California High-Speed Rail Authority

Merced to Fresno Section: Central Valley Wye

Final
Second Supplemental Wetlands Delineation Report

USACE File Number SPK-2009-01483

February 2018

CALIFORNIA High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

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ACRONYMS AND ABBREVIATIONS

˚F	degrees Fahrenheit
Approved JD form	Approved Jurisdictional Determination Form
Authority	California High-Speed Rail Authority
BNSF	BNSF Railway
CDFW	California Department of Fish and Wildlife
Central Valley Wye	Merced to Fresno Section: Central Valley Wye
CWA	Clean Water Act
EIR	environmental impact report
EIS	environmental impact statement
FRA	Federal Railroad Administration
HSR	high-speed rail
Hybrid Alignment	Merced to Fresno Section: Hybrid Alignment
OHWM	ordinary high water mark
PG&E	Pacific Gas and Electric
PJD	preliminary jurisdictional determination
PP1	Permitting Phase 1
RPW	relatively permanent waters
SR	State Route
SWANCC	Solid Waste Agency of Northern Cook County
SWRCB	State Water Resources Control Board
TNW	traditional navigable waters
TPSS	traction power substation
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
WETS	Wetland Determination Tables
WOS	waters of the State
WOUS	waters of the United States
WSA	wetland study area

1 INTRODUCTION

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered high-speed rail (HSR) system in California. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90 percent of the state's population. More than 200 weekday trains would serve the statewide intercity travel market. The HSR would be capable of operating speeds of up to 220 miles per hour, with state-of-the art safety, signaling, and automatic train control systems. The system would connect and serve the major metropolitan areas of California, extending from San Francisco and Sacramento in the north to San Diego in the south.

In 2005, the Authority and the Federal Railroad Administration (FRA) prepared the *Final Program Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) for the Proposed California High-Speed Train System* evaluating the HSR's ability to meet the existing and future capacity demands on California's intercity transportation system (Authority and FRA 2005). This was the first phase of a tiered environmental review process (Tier 1) for the proposed statewide HSR system. The Authority and FRA completed the *San Francisco Bay Area (Bay Area) to Central Valley High-Speed Train Final Program EIR/EIS* (Bay Area to Central Valley Program EIR/EIS) in July 2008 to identify a preferred alignment for the San Francisco Bay Area to Central Valley Section (Authority and FRA 2008). The 2008 Bay Area to Central Valley Program EIR/EIS was followed by the *2010 Bay Area to Central Valley High-Speed Train Revised Final Program EIR* (Authority 2010) and the *2012 Bay Area to Central Valley High-Speed Train Partially Revised Final Program EIR* (Authority 2012). These Tier 1 documents are referred to as the Program EIR/EIS documents.

In 2012, the Authority and FRA prepared a second-tier (project-level) environmental analysis for the Merced to Fresno Section of the HSR system and circulated the *2012 Merced to Fresno Section Final EIR/EIS* (Merced to Fresno Final EIR/EIS) (Authority and FRA 2012a). In May 2012, the Authority Board of Directors approved the Merced to Fresno Final EIR/EIS and identified the Hybrid Alignment along with stations in downtown Merced and downtown Fresno as the preferred alternative for the Merced to Fresno Section. The decision on the location of the connecting wye between the Merced to Fresno Section and the San Jose to Merced Section was deferred and the area around the wye was excluded from the approval. The Merced to Fresno Final EIR/EIS (Authority and FRA 2012a) noted that the two east-west alignments at Avenue 24 and Avenue 21, as well as an alignment along State Route (SR) 152, would be carried forward for additional study as part of a future environmental document. Further study between 2012 and 2014 resulted in refinement of the alternatives to the following three: SR 152 (North) to Road 13 Wye Alternative, SR 152 (North) to Road 19 Wye Alternative, and Avenue 21 to Road 13 Wye Alternative. Since 2014, the Authority and FRA have continued to conduct public outreach with local stakeholders. This effort produced additional information about the Central Valley Wye alternatives and informed further refinements to the alternatives. As a result of this additional stakeholder outreach and upon review of improved mapping documentation for the various alignments, a previously considered alternative, SR 152 (North) to Road 11 Wye, is being carried forward for study. The Authority and FRA are evaluating these Central Valley Wye alternatives in the California High-Speed Rail *Merced to Fresno Section: Central Valley Wye Supplemental EIR/Supplemental EIS* (Authority and FRA 2018), which is anticipated for circulation in the summer of 2018.

Two wetlands delineation reports for the Merced to Fresno Section have been submitted to the USACE, both assigned to USACE file number SPK-2009-01483. The first was the *Merced to Fresno Section Wetlands Delineation Report, California High-Speed Train Project Final EIR/EIS* (Primary Wetlands Delineation Report) (Authority and FRA 2012b), and the second was the *Merced to Fresno Section Permitting Phase 1 Supplemental Wetlands Delineation Report, California High-Speed Train Project* (First Supplemental Wetlands Delineation Report) (Authority and FRA 2013). The Primary Wetlands Delineation Report addressed the entire Hybrid Alignment between and including Merced Station and Fresno Station, as described in the Merced to Fresno Final EIR/EIS (Authority and FRA 2012a) (Figure 1-1b). The First Supplemental Wetlands Delineation Report addressed changes resulting from the completion of final design for the Hybrid

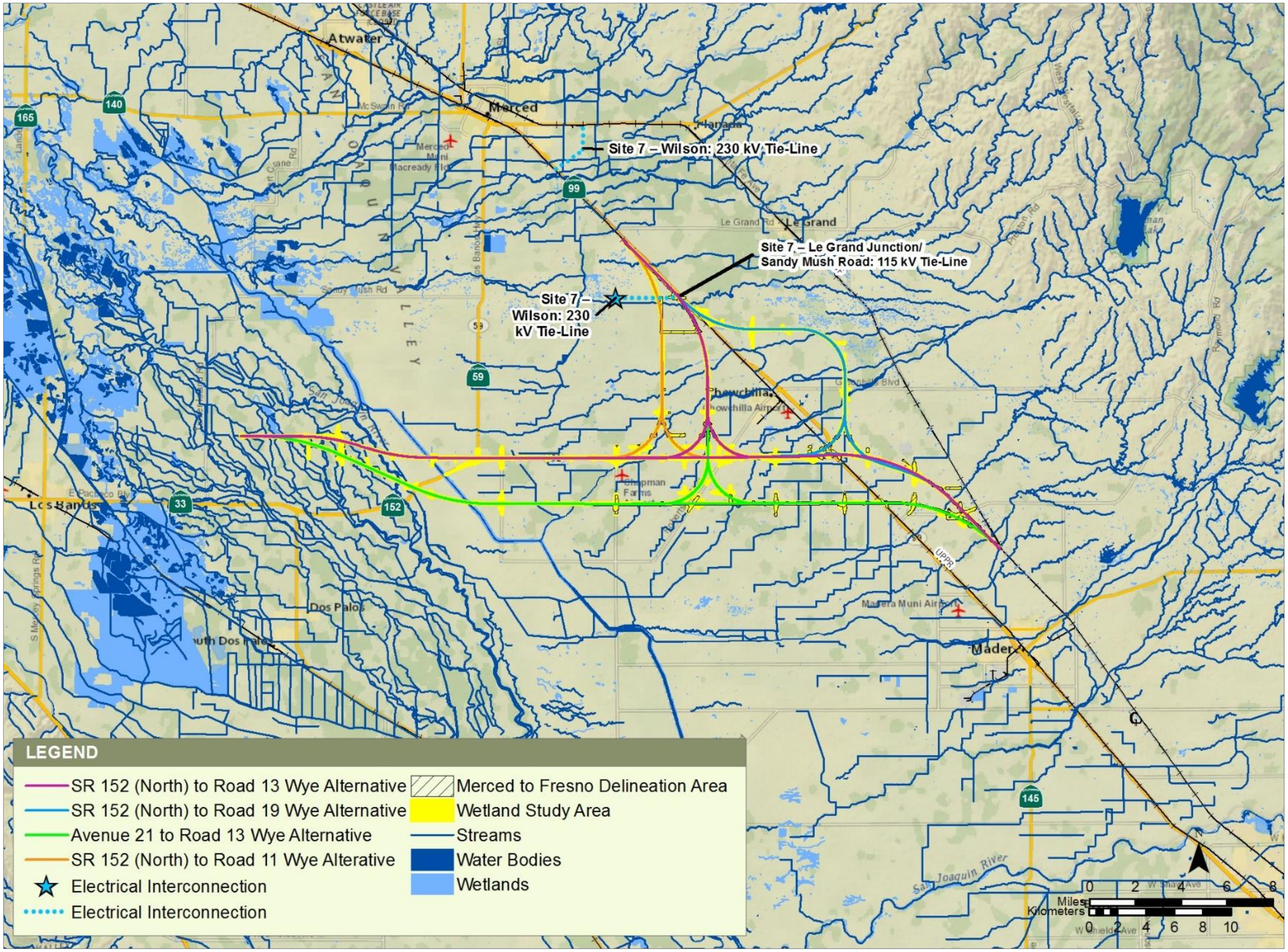
Alignment between Fresno Station and Avenue 17 just north of Madera Acres. A preliminary jurisdictional determination (PJD) was issued by the USACE Sacramento District in November 2011 for aquatic resources (121.87 acres of wetland and 319 acres of other waters) in the Primary Wetlands Delineation Report study area. Additionally, a PJD was issued in 2013 for the First Supplemental Wetlands Delineation Report study area.

This *Merced to Fresno Section: Central Valley Wye Second Supplemental Wetlands Delineation Report* (Second Supplemental Wetlands Delineation Report) discusses the Central Valley Wye and associated electrical interconnection components, herein referred to as the Central Valley Wye[1]. The Central Valley Wye would begin at the intersection of Henry Miller Road and Carlucci Road in the unincorporated area of Merced County and would extend east to its northern endpoint near Ranch Road along SR 99 near the city of Merced and to its southern endpoint at Avenue 19 just north of Madera Acres in an unincorporated area of Madera County (Figure 1-1a).

The purpose of this Second Supplemental Wetlands Delineation Report is to describe the types and extents of aquatic features that occur in the Central Valley Wye that are outside the areas delineated for the Primary Wetlands Delineation Report. The total study area for the Central Valley Wye encompasses 15,530 acres. The wetland study area for this Second Supplemental Wetlands Delineation Report focuses on the 8,360 acres not previously evaluated in the Primary Wetlands Delineation Report and provides an update to mapped features from the overlapping 7,170 acres of the WSA that was verified by the USACE Sacramento District in 2011.

Maps depicting the complete extent of the Central Valley Wye alternatives, the Primary Wetlands Delineation Report study area, and the First Supplemental Wetlands Delineation Report study area are provided on Figures 1-1a, 1-1b, and 1-1c, respectively. Figures 1-1b and 1-1c were taken from the Primary Wetlands Delineation Report and First Supplemental Wetlands Delineation Report, respectively, and reflect the project footprint at the time that the reports were submitted to the USACE, and do not reflect the present Central Valley Wye configuration.

[1] Impacts on WOUS and WOS and associated mitigation pertaining to future implementation of the network upgrades (i.e., future upgrades to the PG&E electrical system to support HSR operational load), anticipated in 2031, are not included and will be permitted at a later date.



Source: ESRI, 2013; CAL FIRE, 2004; ESRI/National Geographic, 2015; Authority and FRA, 2018

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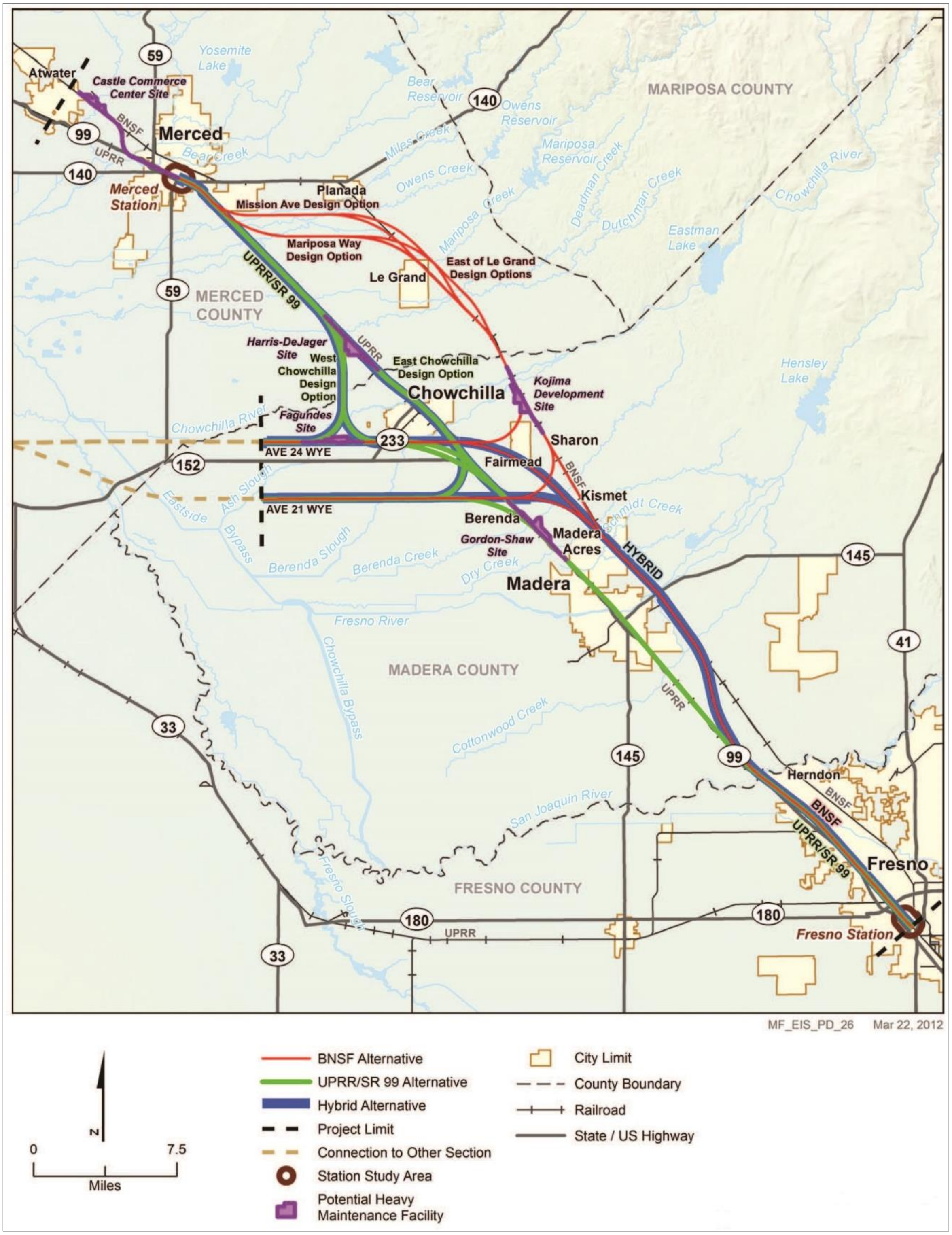
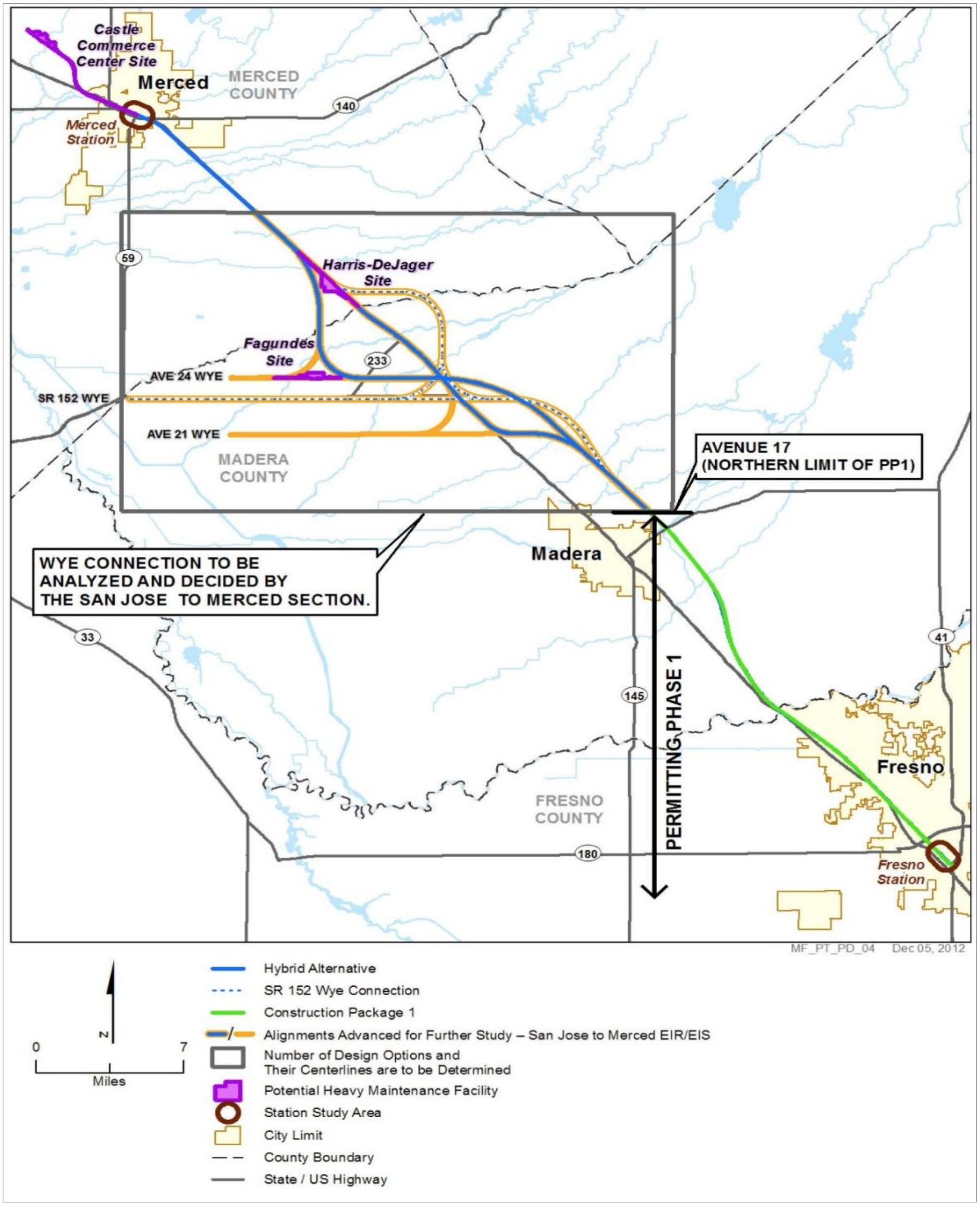
Figure 1-1a Second Supplemental Wetland Delineation Study Area



Source: Authority and FRA, 2012b; Figure from the Primary Wetlands Delineation Report and reflects the project footprint at the time that the report was submitted to the USACE in 2011.

