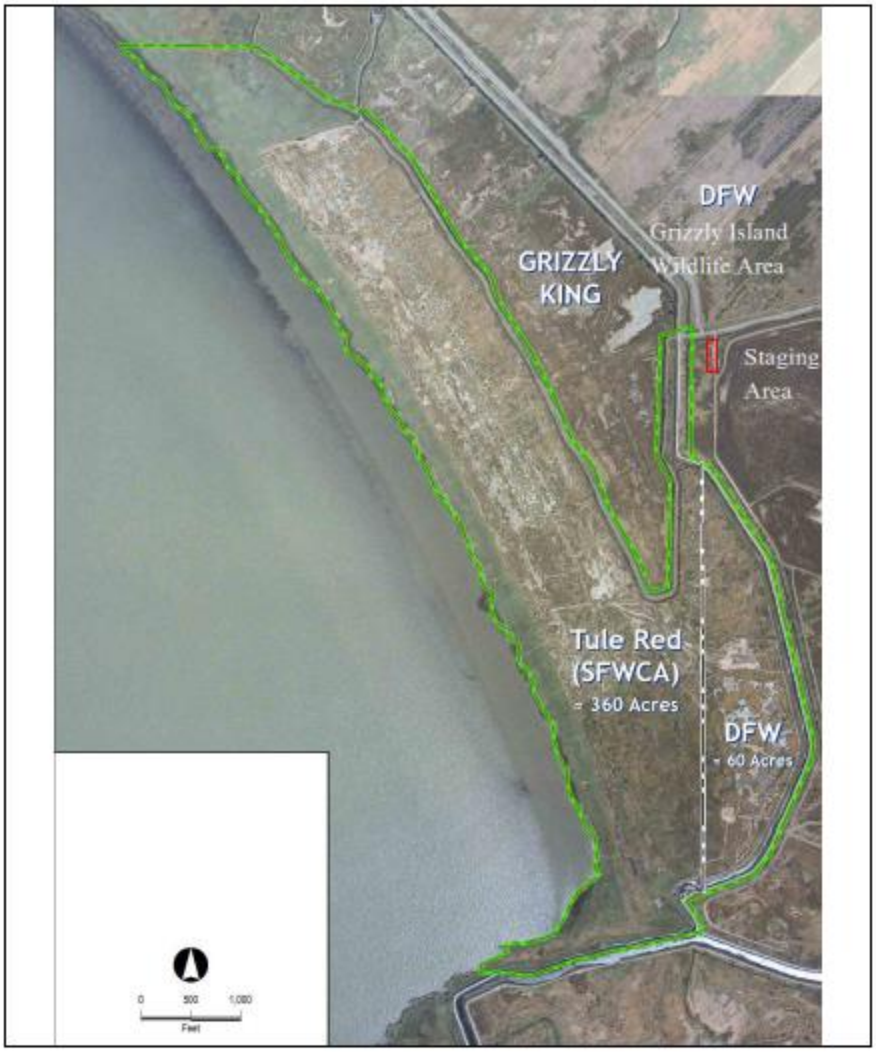
Westervelt Ecological Services, LLC,
a Delaware limited liability company

By: ______________________________
Name: ______________________________
Title: ______________________________

Date: ______________________________

Exhibit A

Map Showing Location of Property (i.e., the 60 acres labeled as "DFW" below together with the "Staging Area" identified below)



SOURCE: Westervelt Ecological Services, 2015

Tule Red Restoration Project . 150158

Figure 2-2
Project Area

Exhibit B

Project Description

The Project site consists of approximately 2,000 acres owned by WES, and approximately 60 acres owned by CDFW. Within the WES property boundary, approximately 1,600 acres lie within the intertidal and sub-tidal zone of Grizzly Bay. The area proposed to be restored to tidal influence is comprised of a crescent of land adjacent to Grizzly Bay, roughly 1,500 feet wide and 8,000 feet long, totaling approximately 420 acres of managed marsh habitat currently maintained as a duck club, generally as shown on the concept plan attached as the last page of this Exhibit B.