Figure 1-1b Primary Wetlands Delineation Study Area



Source: Authority and FRA, 2013; Figure taken from the First Supplemental Wetlands Delineation Report and reflects the project footprint at the time that the report was submitted to the USACE in 2013. Since that time, Permitting Phase 1 has been extended northward from Avenue 17 to Avenue 19, and the Authority and FRA have decided to evaluate Central Valley Wye alternatives in a Merced to Fresno Section: Central Valley Wye Supplemental Environmental Impact Report/Supplemental Environmental Impact Statement instead of a San Jose to Merced Section Environmental Impact Report/Environmental Impact Statement.

Figure 1-1c First Supplemental Wetlands Delineation Study Area

Delineation fieldwork for this Second Supplemental Wetlands Delineation Report was conducted in June and August 2013, December 2014, April 2015, and August and September of 2016 on properties where property owners granted access to identify the general location, type, and characteristics of features in the WSA that may be subject to state and federal regulation. Fieldwork was conducted using the routine on-site determination method described in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the supplemental procedures and wetland indicators provided in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE 2008a). This report is intended to comply with the USACE Sacramento District's *Minimum Standards for Acceptance of Aquatic Resources Delineation Reports* (USACE 2016a) and the South Pacific Division's *Updated Map and Drawing Standards for the South Pacific Division* (USACE 2016b), where applicable. This report was prepared to support an upcoming request from the Authority to the USACE Sacramento District for a PJD. Mapping of potential jurisdictional features presented in this report is subject to verification by USACE.

During the summer and fall of 2016, the 2011 Merced to Fresno delineation data was updated in the Central Valley Wye study area. This update consisted of reviewing each delineated feature and remapping or removing features that have changed over the past 5 years. This updated was conducted by aerial photograph interpretation and viewing features from public rights-of-way. A total of 230.72 acres of potential wetlands and 'other' waters (i.e., non-wetlands) consisting of 71.77 acres of potential wetlands and 158.95 acres of potential other waters were identified in the WSA.

On December 5, 2017, the consultant's wetland specialists and representatives from the USACE Sacramento District conducted a field verification site visit. Aquatic features were updated, added, and removed during the verification process. A total of 215.93 acres of wetlands and other waters consisting of 15.24 acres of wetland and 200.69 acres of other waters were mapped in the WSA. Table 1-1 presents these acreages by type of wetland or other water feature.

Table 1-1 Acreages of Potential Waters of the United States in the Wetland Study Area

Wetlands and Other Waters	Acreage in Wetland Study Area
Wetlands	
Vernal pool	1.52
Seasonal wetland	13.38
Palustrine forested wetland	0.34
Wetlands subtotal	15.24
Other Waters	
Constructed basin	34.45
Constructed watercourse	81.67
Natural watercourse	84.57
Other waters subtotal	200.69
Total Waters of the United States	**215.93**

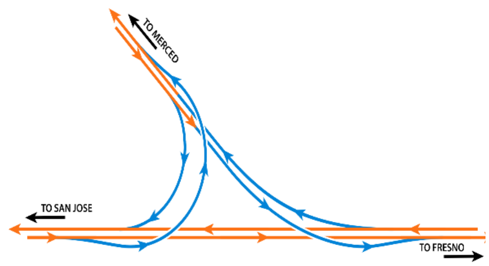
Source: Calculations generated using ESRI ArcGIS versions 10.1, 10.2, and 10.3 from data generated by field surveys and aerial photo interpretation during 2010–2017.
Total wetlands and other waters acreage figures shown in this table may differ slightly from the corresponding acreage figures shown in the Appendix C, Delineated Wetlands and Other Waters of the U.S. Wetland Study Area map book because of rounding differences.

2 MERCED TO FRESNO SECTION: CENTRAL VALLEY WYE

The Central Valley Wye would create the east-west HSR connection between the San Jose to Merced Section to the west and the north-south Merced to Fresno Section to the east.[2] The four Central Valley Wye alternatives addressed in the Supplemental EIR/EIS (Figures 2-1 to 2-4) are:

- SR 152 (North) to Road 13 Wye Alternative
- SR 152 (North) to Road 19 Wye Alternative
- Avenue 21 to Road 13 Wye Alternative
- SR 152 (North) to Road 11 Wye Alternative

Central Valley Wye Schematic



This section describes the common design features of the four alternatives, followed by descriptions of each alternative. Volume 2, Appendix 2-A, System Infrastructure, of the Supplemental EIR/EIS provides further detail on performance criteria, infrastructure components and systems, and function of the Central Valley Wye and the HSR system as a whole.

2.1 Common Features

The Central Valley Wye alternatives would cross rural areas in unincorporated Merced and Madera Counties, and would travel through the southern portion of Chowchilla and the rural-residential community of Fairmead. Volume 3 of the Supplemental EIR/EIS provides detailed design drawings that support the descriptions of the Central Valley Wye alternatives.

The HSR alignment would be entirely grade-separated, meaning that crossings of roads, railroads, and other transport facilities would use overpasses or underpasses so that the HSR would operate independently of other modes of transport. The HSR right-of-way would also be fenced to prevent public or vehicle access. The Central Valley Wye project footprint would primarily consist of the train right-of-way, which would accommodate two sets of tracks in an area with a minimum width of 100 feet. Additional right-of-way would be required to accommodate grade separations, embankments, traction power facilities, and transitional portions of the Central Valley Wye that allow for bidirectional interface between north-south and east-west trending alignments.

The Central Valley Wye alternatives would include at-grade, below-grade, and above-grade (elevated) track segments. The at-grade track would be laid on an earthen railbed raised 6–10 feet (embankment heights are in excess of 35 feet) off the ground level, set on ties with rock ballast; fill and ballast for the railbed would be obtained from permitted borrow sites and quarries. Below-grade track would be laid in open cut, trench, or cut-and-cover tunnel at a depth that would allow roadway and other grade-level uses above the track. Elevated track segments would span some waterways, roadways, railroad, and other HSR tracks, and would consist of precast, pre-stressed concrete box girders, cast-in-place concrete box girders, or steel box girders. The height of elevated track sections would depend on the height of existing structures below, or clearances to existing roads or other HSR facilities, and would range from 35 to 90 feet above grade. Columns would be spaced approximately 100–120 feet apart on average.

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[2] The term *wye* refers to the Y-like formation created at the point where train tracks branch off the mainline to continue in different directions. The transition of mainline track to a wye requires splitting two tracks into four tracks that cross over one another before the wye "legs" (segments) can diverge in opposite directions to allow two-way travel. For the Merced to Fresno Section of the HSR system, the two tracks traveling east-west from the San Jose to Merced Section must become four tracks—a set of two tracks branching toward Merced to the north and a set of two tracks branching toward Fresno to the south.

2.2 SR 152 (North) to Road 13 Wye Alternative

The SR 152 (North) to Road 13 Wye Alternative (Figure 2-1) follows the existing Henry Miller Road and SR 152 rights-of-way as closely as possible in the east-west direction, and the Road 13, SR 99, and BNSF Railway (BNSF) rights-of-way in the north-south direction. Deviations from these existing transportation routes or corridors are necessary to accommodate design requirements; specifically, wider curves are necessary to accommodate the speed of the HSR compared to lower-speed roadway alignments. The SR 152 (North) to Road 13 Wye Alternative would not follow existing transportation rights-of-way where it transitions from following one transportation corridor to another.

2.2.1 Alignment and Ancillary Features

The SR 152 (North) to Road 13 Wye Alternative would extend approximately 52 miles, mostly at-grade on raised embankment, although it would also have aerial structures and a segment of retained cut (depressed alignment). The wye configuration of this alternative would be located southwest of the city of Chowchilla, with the east-west axis along the north side of SR 152 and the north-south axis on the east side of Road 13.

As shown on Figure 2-1, this alternative would begin in Merced County at the intersection of Henry Miller Road and Carlucci Road, and would continue at-grade on embankment due east toward Elgin Avenue, where it would curve southeast toward the San Joaquin River and Eastside Bypass. Approaching Willis Road, the alignment would cross the San Joaquin River on an aerial structure, and then would return to embankment. It would then cross the Eastside Bypass on an aerial structure. After crossing the Eastside Bypass, the alignment would continue east and cross SR 59 at-grade just north of the existing SR 152/SR 59 interchange, entering Madera County. The SR 152/SR 59 interchange would be reconstructed a little to the south and SR 59 would be grade-separated to pass above the HSR on an aerial structure. The alignment would continue east at-grade along the north side of SR 152 toward Chowchilla, splitting into two legs (four tracks) near Road 11 to transition to the Merced to Fresno Section: Hybrid Alignment, and would cross Ash Slough on an aerial structure. All but the northbound track of the San Jose to Merced section of the alignment (leg) would then return to at-grade embankment. The northbound track would rise to cross over the tracks of the San Jose to Fresno leg on aerial structure as it curves north toward Merced. The SR 152 (North) to Road 13 Wye Alternative legs would be routed as described below and as shown on Figure 2-1:

- The southbound track of the San Jose to Merced leg[3] would be at-grade. This split (where tracks separate) would be west of Chowchilla, at approximately Road 11. The two San Jose to Merced tracks would continue north on the eastern side of Road 13, crossing Ash Slough and the Chowchilla River, and then would cross over Road 13 to its west side. As the tracks return to grade, they would curve northwest, crossing Dutchman Creek on an aerial structure, and follow the west side of the Union Pacific Railroad (UPRR)/SR 99 corridor. At Sandy Mush Road, the alignment would descend into a shallow cut (depressed) section for approximately 0.5 mile, with a retained cut-and-cover undercrossing[4] at Caltrans' Sandy Mush Road overhead. The alignment would return to grade and continue along the west side of the UPRR/SR 99 corridor, connecting to the Merced to Fresno Section: Hybrid Alignment at Ranch Road.

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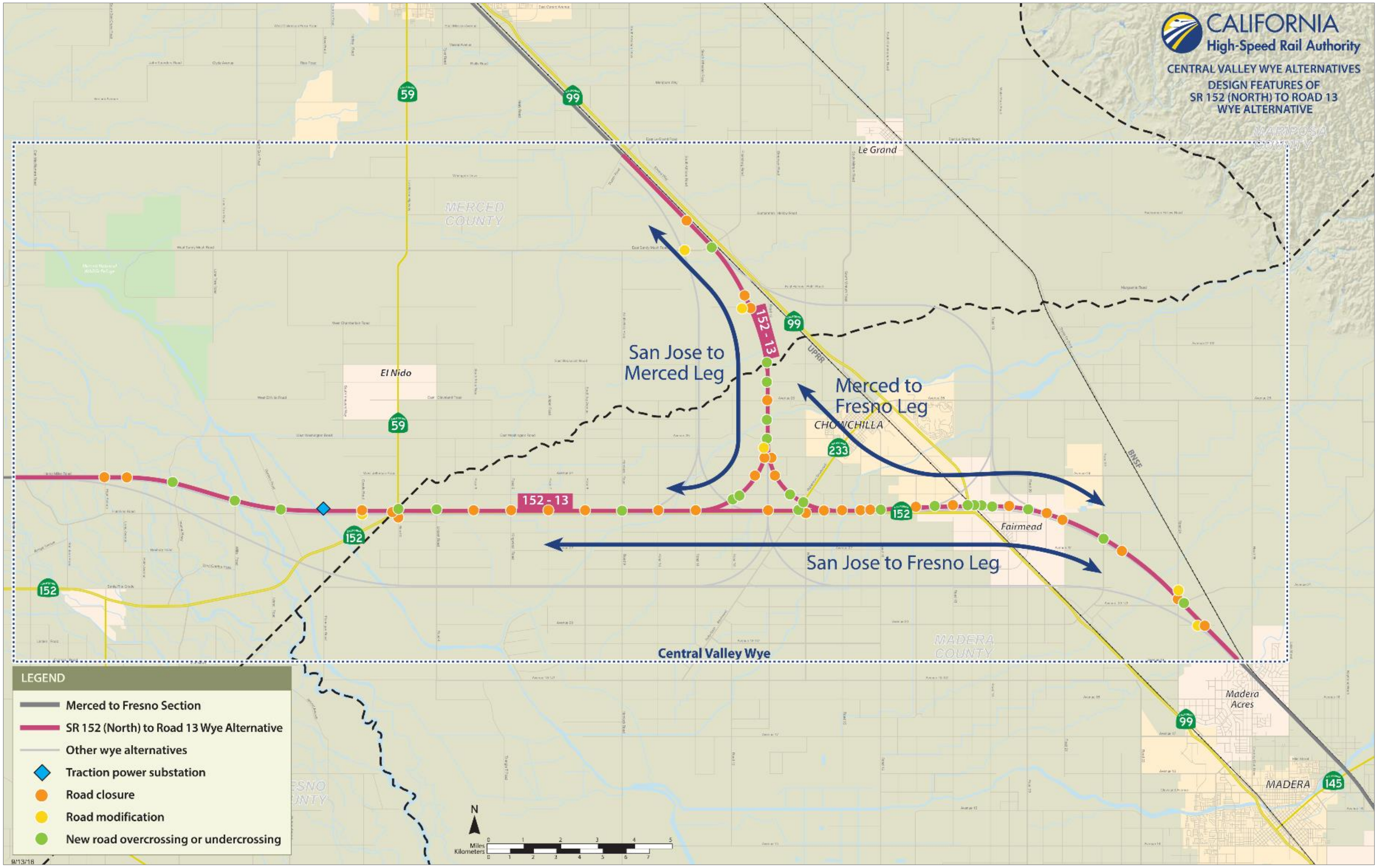
[3] A track is included in a leg; e.g., southbound track of the San Jose to Merced leg.
[4] An undercrossing is a road or track crossing under an existing road or track.



Source: ESRI, 2013; CAL FIRE, 2004; ESRI/National Geographic, 2015; Authority and FRA, 2018

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Figure 2-1 SR 152 (North) to Road 13 Wye Alternative Alignment and Key Design Features

- The San Jose to Fresno leg of this alternative would continue east from the split near Road 11 and along the north side of SR 152 toward Chowchilla. It would be predominantly at-grade, crossing several roads and Berenda Slough on aerial structures. The alignment would pass south of Chowchilla at-grade then would rise to cross over the UPRR/SR 99 corridor and Fairmead Boulevard on an aerial structure. East of the UPRR/SR 99 corridor, the alternative would extend at-grade through Fairmead, north of Avenue 23. At approximately Road 20, the alignment would curve southeast toward the BNSF corridor and cross Dry Creek on a short aerial structure. The San Jose to Fresno leg would align parallel to the west side of the BNSF corridor as it meets the Merced to Fresno Section: Hybrid Alignment at Avenue 19.
- The Merced to Fresno leg of the alternative would split from the San Jose to Fresno leg near Road 14, where the southbound track of the Merced to Fresno leg would ascend on aerial structure, crossing over the tracks of the San Jose to Fresno leg. The northbound track would curve northwest, rise on a high embankment crossing over several roads, and continue on an at-grade embankment until joining the San Jose to Merced leg near Avenue 25.

Wildlife undercrossing structures would be installed in at-grade embankments along this alternative where the alignment intersects wildlife corridors.

2.2.2 Electrical Interconnections

For Site 6—El Nido, interconnection facilities would include a 115 kV TPSS and switching station located immediately east of where the SR 152 (North) to Road 13 Wye Alternative crosses the Eastside Bypass. This new switching station would connect to the Wilson–Oro Loma 115 kV Power Line.

For Site 7—Wilson, interconnection facilities would include a 230 kV TPSS and an approximately 2.3-mile double-circuit 230 kV transmission line (230 kV Tie-Line) to the Wilson Substation. The TPSS and approximately 0.5 mile of the 230 kV Tie-Line were previously analyzed in the Merced to Fresno Final EIR/EIS. To support this interconnection, PG&E would need to rebuild the existing Wilson 230 kV Substation to a 4-Bay Breaker-And-A-Half (BAAH) configuration within the existing fence line.

Backup electrical power would be supplied by an emergency standby generator for select electrical loads, including fire protection systems, ventilation systems, emergency lights and signage, communication systems, train controls systems, and low-voltage direct-current battery supply systems to support emergency lighting and communications.

2.2.3 State Highway or Local Roadway Modifications

The SR 152 (North) to Road 13 Wye Alternative would require the permanent closure of 38 public roadways at selected locations and the construction of 24 overcrossings[5] or undercrossings in lieu of closure. Figure 2-1 shows the anticipated state highway and local roadway closures and modifications. Fourteen of these permanent road closures would be located at SR 152, where roads currently cross at-grade but need to be closed to convert SR 152 to a fully access-controlled corridor. The 14 proposed closures are Road 5, Road 6, Road 7, Road 8, Road 10, Road 11, Road 13, Road 14, Road 14 1/2, Road 15, Road 15 1/2, Road 15 3/4, Road 17, and Road 18. Planned new grade separations along SR 152 at the SR 59/SR 152 Interchange, Road 4/Lincoln Road, Road 12, and Road 17 1/2 would maintain access to, and across, SR 152. These roadways would be reconfigured to two 12-foot lanes with two 8-foot shoulders. Each of the new interchanges would require realigning SR 152. Three new interchanges are proposed between SR 59 and SR 99 to provide access to SR 152: at Road 9/Hemlock Road, SR 233/Robertson Boulevard, and Road 16.

The distance between overcrossings or undercrossings would vary from less than 2 miles to approximately 5 miles where other roads are perpendicular to the proposed HSR. Between these overcrossings or undercrossings, 24 additional roads would be closed, as shown on Figure 2-1.

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[5] An overcrossing is a road or track crossing over an existing road or track.

Local roads paralleling the proposed HSR alignment and used by small communities and farm operations may be shifted and reconstructed to maintain their function. Access easements would be provided to maintain access to properties severed by HSR.

2.2.4 Freight or Passenger Railroad Modifications

The SR 152 (North) to Road 13 Wye Alternative would cross over the UPRR right-of-way south of Chowchilla. This alternative would maintain required vertical (at least 23.3 feet) clearance over UPRR operational right-of-way to avoid or minimize impacts on UPRR rights-of-way, spurs, and facilities (BNSF and UPRR 2007). In areas where the SR 152 (North) to Road 13 Wye Alternative parallels the UPRR right-of-way, the alternative maintains a minimum horizontal clearance of 102 feet from the centerline to the UPRR right-of-way.

2.2.5 Summary

Table 2-1 summarizes the design features for the SR 152 (North) to Road 13 Wye Alternative.

Table 2-1 Design Features of the SR 152 (North) to Road 13 Wye Alternative

Feature	SR 152 (North) to Road 13 Wye
Total length (linear miles)[1]	52
At-grade profile (linear miles)[1]	48.5
Elevated profile (linear miles)[1]	3
Below-grade profile (linear miles)[1]	0.5
Number of straddle bents	32
Number of railroad crossings	1
Number of major water crossings	12
Number of road crossings	62
Approximate number of public roadway closures	38
Number of roadway overcrossings and undercrossings	24
Traction power substation sites	1
Switching and paralleling stations	1 switching station, 8 paralleling stations
Signaling and train-control elements	18
Communication towers	9
Wildlife crossing structures	39

Source: Authority, 2015

[1] Lengths shown are based on equivalent dual-track alignments and are one-way mileages. For example, the length of single-track elevated structure will be divided by a factor of 2 to convert to dual-track equivalents.

2.3 SR 152 (North) to Road 19 Wye Alternative

The SR 152 (North) to Road 19 Wye Alternative (Figure 2-2) is designed to follow the existing Henry Miller Road and SR 152 rights-of-way as closely as practicable in the east-west direction and Road 19, SR 99, and BNSF rights-of-way in the north-south direction. Deviations from these existing transportation corridors would be necessary to accommodate design requirements; specifically, larger curves would be necessary to accommodate the high speed of the HSR compared to lower-speed roadway alignments. The SR 152 (North) to Road 19 Wye Alternative would not follow existing transportation rights-of-way as it transitions from following one transportation corridor to another.

2.3.1 Alignment and Ancillary Features

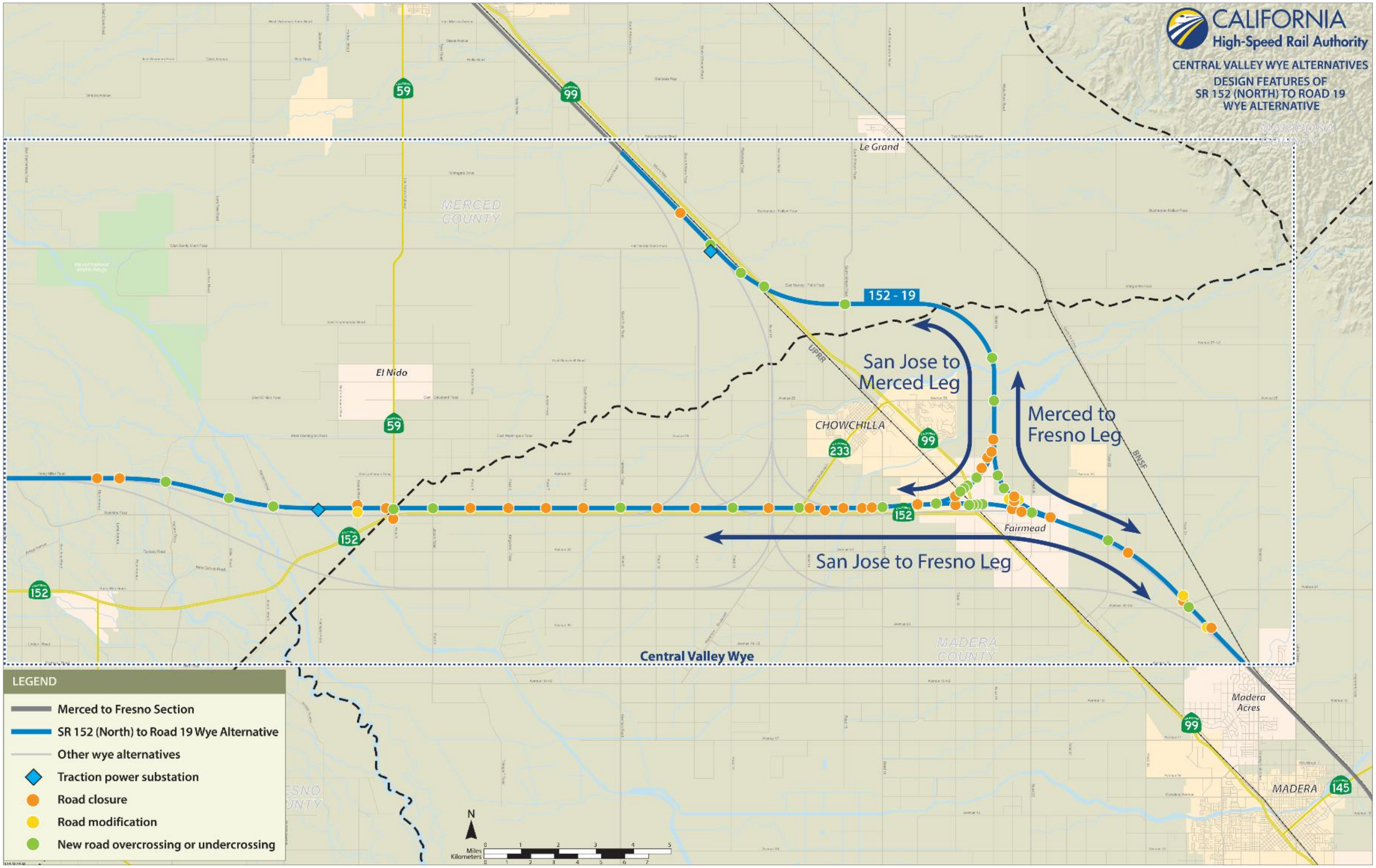
The SR 152 (North) to Road 19 Wye Alternative would extend approximately 55 miles, mostly at-grade on embankment, although it would also have aerial structures, retained cut (depressed alignment), and depressed tunnel undercrossings of major railroad and highway corridors. The wye configuration of this alternative would be located southeast of the city of Chowchilla and north of Fairmead, with the east-west axis along the north side of SR 152 and the north-south axis on the east side of Road 19.

Beginning at the intersection of Henry Miller Road and Carlucci Road (at the same point in Merced County as the SR 152 [North] to Road 13 Wye Alternative), this alternative would continue east toward Elgin Avenue, where it would curve southeast toward the San Joaquin River. It would cross the river on an aerial structure, returning to an at-grade embankment, then onto another aerial structure to cross the Eastside Bypass. After crossing the Eastside Bypass, the alignment would continue east and cross SR 59 at-grade just north of the existing SR 152/SR 59 interchange, where it would enter Madera County. It would continue east at-grade along the north side of SR 152 toward Chowchilla, crossing Ash Slough and Berenda Slough on aerial structures. As it crosses Road 16, the alignment would split into two legs (four tracks) to transition to the Merced to Fresno Section: Hybrid Alignment. East of Road 17, the San Jose to Merced leg would curve northeast, rising to cross the UPRR/SR 99 corridor on an aerial structure, and then would continue north along the east side of Road 19.

As the alignment approaches Avenue 25, the San Jose to Merced and Merced to Fresno legs would converge, requiring the northbound track of the San Jose to Merced leg to rise on an aerial structure and cross over the tracks of the Merced to Fresno leg.

- The San Jose to Merced leg would continue north to just south of Ash Slough, where it would curve west, cross Ash Slough and the Chowchilla River on aerial structures, and continue west approximately 0.5 mile south of Harvey Pettit Road. West of South Minturn Road, the leg would curve northwest and descend below-grade into a series of three tunnels crossing under the SR 99 and UPRR corridors and the Caltrans Sandy Mush Road overhead. The UPRR tracks would be reconstructed on the roof of the HSR cut-and-cover tunnels, while maintaining the same horizontal and vertical alignment. Construction of this type of below-grade crossing would require temporarily realigning the UPRR tracks. Approximately 0.6 mile north of Sandy Mush Road, the alternative would ascend to grade and continue along the UPRR/SR 99 corridor to connect with the Merced to Fresno Section: Hybrid Alignment at Ranch Road.
- The San Jose to Fresno leg would continue east from Road 16 and, east of Road 18, ascend on an aerial structure to cross SR 99 north of the SR 99/SR 152 interchange. East of the UPRR/SR 99 corridor, the leg would continue north of Avenue 23 through Fairmead, descending to grade east of Road 18 ¾. The alternative would then curve southeast toward the BNSF corridor, crossing Dry Creek on a short aerial structure, and continuing along the west side of the BNSF corridor to join the Merced to Fresno Section: Hybrid Alignment at Avenue 19.
- The Merced to Fresno leg would split from the San Jose to Fresno leg near Road 20 ½. The southbound track of the Merced to Fresno leg would ascend on an aerial structure and cross over the tracks of the San Jose to Fresno leg. The Merced to Fresno leg would curve northwest, rise on aerial structures over several road crossings, and then continue at-grade to join the San Jose to Merced leg near Avenue 25.

Wildlife undercrossing structures would be provided in at-grade embankments where the alignment intersects wildlife corridors.



Source: ESRI, 2013; CAL FIRE, 2004; ESRI/National Geographic, 2015; Authority and FRA, 2018

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Figure 2-2 SR 152 (North) to Road 19 Wye Alternative Alignment and Key Design Features

2.3.2 Electrical Interconnections

For Site 6—El Nido, interconnection facilities would include a 115 kV TPSS and switching station located immediately east of where the SR 152 (North) to Road 19 Wye Alternative crosses the Eastside Bypass. This new switching station would connect to the existing Wilson–Oro Loma 115 kV power line.

For Site 7—Le Grand Junction/Sandy Mush Road, interconnection facilities would include a 115 kV TPSS connected to a new switching station located on the east side of the UPRR/SR 99 corridor at the corner of East Sandy Mush Road and South Bliss Road via a new approximately 2.6-mile double-circuit 115 kV power line (115 kV Tie-Line). The new switching station would connect to the Wilson–Oro Loma, Wilson–Le Grand and Wilson–Dairyland (idle) 115 kV lines.

Backup electrical power would be supplied by an emergency standby generator for select electrical loads, including fire protection systems, ventilation systems, emergency lights and signage, communication systems, train controls systems, and low-voltage direct-current battery supply systems to support emergency lighting and communications.

2.3.3 State Highway or Local Roadway Modifications

The SR 152 (North) to Road 19 Wye Alternative would require the permanent closure of 36 public roadways at selected locations and the construction of 29 overcrossings or undercrossings. Table 2-2 and Figure 2-2 show the anticipated state highway and local roadway closures and modifications. Fourteen of these permanent road closures would be located at SR 152 where roads currently cross at-grade but must be closed to convert SR 152 to a fully access-controlled corridor. The proposed 14 closures are Road 5, Road 6, Road 7, Road 8, Road 10, Road 11, Road 13, Road 14, Road 14 ½, Road 15, Road 15 ½, Road 15 ¾, Road 17, and Road 18. New grade separations are planned along SR 152 at the SR 59/SR 152 interchange, Road 4/Lincoln Road, Road 12, SR and Road 17 ½. These roadways would be reconfigured to two 12-foot lanes with two 8-foot shoulders, and several of these interchanges would require realigning SR 152. Interchanges between SR 59 and SR 99 that would provide access to SR 152 are Road 9/Hemlock Road, SR 233/Robertson Boulevard, and Road 16.

The distance between overcrossings or undercrossings would vary from less than 2 miles to approximately 5 miles where roads would be perpendicular to the proposed HSR. Between these overcrossings or undercrossings, 22 additional roads would be closed (Figure 2-2). Local roads paralleling the proposed HSR alignment and used by small communities and farm operations may be shifted and reconstructed to maintain their function. Access easements would be provided to maintain access to properties severed by HSR.

The SR 152 (North) to Road 19 Wye Alternative would cross over SR 99 at three locations. South of Chowchilla, both the San Jose to Merced and the San Jose to Fresno legs would rise on aerial structures to cross SR 99. Another crossing of SR 99 would be at the northern end of the alternative, where it descends below-grade into an undercrossing tunnel segment. SR 99 would be temporarily realigned during construction, and would be reconstructed on the roof of the undercrossing tunnel.

2.3.4 Freight or Passenger Railroad Modifications

The SR 152 (North) to Road 19 Wye Alternative would cross over the UPRR corridor at three separate locations. South of Chowchilla, both the San Jose to Merced and the San Jose to Fresno legs would rise on aerial structures to cross the UPRR operational right-of-way. In these instances, the alternative would maintain required vertical (at least 23.3 feet) clearance over UPRR operational right-of-way to avoid or minimize impacts on UPRR rights-of-way, spurs, and facilities (BNSF and UPRR 2007). The third crossing of the UPRR corridor would be at the northern end of the alternative, where the alignment would descend into an undercrossing tunnel. The UPRR tracks would be reconstructed on the roof of the HSR tunnel, maintaining the same vertical alignment. Construction of this crossing would require the temporary detour (shoofly)[6] of the UPRR tracks. In areas where the SR 152 (North) to Road 19 Wye Alternative parallels the UPRR right-of-way, the alternative maintains a minimum horizontal clearance of 102 feet from the centerline to the UPRR right-of-way.