The overall purpose for the Project is to restore and enhance approximately 420 acres of tidal wetlands to benefit listed fishes (delta smelt, longfin smelt, and salmonids). The proposed Project would restore managed marsh habitat that is currently used for duck hunting to tidal wetlands, by grading and recontouring a portion of the site to create tidal channels, tidal pannes/basins, and habitat berm; permanently breaching the existing natural berm to reintroduce full daily tidal exchange to the site; and increasing topographic variability and habitat diversity across the site. The project would cut and fill (and balance on-site) approximately 300,000 cubic yards of native soil across approximately 150 acres. The project would commence in the summer of 2016, and is expected to take 2-3 construction seasons (summers) to complete construction, including a 1-2 year period of site stabilization (including re-vegetation) between grading and recontouring activities (Phase 1) and full tidal exposure (Phase 2). The Project is being designed to become a naturally, self-regulating system that would not require extensive management or intervention.

The Project would consist of the following four primary habitat features, as illustrated in the Project Concept Plan:

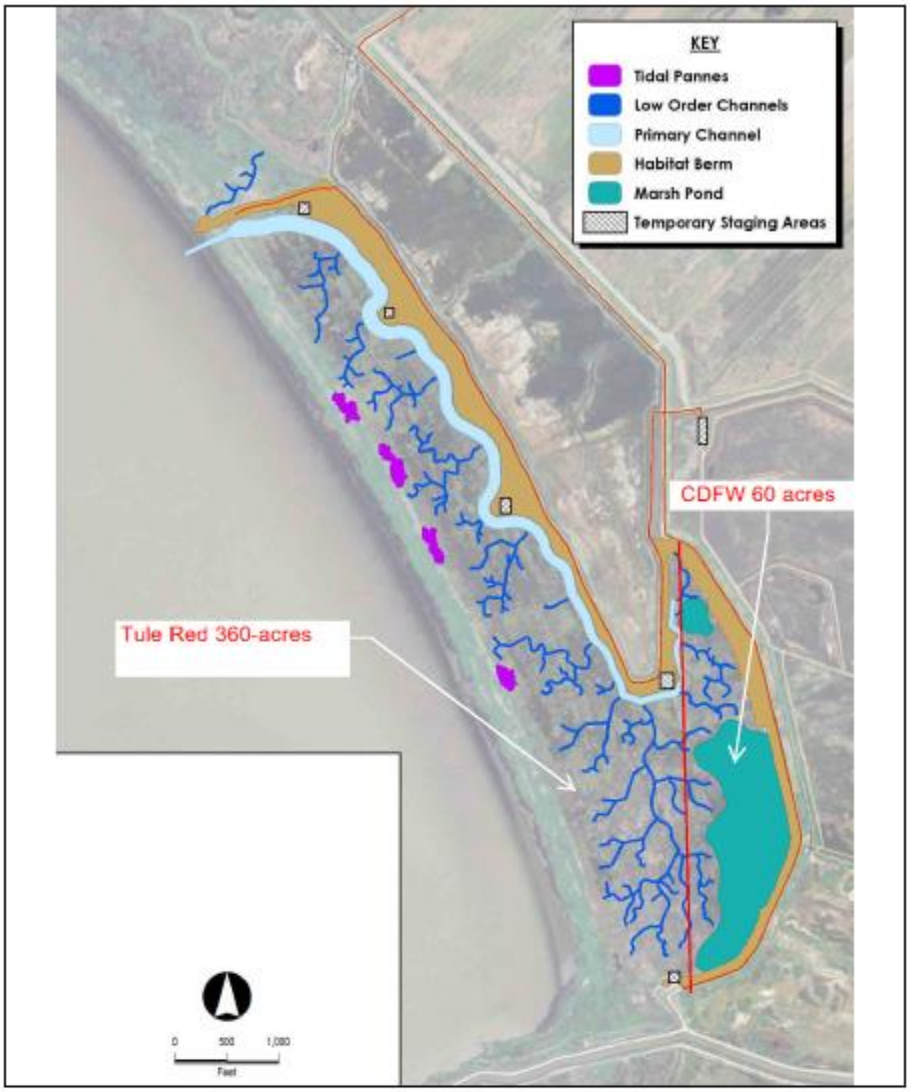
1) a permanent breach of the natural levee to allow for full daily tidal exchange through the interior of the project site;

2) a network of tidal channels to regularly convey water across the marsh plain;

3) a series of tidal pannes/basins intended to retain water for periods of up to 2 weeks, to maximize aquatic food production; and

4) a habitat berm created along the eastern perimeter of the property, which is designed to provide transitional and refugia habitat for sensitive species including the salt marsh harvest mouse; and

5) an array of measures to reduce impacts of low dissolved oxygen drain water received from the CDFW drain pump including, potentially, an aeration structure and retention pond.



SOURCE: Westervelt Ecological Services, 2015

Tule Red Restoration Project
Figure 11
Alternative 4 Concept Design