2.3.5 Summary

Table 2-2 summarizes the design features for the SR 152 (North) to Road 19 Wye Alternative.

Table 2-2 Design Features of the SR 152 (North) to Road 19 Wye Alternative

Feature	SR 152 (North) to Road 19 Wye
Total length (linear miles)[1]	55
At-grade profile (linear miles)[1]	48.5
Elevated profile (linear miles)[1]	3.5
Below-grade profile (linear miles)[1]	3
Number of straddle bents	31
Number of railroad crossings	3
Number of major water crossings	13
Number of road crossings	65
Approximate number of public roadway closures	36
Number of roadway overcrossings and undercrossings	29
Traction power substation sites	2
Switching and paralleling stations	2 switching stations, 7 paralleling stations
Signaling and train-control elements	21
Communication towers	6
Wildlife crossing structures	41

Source: Authority, 2015
[1] Lengths shown are based on equivalent dual-track alignments and are one-way mileages. For example, the length of single-track elevated structure will be divided by a factor of 2 to convert to dual-track equivalents.

2.4 Avenue 21 to Road 13 Wye Alternative

The Avenue 21 to Road 13 Wye Alternative (Figure 2-3) is designed to follow the existing Henry Miller Road and Avenue 21 rights-of-way as closely as practicable in the east-west direction and the Road 13, SR 99, and BNSF rights-of-way in the north-south direction. Deviations from these existing transportation corridors would be necessary to accommodate design requirements; specifically, larger curves would be necessary to accommodate the high speeds of the HSR compared to lower-speed roadway alignments. The Avenue 21 to Road 13 Wye Alternative would not follow existing transportation rights-of-way as it transitions from following one transportation corridor to another.

2.4.1 Alignment and Ancillary Features

The Avenue 21 to Road 13 Wye Alternative would extend approximately 53 miles, mostly at-grade on embankment, although it would also have aerial structures and a short segment of retained cut (depressed alignment). The wye configuration of this alternative would be located

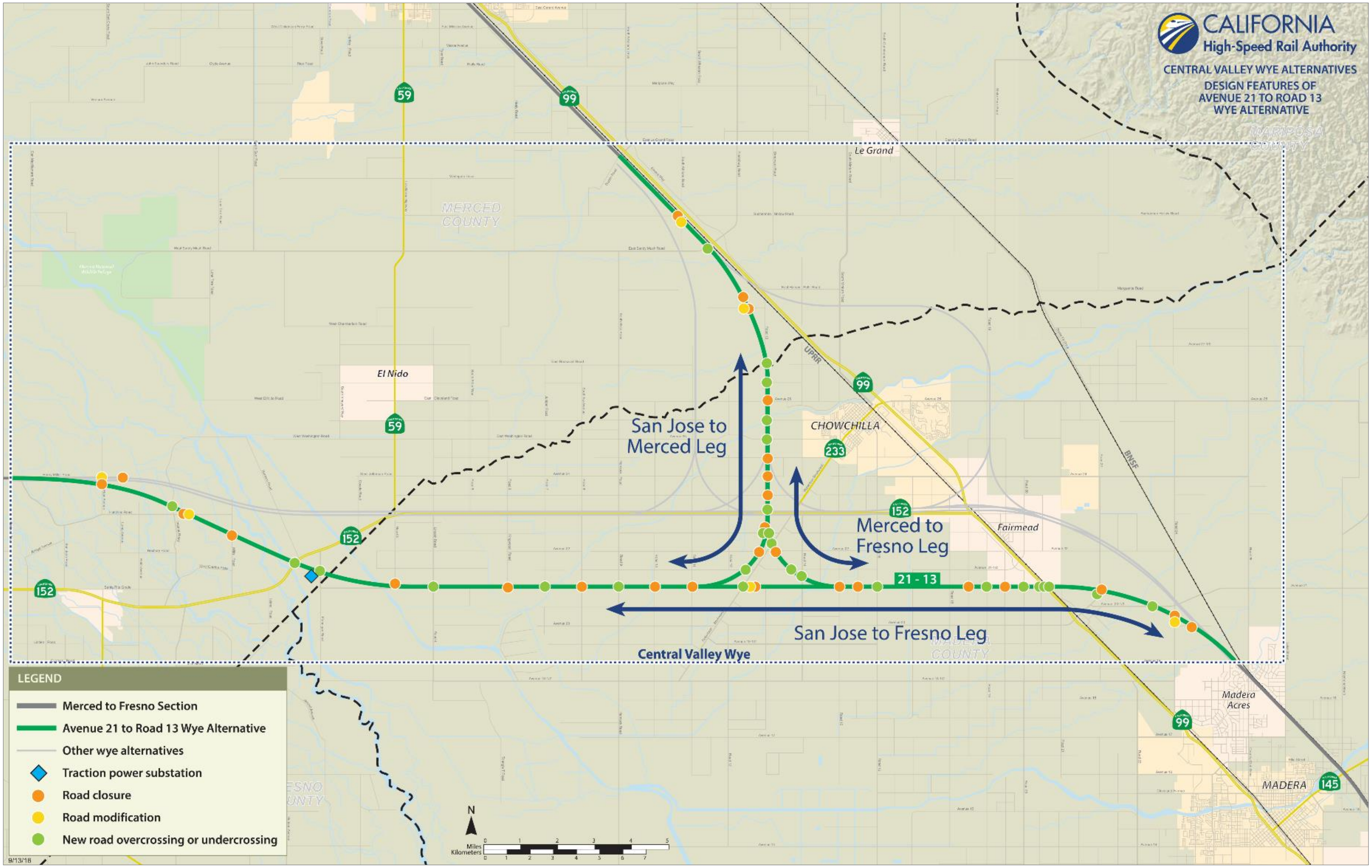
[6] A shoofly is a temporary track alignment that detours trains around a construction site.

approximately 4 miles southwest of the city of Chowchilla, with the east-west axis along the north side of Avenue 21 and the north-south axis on the east side of Road 13.

Beginning at the intersection of Henry Miller Road and Carlucci Road (at the same point in Merced County as the SR 152 [North] to Road 13 Wye Alternative), west of Elgin Avenue this alternative would curve southeast toward the San Joaquin River and Eastside Bypass. East of Willis Road, the alignment would rise to an aerial structure to cross the river, SR 152, and the Eastside Bypass. The alignment would continue east along the north side of Avenue 21, crossing Ash Slough on an aerial structure. Southwest of Chowchilla, near Road 11, the alignment would split into two legs (four tracks) for transition to the Merced to Fresno Section: Hybrid Alignment. The San Jose to Merced leg would curve northeast, cross Road 13, and continue north along the east side of Road 13. At the beginning of the San Jose to Merced leg, the northbound track alternative would rise onto an aerial structure to cross over the tracks of the San Jose to Fresno leg. The Avenue 21 to Road 13 Wye Alternative legs would be routed as described below and shown on Figure 2-3:

- As the San Jose to Merced leg approaches SR 152, it would converge with the Merced to Fresno leg, requiring the northbound track of the San Jose to Merced leg to rise on an aerial structure and cross over the tracks of the Merced to Fresno leg. The San Jose to Merced leg would continue north on an elevated alignment crossing Ash Slough, the Chowchilla River, and Road 13 on aerial structures. As the leg returns to grade, it would curve northwest, cross Dutchman Creek on an aerial structure, and follow along the west side of the UPRR/SR 99 corridor. At Sandy Mush Road, the alternative would descend into a shallow cut (depressed) section for approximately 0.5 mile, with a retained cut-and-cover undercrossing tunnel segment at the Caltrans Sandy Mush Road Overhead. The alternative would return to grade and continue along the UPRR/SR 99 corridor, connecting to the Merced to Fresno Section: Hybrid Alignment at Ranch Road.
- The San Jose to Fresno leg would continue east from the split near Road 11 along the north side of Avenue 21 toward Chowchilla. It would be predominantly at-grade on embankment, ascending to cross Berenda Slough on an aerial structure. East of the wye configuration, the alignment would extend south of Chowchilla, ascend on an aerial structure east of Road 19 ½, and cross the UPRR/SR 99 corridor. The alternative would extend south of Fairmead and curve southeast toward the BNSF corridor, cross Dry Creek on an aerial structure, and run adjacent to the west side of the BNSF corridor to its meeting with the Merced to Fresno Section: Hybrid Alignment at Avenue 19.
- The Merced to Fresno leg would split from the San Jose to Fresno leg near Road 15. The southbound track of the Merced to Fresno leg would ascend on an aerial structure and cross over the tracks of the San Jose to Fresno leg. The Merced to Fresno leg would curve northwest, rise on aerial structures over several road crossings, and then continue on an at-grade embankment to join the San Jose to Merced leg near SR 152.

Wildlife undercrossing structures would be provided along this alternative in at-grade embankment portions of the HSR corridor where the alignment intersects wildlife corridors.



Source: ESRI, 2013; CAL FIRE, 2004; ESRI/National Geographic, 2015; Authority and FRA, 2018

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Figure 2-3 Avenue 21 to Road 13 Wye Alternative Alignment and Key Design Features

2.4.2 Electrical Interconnections

For Site 6—El Nido, interconnection facilities would include a 115 kV TPSS and switching station located on the west side of Flanagan Road. This new switching station would connect to the Wilson–Oro Loma 115 kV Power Line. Section 2.2.2 further describes the interconnection facilities associated with Site 7—Wilson.

In addition, the Avenue 21 to Road 13 Wye Alternative would require the Authority to relocate the existing PG&E Dairyland Substation. It is estimated that relocation would take approximately 18 months to complete and specific construction related activities would include the following:

- **Below-Grade Components**—Foundations, a stormwater detention and Spill Prevention Control and Countermeasure (SPCC) basin, raceways, and underground conduit would be constructed. Reinforced concrete subsurface footings and concrete slabs would be installed along with the ground grid. Substation equipment foundations would be approximately 5–16 feet deep.
- **Aboveground Structures**—These structures would include steel structures, circuit breakers, transformers, switchgears, buses, and other electrical equipment. These elements would be installed once the below-grade construction is complete. Equipment would be bolted or welded to slabs and footings and connected to the ground grid. The maximum height of substation equipment would be approximately 35 feet for the dead-end structures supporting the 115-kV power line interconnection. The transformers, switches, and buswork would be approximately 15 feet tall. Substation structures and equipment would be neutral gray.
- **Perimeter Fencing**—A perimeter enclosure with two access gates would be constructed around the substation perimeter for security. An 8- to 10-foot-high chain-link fence with barbed wire would be installed around the substation.
- **Security Lighting**—Security lighting would consist of sodium vapor lamps, and all exterior lighting would use non-glare light bulbs, designed and positioned to minimize casting light or glare to off-site locations. Light poles placed at each corner of the substation would be approximately 10 feet high and constructed of galvanized steel. The lights would be controlled by a photocell that automatically turns the lights off during the day and on at night.
- **Access Roads**—Access roads leading to the substation would be dirt and roads in the substation would be paved. Generally, access roads would be 20 feet wide.

Backup electrical power will be supplied by an emergency standby generator for select electrical loads including fire protection systems, ventilation systems, emergency lights and signage, communication systems; train controls systems, and low-voltage direct-current battery supply systems to support emergency lighting and communications.

2.4.3 State Highway or Local Roadway Modifications

The Avenue 21 to Road 13 Wye Alternative would require the permanent closure of 30 public roadways at selected locations and the construction of 28 overcrossings or undercrossings. Table 2-3 and Figure 2-3 show the anticipated state highway and local roadway closures. This alternative would require the fewest roadway and state highway modifications.

The Avenue 21 to Road 13 Wye Alternative would rise on aerial structures and cross over state highway facilities in three locations: SR 59 at Harmon Road, SR 152 at Road 13, and SR 99 at Avenue 21. Where other roads would be perpendicular to the proposed HSR, over- or undercrossings are planned at distances from less than 2 miles to 5 miles. Between these over- and undercrossings, some roads may be closed. Local roads paralleling the HSR alignment and used by small communities and farm operations may be shifted and reconstructed to maintain their function. Access easements would be provided to maintain access to properties severed by HSR.

2.4.4 Freight or Passenger Railroad Modifications

The Avenue 21 to Road 13 Wye Alternative would cross the UPRR operational right-of-way on an aerial structure south of Fairmead and maintain a vertical (at least 23.3 feet) clearance over UPRR operational right-of-way to avoid or minimize impacts on other UPRR rights-of-way, spurs, and facilities. In areas where the Avenue 21 to Road 13 Wye Alternative parallels the UPRR right-of-way, the alternative maintains a minimum horizontal clearance of 102 feet from the centerline to the UPRR right-of-way.

2.4.5 Summary

Table 2-3 summarizes the design features for the Avenue 21 to Road 13 Wye Alternative.

Table 2-3 Design Features of the Avenue 21 to Road 13 Wye Alternative

Feature	Avenue 21 to Road 13 Wye
Total length (linear miles)[1]	53
At-grade profile (linear miles)[1]	48.5
Elevated profile (linear miles)[1]	4
Below-grade profile (linear miles)[1]	0.5
Number of straddle bents	32
Number of railroad crossings	1
Number of major water crossings	11
Number of road crossings	58
Approximate number of public roadway closures	30
Number of roadway overcrossings and undercrossings	28
Traction power substation sites	1
Switching and paralleling stations	1 switching station, 7 paralleling stations
Signaling and train-control elements	15
Communication towers	6
Wildlife crossing structures	44

Source: Authority, 2015

[1] Lengths shown are based on equivalent dual-track alignments and are one-way mileages. For example, the length of single-track elevated structure will be divided by a factor of 2 to convert to dual-track equivalents.

2.5 SR 152 (North) to Road 11 Wye Alternative

The SR 152 (North) to Road 11 Wye Alternative (Figure 2-4) follows the existing Henry Miller Road and SR 152 rights-of-way as closely as practicable in the east-west direction, and the Road 11, SR 99, and BNSF rights-of-way in the north-south direction. Deviations from these existing transportation corridors are necessary to accommodate design requirements; specifically, wider curves are necessary to accommodate the speed of the HSR compared to lower-speed roadway alignments. The SR 152 (North) to Road 11 Wye Alternative would not follow existing transportation rights-of-way where it transitions from following one transportation corridor to another.

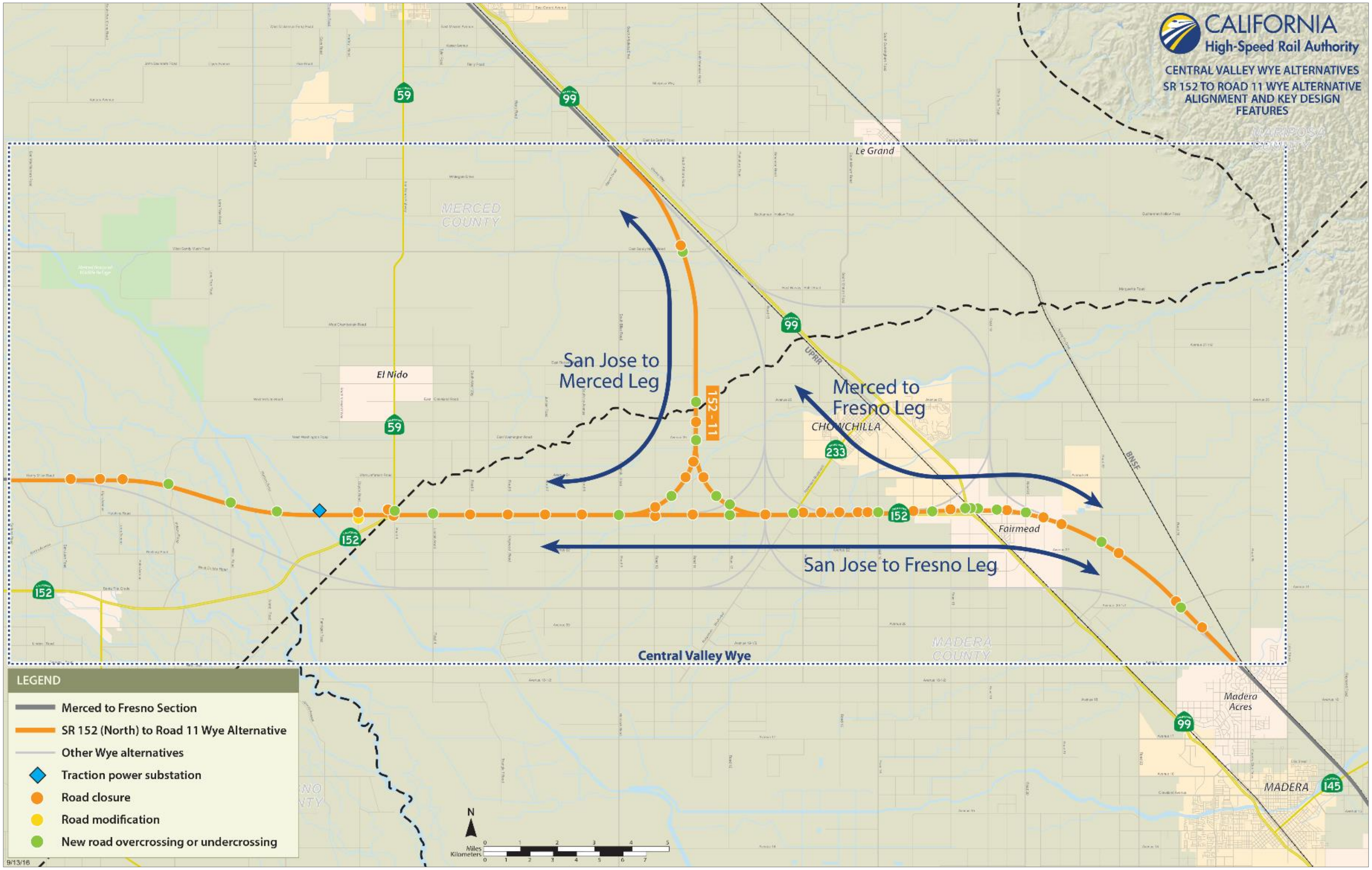
2.5.1 Alignment and Ancillary Features

The SR 152 (North) to Road 11 Wye Alternative would extend approximately 51 miles, mostly at-grade on raised embankment, although it would also have aerial structures. The wye configuration of this alternative would be located west-southwest of the city of Chowchilla, with the east-west axis along the north side of SR 152 and the north-south axis on the east side of Road 11.

Like the other three alternatives, this alternative would begin in Merced County at the intersection of Henry Miller Road and Carlucci Road, and would continue at-grade on embankment east toward Elgin Avenue, where it would curve southeast toward the San Joaquin River and Eastside Bypass. Approaching Willis Road, the alignment would rise to cross the San Joaquin River on an aerial structure, return to embankment, then cross the Eastside Bypass on an aerial structure. After crossing the Eastside Bypass, this alternative would continue east, crossing SR 59 at-grade just north of the existing SR 152/SR 59 interchange, entering Madera County. To accommodate the SR 152 (North) to Road 11 Wye Alternative, the SR 152/SR 59 interchange would be reconstructed slightly to the south, and SR 59 would be grade-separated to pass above the HSR on an aerial structure. The alignment would continue east at-grade along the north side of SR 152 toward Chowchilla, splitting into two legs (four tracks) near Road 10 to transition to the Merced to Fresno Section: Hybrid Alignment, and would cross Ash Slough on an aerial structure. All but the northbound track of the San Jose to Merced leg of the alternative would then return to at-grade embankment; the northbound track would rise to cross over the tracks of the San Jose to Fresno leg on an aerial structure as it curves north toward Merced. The SR 152 (North) to Road 11 Wye Alternative legs would be routed as described below and shown on Figure 2-4:

- The southbound track of the San Jose to Merced leg would turn north at-grade. This split would be west of Chowchilla, at approximately Road 10. The two San Jose to Merced tracks would continue north on the eastern side of Road 11, crossing the Chowchilla River, and then would cross over Road 11 to follow its west side. As the tracks return to grade, they would curve northwest, crossing Dutchman Creek on an aerial structure, following the west side of the UPRR/SR 99 corridor. The alignment would continue north, crossing over Sandy Mush Road on an aerial structure. The alignment would return to grade and continue along the west side of the UPRR/SR 99 corridor, connecting to the Merced to Fresno Section: Hybrid Alignment at Ranch Road.
- The San Jose to Fresno leg would continue east from the wye split near Road 10, along the north side of SR 152 toward Chowchilla. It would be predominantly at-grade, ascending on aerial structures at several road crossings and Berenda Slough. The leg would pass south of Chowchilla at-grade then rise to cross over the UPRR/SR 99 corridor and Fairmead Boulevard on an aerial structure. East of the UPRR/SR 99 corridor, the alignment would extend at-grade through Fairmead, north of Avenue 23. At approximately Road 20, the leg would curve southeast toward the BNSF corridor and cross Dry Creek on a short aerial structure. The SR 152 (North) to Road 11 Wye Alternative would align parallel to the west side of the BNSF corridor as it meets the Merced to Fresno Section: Hybrid Alignment at Avenue 19.
- The Merced to Fresno leg would split from the San Jose to Fresno leg near Road 13. The southbound track of the Merced to Fresno leg would ascend on an aerial structure and cross over the tracks of the San Jose to Fresno leg. The Merced to Fresno leg would curve northwest, rise on a high embankment crossing over several roads, and continue at-grade on embankment to join the San Jose to Merced leg near Avenue 25.

Wildlife undercrossing structures would be installed in at-grade embankments along this alternative where the alignment intersects wildlife corridors.



Source: ESRI, 2013; CAL FIRE, 2004; ESRI/National Geographic, 2015; Authority and FRA, 2018

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Figure 2-4 SR 152 (North) to Road 11 Wye Alternative Alignment and Key Design Features

2.5.2 Electrical Interconnections

The electrical interconnections for the SR 152 (North) to Road 11 Wye Alternative would be the same as those described in Section 2.2.2.

2.5.3 State Highway or Local Roadway Modifications

The SR 152 (North) to Road 11 Wye Alternative would require the permanent closure of 33 public roadways at selected locations and the construction of 24 overcrossings or undercrossings in lieu of closure. Table 2-4 and Figure 2-4 show the anticipated state highway and local roadway closures and modifications. Fourteen of these permanent road closures would be located at SR 152 where roads currently cross at-grade but need to be closed in order to convert SR 152 to a fully access-controlled corridor. The 14 proposed closures are Road 5, Road 6, Road 7, Road 8, Road 10, Road 11, Road 13, Road 14, Road 14 1/2, Road 15, Road 15 1/2, Road 15 3/4, Road 17, and Road 18. Planned new grade separations along SR 152 at the SR 59/SR 152 Interchange, Road 4/Lincoln Road, Road 12, and Road 17 1/2 would maintain access to SR 152. These roadways would be reconfigured to two 12-foot lanes with two 8-foot shoulders. Several of these new interchanges would require realigning SR 152. Three new interchanges are proposed between SR 59 and SR 99 to provide access to SR 152: at Road 9/Hemlock Road, SR 233/Robertson Boulevard, and Road 16.

The distance between overcrossings or undercrossings would vary from less than 2 miles to approximately 5 miles where other roads are perpendicular to the proposed HSR Between these over- or undercrossings, 19 additional roads would be closed. Local roads paralleling the proposed HSR alignment and used by small communities and farm operations may be shifted and reconstructed to maintain their function. Access easements would be provided to maintain access to properties severed by HSR.

2.5.4 Freight or Passenger Railroad Modifications

The SR 152 (North) to Road 11 Wye Alter native would cross over the UPRR right-of-way as it passes south of Chowchilla. This alternative would maintain required vertical (at least 23.3 feet) clearance over UPRR operational right-of-way to avoid or minimize impacts on UPRR rights-of-way, spurs, and facilities (BNSF and UPRR 2007). In areas where the SR 152 (North) to Road 11 Wye Alternative parallels the UPRR right-of-way, the alternative maintains a minimum horizontal clearance of 102 feet from the centerline to the UPRR right-of-way.

2.5.5 Summary

Table 2-4 summarizes the design features for the SR 152 (North) to Road 11 Wye Alternative.

Table 2-4 Design Features of the SR 152 (North) to Road 11 Wye Alternative

Feature	SR 152 (North) to Road 11 Wye
Total length (linear miles)[1]	51
At-grade profile (linear miles)[1]	46.5
Elevated profile (linear miles)[1]	4.5
Below-grade profile (linear miles)[1]	0
Number of straddle bents	27
Number of railroad crossings	1
Number of major water crossings	13
Number of road crossings	57
Approximate number of public roadway closures	33

Feature	SR 152 (North) to Road 11 Wye
Number of roadway overcrossings and undercrossings	24
Traction power substation sites	1
Switching and paralleling stations	1 switching station, 7 paralleling stations
Signaling and train-control elements	19
Communication towers	9
Wildlife crossing structures	37

Source: Authority and FRA, 2018

[1] Lengths shown are based on equivalent dual-track alignments and are one-way mileages. For example, the length of single-track elevated structure will be divided by a factor of 2 to convert to dual-track equivalents.

2.6 Construction

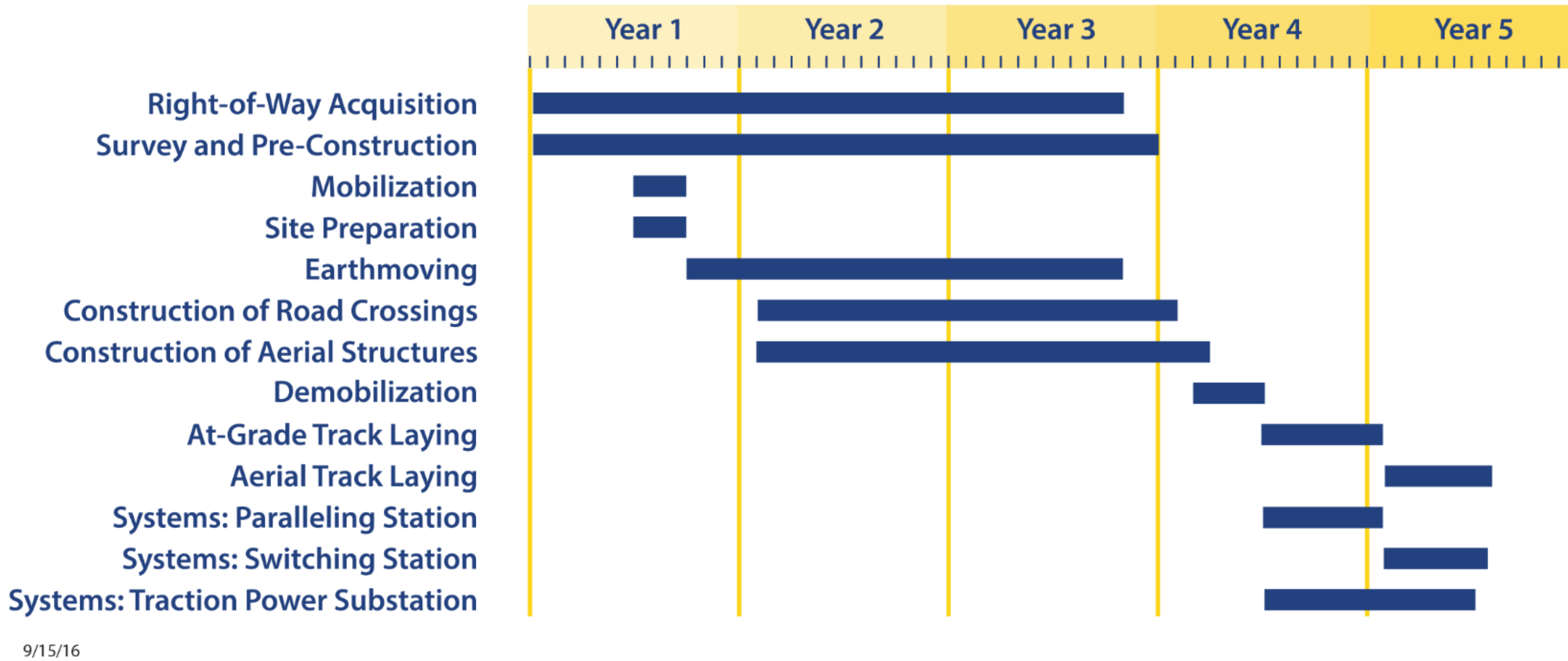
For the Central Valley Wye, specific construction elements would include at-grade, below-grade, and elevated track; track work; grade crossings; installation of the enhanced automatic train control system; and construction of electrical interconnection components. At-grade track sections would be built using conventional railroad construction techniques. A typical sequence includes clearing, grubbing, grading, and compacting the railbed; applying crushed rock ballast; laying track; and installing electrical and communications systems.

The precast segmental construction method is proposed for elevated track sections. In this construction method, large concrete bridge segments would be mass-produced at an on-site temporary casting yard. Precast segments would then be transported atop the already completed portions of the elevated track and installed using a special gantry crane positioned within the HSR footprint. Although the precast segmental method is the favored technique for aerial structure construction, other methods may be used, including cast-in-place, box girder, or precast span-by-span techniques.

Pre-construction activities would be conducted during final design and include geotechnical investigations; identification of staging areas; initiation of site preparation and demolition; relocation of utilities; and implementation of temporary, long-term, and permanent road closures. Additional studies and investigations to develop construction requirements and worksite traffic control plans would be conducted as needed.

Major construction activities would include earthwork and excavation support systems construction, bridge and aerial structure construction, and railroad systems construction (including trackwork, traction electrification, signaling, and communications). During peak construction periods, work is envisioned to be underway at several locations along the route at the same time, with overlapping construction of various elements. Working hours and workers present at any time will vary depending on the activities being performed. Figure 2-5 illustrates the approximate durations of construction activities for the Central Valley Wye; the design-build contractor would set the actual schedule. Pursuant to the Authority’s Policy Directive on sustainability (POLI-PLAN-03) and other commitments referenced therein, the Authority intends to build the Central Valley Wye using sustainable methods that:

- Minimize the use of nonrenewable resources
- Minimize the impacts on the natural environment
- Protect environmental diversity
- Emphasize the use of renewable resources in a sustainable manner



Source: Authority and FRA, 2018

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Figure 2-5 Central Valley Wye Construction Activity

2.7 Purpose of the Technical Report

The purpose of this technical report is to describe the existing extent, location and characteristics of aquatic features associated with the portion of the Central Valley Wye alternatives that are outside of the study area evaluated in the Primary Wetlands Delineation Report (Authority and FRA 2012b) (Figure 1-1b). Additional supporting information and maps are provided in the appendices to this technical report.

- Appendix A, National Wetlands Inventory and Central Valley Vernal Pool Complexes in Merced to Fresno Section: Central Valley Wye“, provides a map of publicly recorded vernal pool data compiled from the U.S. Fish and Wildlife Service’s National Wetlands Inventory and CDFW’s Central Valley Vernal Pool Habitat Dataset in the Central Valley Wye vicinity (CDFW 2014; USFWS 2014).
- Appendix B, Central Valley Biological Resources and Wetlands Survey Plan, contains the Central Valley Biological Resources and Wetlands Survey Plan (Authority and FRA 2010) that was used as guidance for preparing this report.
- Appendix C, Delineated Wetlands and Other Waters of the U.S. Wetland Study Area Map provides maps that depict the locations of wetlands and other waters of the U.S. in the WSA.
- Appendix D, Wetland Determination Data Sheets, provides the wetland determination data sheets.
- Appendix E, Photographs of Wetlands and Other Waters of the U.S. Delineated in the Wetland Study Area, provides photographs of representative features in the WSA.
- Appendix F, Wetland Plant Indicator List, provides a list of plants observed in the WSA with their wetland indicator status.
- Appendix G, Hydric Status of Soils in the Wetland Study Area, provides maps of hydric soils.
- Appendix H, Water Crossings Maps, contains maps depicting water crossings in the WSA.
- Appendix I, Request Letters and Signed Determination Forms for Preliminary Jurisdictional Determination for the Merced to Fresno Section and the Permitting Phase 1 Supplemental Wetlands Delineation Reports, provides a copy of the request letters and signed PJD Forms for the Merced to Fresno Section and the Permitting Phase 1 (PP1) Supplemental Wetlands Delineation Reports.

2.8 Summary of Waters of the United States and Waters of the State Regulations

Waters of the United States (WOUS) and State (WOS) (including wetlands and other aquatic features and habitats) are regulated under federal and state laws. Laws or regulations relevant to the WSA are described in this section.

2.8.1 Federal

2.8.1.1 Protection of Wetlands (USEO 11990)

U.S. Presidential Executive Order 11990 aims to avoid direct or indirect impacts on wetlands from federal or federally approved projects when a practicable alternative is available. If wetland impacts cannot be avoided, all practicable measures to minimize harm must be included.

2.8.1.2 Section 401 of the Clean Water Act

Pursuant to Section 401 of the Clean Water Act (CWA), the State Water Resources Control Board (SWRCB) certifies that any discharge of pollutants will comply with state water quality standards. The SWRCB, as delegated by the U.S. Environmental Protection Agency, has principal authority to issue a CWA Section 401 water quality certification or waiver.

2.8.1.3 Section 402 of the Clean Water Act

Pursuant to Section 402 of the CWA, all point-source discharges, including, but not limited to, construction-related stormwater discharges to surface waters, are regulated through the National Pollutant Discharge Elimination System program. Project sponsors must obtain a National Pollutant Discharge Elimination System permit from the SWRCB.

2.8.1.4 Section 404 of the Clean Water Act

Pursuant to Section 404 of the CWA (as amended), USACE is authorized to regulate any activity that would result in the discharge of dredged or fill material into WOUS (including wetlands), which include those waters listed in 33 Code of Federal Regulations (C.F.R.) Part 328 (Definitions). USACE, with oversight by the U.S. Environmental Protection Agency, has principal authority to issue CWA Section 404 permits.

2.8.1.5 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from USACE for the construction of any structure in or over any navigable WOUS.

2.8.1.6 U.S. Fish and Wildlife Coordination Act (16 U.S.C. §§ 661–667 et. seq.)

The U.S. Fish and Wildlife Coordination Act applies to any federal project where any body of water is impounded, diverted, deepened, or otherwise modified. Project proponents are required to consult with the U.S. Fish and Wildlife Service and the appropriate state wildlife agency.

2.8.1.7 Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers

In 1986, in an attempt to clarify the reach of its jurisdiction, USACE stated that Section 404(a) extends to intrastate waters that:

> *…(a) are or would be used as habitat by birds protected by migratory bird treaties, or (b) are or would be used as habitat by other migratory birds which cross state lines, or (c) are or would be used as habitat for endangered species, or (d) used to irrigate crops sold in interstate commerce." (51 Federal Register 41217).*

As a result of the 2001 *Solid Waste Agency of Northern Cook County (SWANCC)* case, the U.S. Supreme Court held that USACE may not rely on the Migratory Bird Rule to establish a significant nexus to interstate or foreign commerce. Although no formal guidance was issued by USACE interpreting the extent to which the SWANCC decision would limit jurisdictional determinations, in practice, USACE considers intrastate waters as WOUS where there is an appropriate connection to a navigable water or other clear interstate commerce connection. Therefore, WOUS, including jurisdictional wetlands, must show connectivity with (i.e., be tributary to) a navigable water to be subject to USACE under Section 404 of the CWA.

2.8.1.8 Rapanos v. United States and Carabell v. United States Army Corps of Engineers

In 2006, the U.S. Supreme Court issued an opinion regarding the extent of USACE jurisdiction over certain waters under Section 404 of the CWA. The *Rapanos-Carabell* consolidated decisions (*Rapanos*) addressed the question of jurisdiction over attenuated tributaries to WOUS, as well as wetlands adjacent to those tributaries.

On June 5, 2007, the USACE and the U.S. Environmental Protection Agency (USEPA) issued guidance related to the *Rapanos* decision. The guidance identifies those waters over which the agencies (USACE and USEPA) will assert jurisdiction categorically and on a case-by-case basis. To summarize, USACE will continue to assert jurisdiction over the following features:

- Traditional navigable waters (TNW) and their adjacent wetlands.
- Non-navigable tributaries of TNWs that are relatively permanent waters (RPW) (e.g., tributaries that typically flow year-round or have a continuous flow at least seasonally (i.e., typically 3 months)) and wetlands that directly abut such tributaries (i.e., not separated by uplands, berm, dike, or similar feature).

For non-RPWs, the agencies will determine whether a “significant nexus” exists with a TNW using the data found in an Approved Jurisdictional Determination Form (Approved JD form). The purpose of the significant nexus evaluation is to determine whether the existing functions of a tributary affect the chemical, physical, or biological integrity of a downstream TNW. Tributary characteristics that are considered when evaluating whether a significant nexus exists include volume, duration, and frequency of flow; proximity to a TNW; and hydrologic and ecologic functions performed by the tributary and all of its adjacent wetlands. Based on that information, the agencies may assert jurisdiction over the following features:

- Non-navigable tributaries that do not typically flow year-round or have continuous flow at least seasonally
- Wetlands adjacent to such tributaries
- Wetlands adjacent to but not directly abutting a relatively permanent non-navigable tributary

The agencies will typically not assert jurisdiction over the following features:

- Swales or erosional features (e.g., gullies and small washes characterized by low volume and infrequent or short-duration flow)
- Ditches (including roadside ditches) excavated wholly in uplands and draining only uplands that do not carry a relatively permanent flow of water

2.8.2 State

2.8.2.1 Porter-Cologne Water Quality Control Act

Pursuant to the Porter-Cologne Water Quality Control Act (Cal. Water Code § 13000 et seq.), the SWRCB is authorized to regulate any activity that would result in discharges of waste or fill material into WOS, including “isolated” waters and wetlands (e.g., vernal pools and seeps), saline waters, and groundwater within the boundaries of the state (Cal. Water Code § 13050(e)). The Porter-Cologne Water Quality Control Act authorizes the SWRCB to adopt, review, and revise policies for all WOS and directs the SWRCB to develop and implement regional basin plans that recognize and maintain the unique characteristics of each region with regard to natural water quality, actual and potential beneficial uses, maintaining water quality, and addressing the water quality issues of that region. California Water Code section 13170 also authorizes the SWRCB to adopt water quality control plans on its own initiative.

The water quality control plan is designed to maintain, preserve, and enhance the quality of water resources. The purpose of the plan is to designate beneficial uses for surface and groundwater, designate water quality objectives for the reasonable protection of those uses, and establish an implementation plan to achieve the objectives in all nine SWRCB regions of California. This may include preservation and enhancement of fish, wildlife, and designated biological habitats of special significance as well as other aquatic resources or preserves.

Some regional water quality control boards have adopted a wetland definition in their basin plans. The Central Valley Regional Water Quality Control Board, which has jurisdiction over all drainage basins that could be affected by the Central Valley Wye, has not yet adopted a wetland definition in its basin plan. Therefore, the definition in the 1987 USACE wetlands delineation manual and regional supplement (USACE 1987: page 9 and 2008a: page 2) was followed in conducting this wetlands delineation.

2.8.2.2 Lake and Streambed Alteration Program

Pursuant to California Fish and Game Code section 1600 et seq., CDFW regulates activities of an applicant's project that would substantially alter the flow, bed, channel, or bank of streams or lakes, unless certain conditions outlined by CDFW are met by the applicant. The limits of CDFW jurisdiction are defined in California Fish and Game Code section 1602 et seq. as the "bed, channel, or bank of any river, stream, or lake designated by CDFW in which there is, at any time, an existing fish or wildlife resource or from which these resources derive benefit." However, in practice, CDFW usually extends its jurisdictional limit and assertion to the top of a bank of a stream, the bank of a lake, or outer edge of the riparian vegetation, whichever is wider.

For aquatic features in arid and semi-arid climatic regions, CDFW provides specific guidance concerning its regulatory administration over jurisdictional WOS in California Code of Regulations, title 14, section 720 (Designation of Waters of Department Interest):

> *For the purpose of implementing Sections 1601 and 1603 of the Fish and Game Code, which requires submission to [CDFW] of general plans sufficient to indicate the nature of a project for construction by or on behalf of any person, governmental agency, state or local, and any public utility, of any project which will divert, obstruct, or change the natural flow or bed of any river, stream, or lake designated by CDFW, or will use material from the streambeds designated by the department, all rivers, streams, lakes, and streambeds in the State of California, including all rivers, streams, and streambeds, which may have intermittent flows of water, are hereby designated for such purpose.*

2.8.2.3 Keene-Nejedly Wetlands Preservation Act

Pursuant to the Keene-Nejedly Wetlands Preservation Act, the California state legislature recognizes that the remaining wetlands of the state are of increasingly critical economic, aesthetic, and scientific value to the people of California and that the need exists for an affirmative and sustained public policy and program directed at their preservation, restoration, and enhancement so that wetlands will continue in perpetuity to meet the needs of the people. This act allows both CDFW and the California Department of Parks and Recreation to acquire interests in real property to protect, preserve, and restore wetlands. Additionally, both departments can enter into operating agreements with cities, counties, and districts for the management and control of wetlands.

2.9 Relationship of Waters of the State to Waters of the United States

The aquatic features shown in Appendix C were mapped based on whether or not they appeared to meet the technical criteria for wetlands and other waters, regardless of their potential to qualify as isolated waters under the CWA. The Authority is seeking a PJD from the USACE, which means that questions regarding the jurisdictional status of the wetlands and other waters in the WSA are being waived or set aside by the Authority. Therefore, under a PJD, all of the wetlands and other waters mapped in the WSA would be considered WOUS, and there would be no features that would only qualify as WOS for this report. All mapped features in the WSA are subject to regulation as WOUS and WOS.

3 PROJECT SETTING

This section provides an overview of the typical vegetation communities and land uses, topography and climate, hydrology, soils, and publicly recorded wetlands data. Some but not all of the following vegetation communities are considered WOUS.

The WSA is located in the Great Valley Ecological Subregion of California and the Granitic Alluvial Fans and Terraces Ecological Subsection, which includes the alluvial fans and terraces on the eastern side of San Joaquin Valley (Miles and Goudey 1998). The fans and terraces in this area formed predominantly from granitic alluvium that originated in the Sierra Nevada. The topography is nearly level, with slopes ranging between 0 percent and 2 percent and elevations ranging from 160 feet to 300 feet above mean sea level. The regional drainage pattern is generally to the west and southwest.

3.1 Vegetation Communities

The WSA is in the San Joaquin Valley Subregion of the California Floristic Province's Great Central Valley Region. This subregion extends from the northern border of Contra Costa and San Joaquin Counties south to the northern boundary of Ventura and Santa Barbara Counties (Baldwin et al. 2012: pages 42, 43). Historically, the Central Valley was characterized by California prairie, marshlands, valley oak savanna, and extensive riparian woodlands (Hickman 1993: page 41). Today, more than 80 percent of the land is covered by farms and ranches (NRCS 2006a: page 53). Urban areas are located in the eastern portion of the WSA and include the communities of Chowchilla and Fairmead. Natural and semi-natural vegetation communities are uncommon and are limited to uncultivated areas that support California annual grassland and wetland communities in duck clubs and floodplain terraces or areas that are associated with watercourses.

Detailed vegetation mapping was completed by conducting fieldwork, reviewing available geographic information system wetland mapping data, and using aerial photograph interpretation. The classification scheme for the land cover and vegetation communities was adapted from the existing Merced to Fresno Section or identified using the CDFW (formerly the California Department of Fish and Game) *Hierarchical List of Natural Communities with Holland Types* (CDFG 2010) and *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988).

Analysts identified 21 land cover types and vegetation communities in the WSA. Of these, six are considered wetlands or other WOUS: vernal pool, seasonal wetland, palustrine forested wetland, constructed basin, natural watercourse, and constructed watercourse. Natural and semi-natural vegetated communities in the WSA that are not considered WOUS consist of riparian woodlands (Great Valley mixed riparian and other riparian), California annual grassland, and ruderal areas. The rest of the land cover types in the WSA are developed or paved areas, residential landscaping, and industrial or agricultural lands that are heavily disturbed by management activities such as disking, herbicide application, and mowing.

Appendix F provides a list of plants observed in the WSA and the wetland indicator status of each. Plant scientific names are based on the taxonomy (and synonymies) used in the second edition of the *Jepson Manual* (Baldwin et al. 2012). Wetland plant indicator status information was obtained from the latest National Wetland Plant list existing at the time of the field surveys (Lichvar et al. 2016).

3.1.1 Agricultural Lands

Agriculture is the predominant land use in the WSA (e.g., orchards, vineyards, irrigated hay, or alfalfa fields). Common orchard crops include almonds (*Prunus dulcis*) and walnuts (*Juglans regia*). Vineyard crops include cultivated wine, table, and raisin grapes (*Vitis* spp.). Irrigated hay and alfalfa crops, including common timothy (*Phleum pratense*), common cultivated oat (*Avena sativa*), orchard grass (*Dactylis glomerata*), red clover (*Trifolium pratense*), and alfalfa (*Medicago sativa*), are most often grown as silage for dairy farms. Other common agricultural land uses are field crops, such as tomatoes (*Solanum lycopersicum*), lettuce (*Lactuca* spp.), and beans (*Phaseolus vulgaris*), and irrigated pasturelands. Depending on the time of year and other considerations, fields may be fallowed (i.e., short resting periods between planting cycles) or idled (i.e., extended periods of idling, which are commonly market driven).

3.1.2 Developed Lands

The WSA contains areas of urban and rural development, including residential areas, commercial and industrial buildings, parks, roadways, and barren areas where vegetation has been removed. Residential land uses consist of both urban neighborhoods and rural homes, and often include landscaped yards, gardens, and outbuildings. Commercial and industrial areas contain urban shops, businesses, warehouses, railroad facilities, industrial plants, factories, junkyards, equipment storage yards, airports, and various municipal facilities as well as associated parking lots. Rural commercial areas include dairies, farm equipment yards, and agricultural processing and storage facilities. Parkland typically consists of open grassy areas with landscape trees, picnic facilities, and playgrounds.

3.1.3 Natural and Semi-Natural Habitats

The terms *natural* and *semi-natural* refer to native and introduced terrestrial vegetation communities. Areas mapped as natural and semi-natural habitats are not considered WOUS because they lack one or more of the three federal wetland criteria (i.e., wetland hydrology, hydric soil, and hydrophytic vegetation).

Riparian communities, including Great Valley mixed riparian and other riparian, do not meet one of the three federal wetland criteria and are not considered WOUS but are considered WOS. These riparian communities are located on the banks of natural waterways, including streams, sloughs, rivers, and, in some cases, along constructed waterway features where they form transition zones between terrestrial and wetland ecosystems. Some of the riparian areas are characterized by a prevalence of hydrophytic vegetation but do not meet other criteria for wetlands. Such riparian communities may consist of overstory species that are facultative wetland; however, the communities’ soils, hydrology, or understory vegetation are not representative of wetland communities. These types of riparian areas would be regulated by the state (under Sections 401 and 1601) but would not be federally regulated (under Section 404).

The most common semi-natural habitat in the WSA is California annual grassland, which is characterized by nonnative annual grasses such as ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), Mediterranean barley (*Hordeum marinum*), medusa-head (*Elymus caput-medusae*), and common wild oat (*Avena barbata*). Native annual and perennial herbaceous species may also be present in the California annual grassland community.

3.1.4 Wetland Communities and Other Waters of the United States

Aquatic resources in the WSA include vernal pool, seasonal wetland, palustrine forested wetland, natural watercourse, constructed watercourse, and constructed basin. These resources may be grouped into two categories: (1) palustrine wetlands and (2) other WOUS.

Palustrine wetlands are a broad class of nontidal wetlands that include marshes, swamps, bogs, fens, and prairies (Cowardin et al. 1979: page 10). In the WSA, vernal pool, seasonal wetland, and palustrine forested wetland are considered palustrine wetlands.

Other WOUS include aquatic features that do not meet the wetland criteria established by the USACE (USACE 1987: page 11, 2008a: pages 3–4). In the WSA, constructed basins, natural watercourses, and constructed watercourses are considered other WOUS. A description of each type of aquatic resource mapped in the WSA is provided in the following sections.

3.1.4.1 Vernal Pools

Vernal pools are a subclass of depressional wetlands classified as palustrine emergent seasonally flooded wetlands by Cowardin et al. (1979: page 22). Vernal pools are inundated during winter precipitation months and dry or moist during summer months, with no standing water. Evaporation, not runoff, empties the pools in the spring. Vernal pools are associated with a variety of landform types, including low terraces with undulating to slightly hummocky topography, with mounds intervening between localized depressions (Holland 1986). Vernal pools are associated with certain types of soils that have a subsurface hardpan, such as the San Joaquin and Lewis soil series, and soils with a subsurface claypan that limits the downward percolation of water. Conditions lending themselves to this type of habitat often occur over continuous areas rather than in isolated spots; therefore, vernal pools in the Central Valley tend to occur in clusters, called *complexes*. Within these complexes, pools may be fed or connected by shallow drainageways called *swales*.

Vernal pools have specific flora and fauna associated with their seasonal water cycle. Vernal pools contain a low, amphibious, herbaceous community that is dominated by annual and perennial herbs and grasses. Common plant species include short woollyheads (*Psilocarphus brevissimus*), popcorn flower (*Plagiobothrys* spp.), water pigmy-stonecrop (*Crassula aquatica*), annual hairgrass (*Deschampsia danthonioides*), purslane speedwell (*Veronica peregrina*), and toad rush (*Juncus bufonius*). Shallow vernal pools are often characterized by an abundance of nonnative grasses and forbs such as Mediterranean barley and hyssop-loosestrife (*Lythrum hyssopifolia*), but these areas also typically contain a relatively high cover of native vernal pool plants such as coyote thistle (*Eryngium* sp.). Deeper pools are often characterized by creeping spikerush (*Eleocharis macrostachya*). Obligate hydrophytes and other facultative wetland plant species typically are dominant in vernal pools in the spring, but upland species (particularly annuals) may become dominant during the drier portion of the growing season in some areas.

3.1.4.2 Seasonal Wetlands

Seasonal wetlands are nontidal, flooded, depressional wetlands classified as palustrine emergent seasonally flooded wetlands by Cowardin et al. (1979: page 20). Seasonal wetlands are a broad wetland class that is characterized by seasonal inundation or soil saturation and vegetation that consists of a mix of annual herbaceous species and nonnative grasses such as Italian ryegrass and Mediterranean barley (Vollmar 2002: page 37). In the WSA, seasonal wetlands have been degraded by past land management actions (e.g., cultivation, grading) that have reduced their flood storage potential and spread nonnative plant species. Water that collects in seasonal wetlands provides potential breeding habitat for several special-status species, such as vernal pool fairy shrimp, Conservancy fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, and western spadefoot.

3.1.4.3 Palustrine Forested Wetlands

Palustrine forested wetlands are nontidal, flooded, depressional wetlands classified as palustrine wetlands by Cowardin et al. (1979: page 21). They typically occur on soils that are intermittently or seasonally flooded or saturated by freshwater systems and are frequently found along riparian corridors, on floodplains that are subject to high-intensity flooding, or on low-gradient depositional areas along rivers and streams. The overstory of forested wetlands in the WSA is typically dominated by cottonwood or willows but may also include occasional box elder, Oregon ash (*Fraxinus latifolia*), California walnut, or California sycamore. The shrub layer is commonly dominated by willow species and California wild grape (*Vitis californica*), and the herbaceous understory may support emergent perennial vegetation such as cattails, sedges, and rushes.

3.1.4.4 Constructed Basins

Constructed basins in the WSA, which are considered other WOUS, consist of constructed stormwater retention basins, reservoirs, dairy waste settling ponds, and agricultural tailwater ponds. Constructed basins are highly disturbed and may be routinely managed through vegetation removal and dredging. Depending on substrate and management regimes, vegetative type and cover varies, although most constructed basins lack wetland vegetation or may support upland vegetation. Hydrology also varies in relation to precipitation events, irrigation inputs or removal, and other management objectives. Constructed basins are classified as palustrine unconsolidated bottom deepwater habitats by Cowardin et al. (1979: page 14). Palustrine wetlands may be associated with constructed basins at their margins and in shallow areas where deep water does not preclude vegetation establishment.

3.1.4.5 Constructed Watercourses

Canals and ditches in the WSA are channelized water features that have been constructed primarily for the conveyance of agricultural irrigation water. Most of these features are linear, excavated U-shaped or trapezoidal channels that are routinely maintained. Constructed watercourses range in size from small, shallow ditches (10 feet wide and 3–4 feet deep) to broad channels (50 feet wide and 10 feet deep). Scattered emergent vegetation is present in some areas, but most constructed watercourses are routinely cleared of vegetation, sprayed with herbicides, or both. Constructed watercourses are classified as non-wetland riverine systems, similar to natural watercourses, using the Cowardin system; palustrine wetlands may also be associated with these constructed features (Cowardin et al. 1979: page 7). However, an altered hydroperiod and routine maintenance of constructed watercourses for conveyance function limits the establishment and function of these wetland types.

3.1.4.6 Natural Watercourses

Most natural watercourses in the WSA have intermittent or ephemeral flow regimes, either because of their small watershed size or because they have been impounded or diverted upstream for agricultural purposes. All are low-gradient systems and most support some emergent vegetation along their margins, with bottom substrates dominated by fine sediments (i.e., sand, silt, or clay). Natural watercourses in the WSA would be classified as riverine lower perennial, riverine upper perennial, and riverine intermittent systems, depending on the persistence of their surface hydrology and their locations in a watershed (Cowardin et al. 1979: page 8). Riverine systems in the WSA may include a variety of bottom and bank substrate types. Palustrine wetlands may also be associated with natural watercourses at watercourse margins and in-channel islands.

3.2 Topography and Climate

The WSA is in the central part of the San Joaquin Valley, which trends northwest from the Tulare basin at the southern end to the Sacramento–San Joaquin Delta to the north. The eastern edge of the valley meets the western slope of the Sierra Nevada, and the western edge of the valley meets the eastern slope of the Temblor and Diablo Ranges that together comprise the southern interior Coast Ranges.

Elevations in the WSA range from 100 feet (at the western end) to 275 feet (at the eastern end) above mean sea level. Most slopes in the western portion are nearly level; in the eastern part, slopes range from approximately 3–5 percent.

Nearly half of the floor of the San Joaquin Valley is undergoing varying levels of subsidence. Subsidence has a variety of causes, including groundwater extraction–induced aquifer compaction, hydro-compaction of dry soils, fluid removal from oil and gas exploration, and tectonic activity (USGS 1998: page 27).

The WSA has an arid to semi-arid climate. Summers are generally hot and dry, with the majority of rain falling during the mild winter months. Rainfall stations show that upwards of 80 percent of annual precipitation occurs between the months of November and April (NRCS 2002). Rainfall in the San Joaquin Valley and the eastern flanks of the interior Coast Ranges is limited because of the rain shadow effect from the Coast Ranges. Generally, rainfall increases from south to north across the valley floor.

Adiabatic cooling causes warm, moisture-laden air masses generated over the Pacific Ocean to condense and cool as they are pushed upward and over the Sierra Nevada, resulting in heavy precipitation on the western slopes. The resulting snowpack ranges from 20 to 80 inches as elevation increases from the lower foothills to the Sierran crest. Snowmelt during the spring and summer provides the majority of the valley’s water. Mean annual precipitation records from the San Joaquin Valley range from less than 5 inches in the south to upwards of 15 inches in the northern reaches of the valley (USGS 1998: page 6).

The northern and southern portions of the San Joaquin Valley have similar daily temperatures throughout the year, with an average high of 95 degrees Fahrenheit (˚F) and an average low of 37˚F. Wetlands determination (WETS) table data for the National Oceanic and Atmospheric Administration Merced station shows a 50 percent chance occurrence of average annual precipitation being 11.73 inches, with a growing season of 333 days with a mean temperature at 28˚F (NRCS 2002).

Field data in the WSA was collected in 2013, 2014, and 2015. The California Department of Water Resources provides monthly averages of precipitation. The Merced station reported having slightly above average precipitation for June 2013 and below average for August 2013; December 2014 was reported to be above average precipitation and April 2015 reported slightly below average precipitation (CADWR 2013).

3.3 Hydrology

The natural hydrology of the region has been substantially altered by the construction of dams, storage reservoirs, diversion dams, and canals as well as groundwater pumping, which is associated primarily with agricultural irrigation. This section discusses watershed, historic, and present-day hydrology, as well as wetland hydrology and provides a brief description of the growing season.

3.3.1 Watershed Hydrology

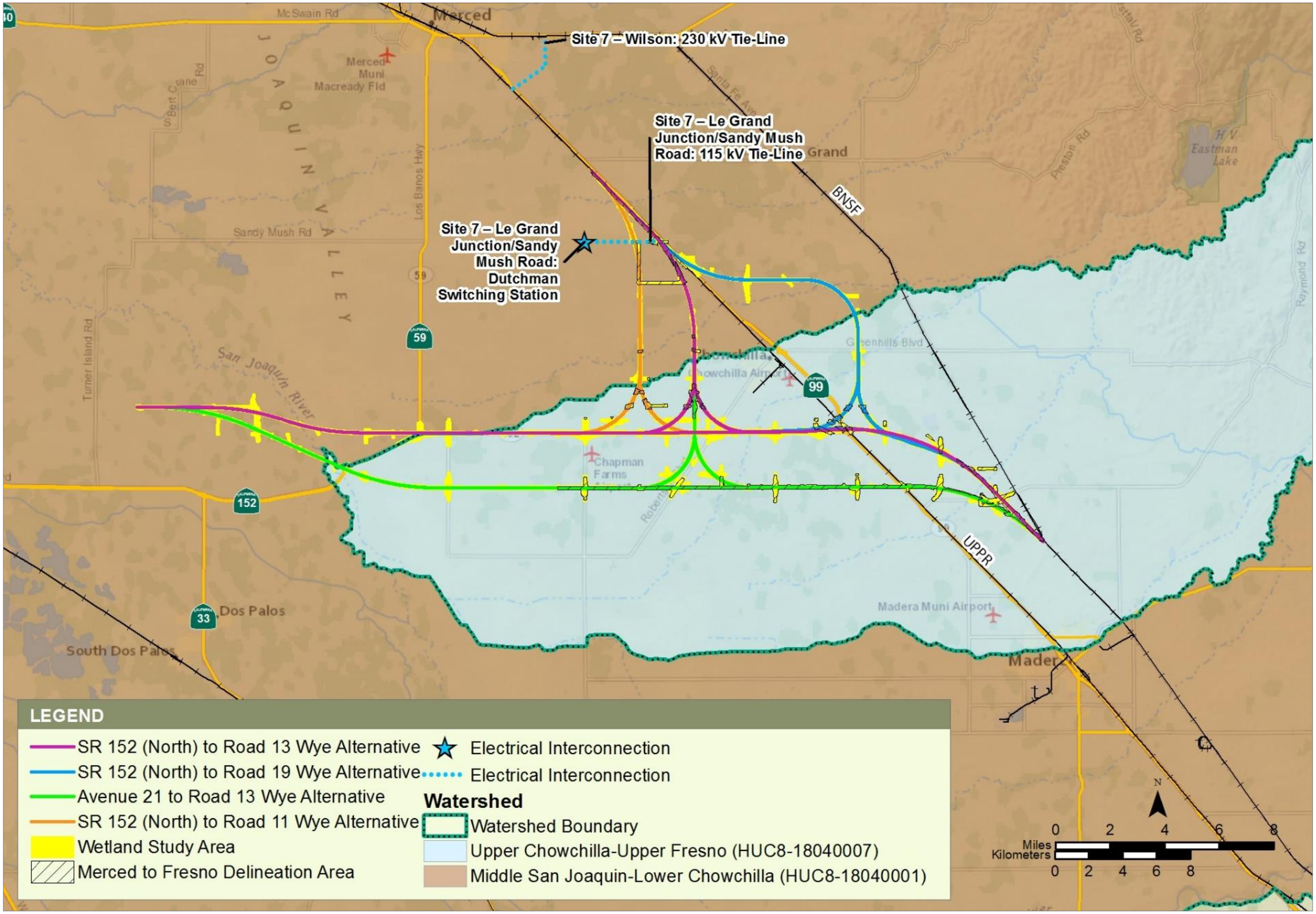
The San Joaquin Valley has a drainage area of approximately 34,100 square miles and is divided into the San Joaquin River Basin (16,700 square miles) and the Tulare Lake Basin (17,400 square miles). The WSA is entirely in the San Joaquin River Basin (NRCS 2007).

The WSA occurs in two Hydrologic Unit Code–8 watersheds (Figure 3-1), the Upper Chowchilla-Upper Fresno watershed (18040007) and the Middle San Joaquin-Lower Chowchilla watershed (18040001). Prominent water features in the WSA include West San Juan Drain No.1, Santa Rita Slough, Wood Slough, San Joaquin River, Fresno River, Eastside Bypass, Ash Slough, Chowchilla River, Dry Creek, Berenda Slough, Berenda Creek, Schmidt Creek as well as named and unnamed canals, drains, and laterals. The names of the Hydrologic Unit Code–8 watersheds and the acreage and major water features in each are summarized in Table 3-1.

Table 3-1 Watersheds in the Wetland Study Area

Subbasin (Hydrologic Unit Code–8)	Major Water Features	Watershed Area (acres)
Upper Chowchilla-Upper Fresno (18040007)	Ash Slough, Berenda Creek, Berenda Slough, Dry Creek, Schmidt Creek, Fresno River, Eastside Bypass	68,444.33
Middle San Joaquin-Lower Chowchilla (18040001)	Chowchilla River, Wood Slough, San Joaquin River, West San Juan Drain No.1, Santa Rita Slough, Eastside Bypass	45,143.79
Total	**–**	**113,588.12**

Source: NRCS, 2007



Source: NRCS, 2013a; Authority and FRA, 2018

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Figure 3-1 Watersheds in the Wetland Study Area

3.3.2 Historical Hydrology

Prior to European settlement and agricultural development, the San Joaquin Basin supported rich and diverse natural communities. Aquatic habitats included sloughs, creeks, rivers, lakes, ponds, and permanent wetlands and their associated plants and animals. Terrestrial habitats included seasonal wetlands, riparian forest, valley oak savanna, grassland, and San Joaquin saltbush communities (USGS 1998: page 6).

Large portions of the southern Central Valley floor were subject to frequent flood events, from either intense fall and winter rainfall or late-spring and early-summer snowmelt originating in the Sierra Nevada. In the WSA, one of the “overflow land” areas existed along the San Joaquin River upstream and downstream of its confluence with the Chowchilla River. Regular flooding is now largely controlled by dams, diversions, levees, and dredging. The former floodplain and riparian habitat have also largely been replaced by agriculture or urban development. Infrequent but catastrophic floods now occur in parts of the San Joaquin Valley; the flood effects are exacerbated by the loss of the flood-attenuating functions provided by riparian and wetland habitats (Vileisis 1997).

The WSA is in the North San Joaquin Valley Groundwater Basin. Most of the San Joaquin Valley floor is underlain by continental and marine sediments that are up to several miles thick. These include coarse-grained, water-bearing zones. Groundwater exists under both unconfined and semi-confined conditions. Groundwater levels vary with seasonal rainfall, withdrawal, and recharge. Depth to groundwater in the valley ranges from a few inches to more than 100 feet (USBR 2003: pages 6-26–6-33).

In spring 2000, depth to groundwater in the unconfined aquifer was as shallow as approximately 10 feet below ground surface near the western part of the WSA, was approximately 100 feet in the central part, and was roughly 180 feet in the eastern part. Shallow perched groundwater occurs locally (USBR 2003: page 6-29). Groundwater recharge occurs through percolation of applied irrigation water, leaking water from agricultural ditches, and infiltration of rainfall and streamflow. High levels of soluble salts and boron in groundwater are of local concern, especially west of the San Joaquin River (USBR 2003: page 6-34; SCS 1990: page 2).

All of the streams and rivers in the WSA have been dredged, culverted, diverted, dewatered, or channelized; some have had their active floodplains severely reduced by levee construction. These areas once sustained rich riparian wetland habitats and shallow groundwater in the deltas of the major rivers that drain into the San Joaquin Valley. Such areas have been greatly reduced or eliminated. Groundwater pumping for large agricultural and urban demands has resulted in groundwater level decline in many areas of the Central Valley. Frequent flooding is now largely controlled by dams, diversions, levees, and dredging. Areas that were previously floodplain and riparian habitat have largely been replaced by agricultural or urban development (Vileisis 1997).

3.3.3 Wetland Hydrology

Alterations to both surface and groundwater in the region have resulted in a significant decline in historical wetland areas. This decline is reflected in the high proportion of “drained” or “partially drained” hydric soils that have been mapped in the area (Section 3.4.2, Soil Survey Reports and Dates).

Hydrologic conditions in the WSA are highly manipulated. Most of the water present in the WSA is diverted by the numerous irrigation canals that are found throughout the valley. Therefore, most of the surface water in the WSA is found either in irrigation canals or in water retention and detention basins but is occasionally found in river channels or precipitation-fed wetlands. The wetlands that remain in the WSA are largely unrelated to the historical floodplains or regional aquifers.

3.3.4 Growing Season Analysis

The growing season is defined as the period when the soil temperature at a depth of 12 inches below the ground surface is greater than 41˚F. The length of the growing season is typically approximated using air temperature threshold of 28˚F at a frequency of 5 years in 10 (i.e., 50 percent) (USACE 2008a: pages 59–61).

Table 3-2 provides a growing season analysis for three climate stations in the WSA vicinity (NRCS 2002). The three stations were selected to capture the geographic variability (and consequently, the climatic variability) of the WSA and to represent the range of growing seasons in the WSA.

To meet the USACE criterion for wetland hydrology, the required minimum number of days of continuous soil saturation in the major part of the root zone or inundation to the surface is approximately 17 days, which is equal to 5 percent of the 333- to 338-day length of the local growing season at a temperature threshold of 28˚F. Observations of soil saturation or inundation during the early spring would be strong indicators for meeting the wetland hydrology criterion, assuming that soil temperature is in the typical range.

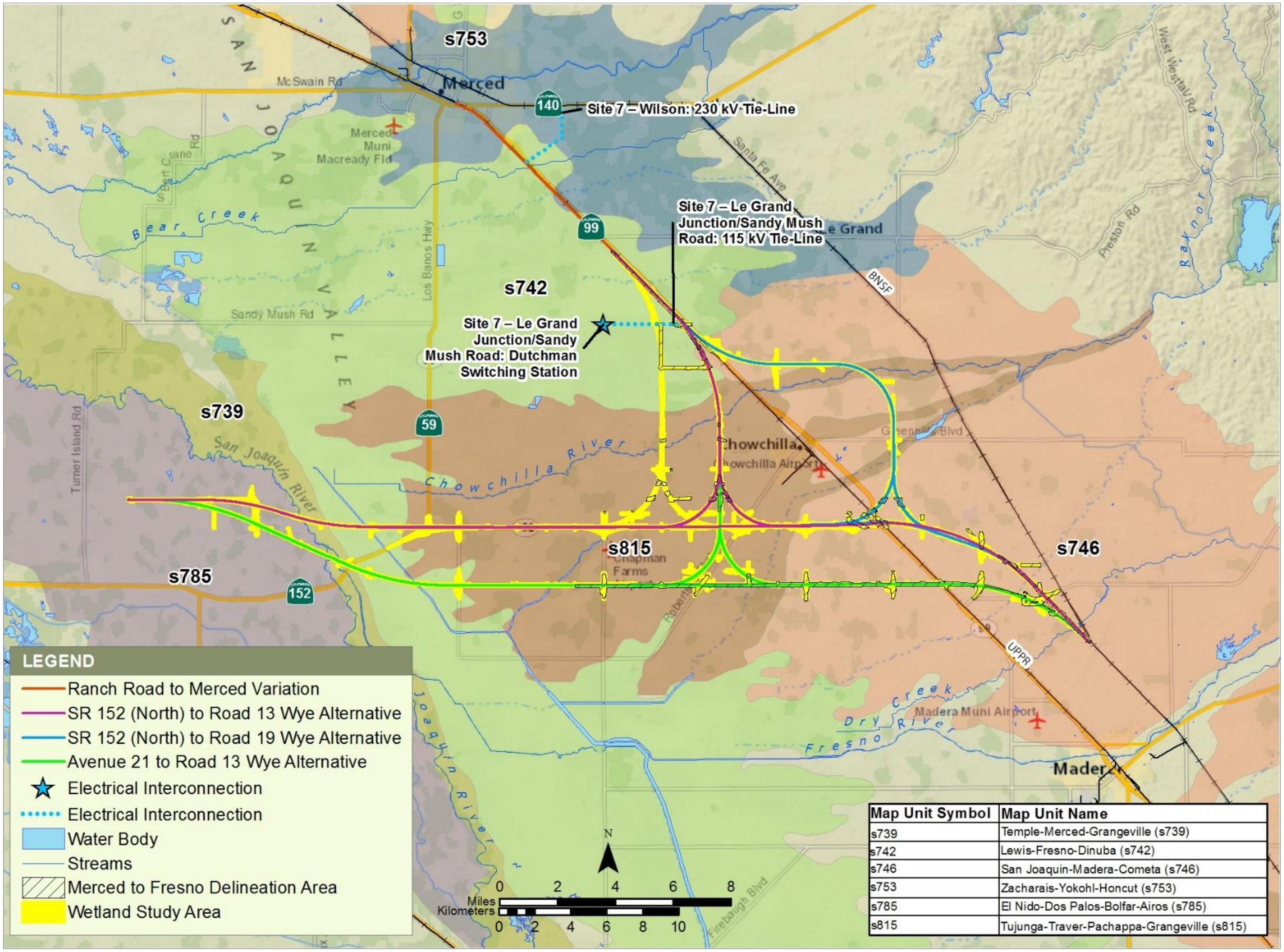
Table 3-2 Growing Season Analysis

Station	Location Relative to WSA	Elevation (feet above msl)	Mean Annual Rainfall (inches)	Rainfall Nov–April (percent)	28°F Growing Season Dates	Number of Growing Season Days
Merced Municipal Airport (CA5532)	North	150	12.57	81	1/20–12/18	333
Los Banos (CA5118)	West	120	9.93	86	1/14–12/17	338
Madera (CA5233)	Southeast	270	11.73	87	1/15–12/13	333

Source: NRCS, 2002; USACE, 2008a
WSA = wetland study area
msl = mean sea level
°F = degrees Fahrenheit

3.4 Soils

The San Joaquin Valley consists of a broad, geomorphically young alluvial basin that is encircled by older, coalescing alluvial fans, alluvial plains, and fan terraces. Table 3-3 lists the general soil map units that occur in the WSA, the geomorphic surfaces upon which they occur, and the Great Group–level taxonomic classification. Each of the generalized geomorphic surfaces found in the WSA is described in this section. The extent of the general soil map units in the WSA is illustrated on Figure 3-2.



Map Unit Symbol	Map Unit Name
s739	Temple-Merced-Grangeville (s739)
s742	Lewis-Fresno-Dinuba (s742)
s746	San Joaquin-Madera-Cometa (s746)
s753	Zacharais-Yokohl-Honcut (s753)
s785	El Nido-Dos Palos-Bolfar-Airos (s785)
s815	Tujunga-Traver-Pachappa-Grangeville (s815)

Source: NRCS, 2006b, Authority and FRA, 2018

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Figure 3-2 Soil Associations in the Wetland Study Area

Table 3-3 General Soil Map Units in the Wetland Study Area

General Soil Map Unit (map symbol)	County	Geomorphic Surface	Primary Soil Classifications
Lewis-Fresno-Dinuba (s742)	Merced, Madera	Hummocky low terraces, alluvial plains	Durixeralfs, Haploxeralfs
San Joaquin-Madera-Cometa (s746)	Merced, Madera	Hummocky old low terraces, stream terraces	Durixeralfs, Palexeralfs
Temple-Merced-Grangeville (s739)	Merced, Madera	Floodplains, basins, alluvial fans	Endoaquolls, Haploxerolls
Elnido-Dospalos-Bolfar-Alros (s785)	Merced, Madera	Floodplains	Haplaquolls, Haplaquepts
Tujunga-Traver-Pachappa-Grangeville (s815)	Merced, Madera	Alluvial fans, floodplains	Haploxeralfs, Haploxerolls, Xeropsamments

Source: SCS, 1962a, 1962b, and 1990; NRCS, 2013b

3.4.1 Basin and Basin Rim

The lowest landform on the landscape is the basin. Basin parent materials are recent (Holocene age [within the last 12,000 years]) alluvial deposits. Because of their relatively young age, soils in these positions have not had time to develop subsurface restrictive layers and therefore tend to lack vernal pools. Unlike many basin areas, those in the WSA are not clayey to the surface. Only the Merced series in the WSA approaches typical basin soil textures, with clay loam, clay, and sandy clay horizons in the profile (NRCS 2012b).The geomorphic surface immediately above the basin is known as the basin rim, which occupies the gradually transitioning area between the older alluvial fans and plains upslope and the younger basin downslope.

Parent material in the basin rim landscape position is Pleistocene-age (2.6 million to 12,000 years old) alluvium. The soils are better developed and commonly have a layer of clay accumulation (Argillic horizon). Soils in this position also tend to have high concentrations of sodium and soluble salts, which is a result of past evaporation of saline waters. Sodium in the soil disperses clay particles, which results in increased clay movement and subsequent clay accumulation in the subsoil (Natric horizon) and slow permeability in the soil profile. These conditions, along with the mound-intermound topography commonly found on these surfaces, result in the occurrence of vernal pools.

3.4.1.1 Floodplain, Alluvial Plain, and Alluvial Fan

The geomorphic surface between the basin rim and the low terrace (described in Section 3.4.1.2, Low Terrace) consists of floodplain, alluvial plains, and alluvial fans. Most areas of these nearly level to gently sloping surfaces consist of alluvium that was deposited more than 12,000 years ago, but in areas adjacent to active stream channels, the alluvium can be much younger. The soils are weakly to moderately developed, with the most mature among them having a layer of clay accumulation (Argillic horizon).

3.4.1.2 Low Terrace

The highest and oldest geomorphic surface in the WSA is the low terrace. Parent materials in these positions are Pleistocene-age alluvium. The microtopography is commonly undulating or hummocky. Soils developed on these surfaces commonly have clay-enriched layers or silica-cemented hardpans known as duripans. Claypans and duripans may cause a shallow perched water table to form in the soil, and where associated with the mound-intermound topography, claypans and duripans are responsible for the occurrence of vernal pools in the WSA. Agricultural development occurred first and most extensively on the low terraces; therefore, wetlands are extremely rare on these surfaces. According to the soil survey reports (Section

3.4.2), duripans are less common in the southern San Joaquin Valley than they are farther north. Two soil series that contain duripans, the San Joaquin and Madera series, are mapped in the eastern part of the WSA. Intensive agricultural practices (e.g., deep ripping) may have eliminated some of the duripans where they historically occurred.

3.4.2 Soil Survey Reports and Dates

The WSA extends over two counties and three soil survey areas:

- Soil Survey of Madera Area, California (SCS 1962a)
- Soil Survey of Merced Area, California (SCS 1962b)
- Soil Survey of Merced County, California, Western Part (SCS 1990)

Figure 3-2 shows general soil mapping (soil associations) derived from State Soil Geographic data and the hydrography of the WSA. Most of the soils in the WSA have been disturbed by agricultural activities. Many of the soils have been leveled, drained, or protected from flooding for agricultural purposes. Drainage systems and levees in the San Joaquin Valley date back many decades, but these were not always as efficient as modern systems for dewatering soils. Local water tables have also dropped because of groundwater overdraft.

Soils that previously had high water tables, or frequent flooding or ponding, are still considered hydric soils by convention, even if they are no longer subject to prolonged saturation or inundation. Some of these soils would revert to their prior condition if drainages or flood protection facilities were removed. Hydric soils that are no longer subject to prolonged saturation or inundation are designated in modern soil surveys by drained or partially drained phases of the map unit.

3.4.3 Hydric Soils

According to Soil Survey Geographic data, soils that formed under hydric conditions occur at various locations in the WSA. Appendix G provides maps of the hydric soils in the WSA. Soil map units categorized as “All Hydric” consist entirely of hydric soils (i.e., the map unit’s component[s] and inclusion[s] are all hydric). Soil map units categorized as “Not Hydric” contain no components or inclusions that are hydric. Soil map units that are categorized as “Partially Hydric” contain both hydric and non-hydric components or inclusions, or both. Soil map units categorized as “Unknown Hydric” may or may not contain hydric soils (i.e., hydric soil information from the database is not available for the soil map unit).

Hydric soils mapped in the WSA represent a range of soil orders: Mollisols, Vertisols, Entisols, Alfisols, and Inceptisols. Common diagnostic subsurface horizons found in these hydric soils include Argillic and Natric horizons. Soil particle size classes range from sandy and coarse-loamy to fine-silty and fine-loamy. The soil temperature regime is thermic, with an assumed growing season of February through October. The predominant soil moisture regime is xeric, but many of the soils have an aquic soil moisture regime.

Soil map units comprised mostly of hydric soils occur at two of the wetland delineation data point locations in the WSA (NRCS 2012a, 2012b). Table 3-4 provides the names of the map units and the respective counties in which these map units occur. At other delineation data point locations, hydric soils (not included in Table 3-4) may also occur as part of some map units as inclusions (i.e., soils that comprise less than 20 percent of a soil map unit). Descriptions of these map units are provided following the table.

Table 3-4 Hydric Soil Map Units at Delineation Data Points in the Wetland Study Area

Mapped Hydric Soil Map Unit	County of Occurrence in WSA	Hydric Soil Criteria[1]
Riverwash	Merced and Madera	4
Grangeville sandy loam, 0 to 1 percent slopes	Madera	2, 4

Sources: NRCS, 2012a; NRCS, 2012b
[1] Hydric Soil National Soil Information System Database Selection Criteria (http://soils.usda.gov/use/hydric/criteria.html).
Some data points were established in mapped areas of water, which is a non-soil miscellaneous area.
WSA = wetland study area

Riverwash—Riverwash is listed as hydric in Merced and Madera Counties (NRCS 2012a). This miscellaneous area consists of areas of deep sand and gravel that are adjacent to, or islands within, the low water channels of rivers and small intermittent streams. At normal flow conditions, many of these areas are flooded; under flood conditions, nearly all are flooded (SCS 1962a: pages 48–49, 1962b: page 62).

Grangeville sandy loam, 0 to 1 percent slopes—The Grangeville component of the map unit makes up 85 percent of the map unit and is listed as hydric in Madera County (NRCS 2012a). Grangeville soils are found on alluvial fans. The parent material consists of alluvium derived from granite. Soils of the Grangeville series are grayish brown and brownish gray sandy loam and fine sandy loam throughout the profile but with redox concentrations typically between depths of 11 and 20 inches. Depth to a root-restrictive layer is greater than 60 inches. The natural drainage class of the map unit is somewhat poorly drained. This soil map unit has altered drainage because of the dams and reservoirs in the Sierra Nevada, pumping from the water table, tile and interceptor drains, and filling and leveling of sloughs in the vicinity. Permeability is moderately rapid and this soil is rarely flooded; there is no zone of water saturation within a depth of 72 inches (SCS 1962a: pages 3233).

3.4.4 Problematic Nature of Soils in the Wetland Study Area

Problematic hydric soils are those whose hydric nature is difficult to determine in the field based on morphological characteristics. Soils in the WSA have formed under several biogeochemical conditions that normally preclude or slow the development of readily apparent hydric soil indicators. Most morphological characteristics (i.e., redoximorphic features) that are used to identify the presence of a hydric soil rely on changes in the soil resulting from the reduction of iron and manganese compounds. These changes normally produce diagnostic colors that persist in the soil from year to year. The hydric soil indicators described in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE 2008a: pages 2757) assume a certain level of expression of this iron and manganese reduction-oxidation; however, the regional supplement also acknowledges that many hydric soils in the arid west either do not form redoximorphic features at all or form them only to a minimal degree that does not meet the technical requirements of the indicators (USACE 2008a: pages 97–98).

Most hydric saline soils and highly alkaline soils in the arid west region do not develop strong redoximorphic features because of: (1) high pH (low redox potentials are required to reduce iron and manganese), (2) low amounts of iron and manganese, and (3) low activity by microorganisms (Boettinger 1997). Alkalinity and salinity also create a harsh environment for the microbes that are responsible for the redox reactions by causing dehydration and micronutrient deficiencies. This results in low plant biomass, which limits the supply of organic carbon necessary for redox reactions to occur. Where soluble salts (salic or Az/Bz horizons) and calcium carbonates (calcic or Bk horizons) are present in the soil, any redoximorphic features that may form are easily masked by the soil matrix color.

The soils in the WSA tend to be wettest when soil temperatures are low, which limits microbial activity and the corresponding development of redoximorphic features. In addition, many parent materials in the arid west region are naturally low in iron and therefore are not conducive to the development of redoximorphic features, even when reducing conditions are present. The low-chroma parent materials include lacustrine deposits and some alluvial deposits that are low in iron because of a formerly reducing environment; these conditions apply to many of the basin landforms in the San Joaquin Valley and the WSA (NRCS 2006a: page 53, USDA 2014). The inability of the wetland delineator to observe redoximorphic features, even though the reducing conditions necessary to form them are present, makes these soils problematic.

4 METHODS

Wetlands delineation methods were developed for the Merced to Fresno, San Jose to Merced, and Fresno to Bakersfield sections of the HSR system, as described in the *Central Valley Biological Resources and Wetlands Survey Plan* and provided as Appendix B. Because of limited property access, delineators could not utilize the pedestrian transects and detailed wetland delineation methods from the survey plan on some of the private properties in the WSA. When pedestrian transects could not be completed, delineators followed the methodology described in Section 4.3 Field Survey Methods for inaccessible areas. Delineators could not implement detailed wetland delineation methods, such as taking paired data points and recording wetland boundaries with a global positioning system, on inaccessible properties. The following sections describe the WSA, the pre-field survey investigation, and the field survey methods.

4.1 Wetland Study Area

The WSA encompasses a total of 8,360 acres specific to, and surrounding, the project footprint for the Central Valley Wye alternatives. The WSA includes the project footprint for the Central Valley Wye alternatives and a 250-foot buffer surrounding those limits. The project footprint includes all project elements (i.e., alternative rights-of-way, station locations, construction staging areas, laydown areas, and borrow sites) associated with the Central Valley Wye alternatives. All direct and indirect impacts associated with the Central Valley Wye are anticipated to occur in the project footprint. The WSA also includes an update for the 7,170-acre portion of the Central Valley Wye that was previously delineated in the Primary Wetlands Delineation Report (Authority and FRA 2012b).

4.2 Pre-Field Survey Investigations

The following resources were reviewed prior to field investigations to obtain information on wetlands and other water features in the WSA:

- U.S. Geological Survey 7.5-minute topographic quadrangles that occur in the WSA (Delta Ranch, Santa Rita Bridge, Bliss Ranch, Chowchilla, Plainsburg, Le Grand, and Berenda)
- National Wetlands Inventory maps (USFWS 2014)
- Biogeographic Information and Observation System, Central Valley Vernal Pool Habitat Dataset (CDFW 2014); Vernal Pool Mapping Dataset (Holland 2005-2012), results are presented in Appendix A
- National Hydrography Dataset (USGS 2013), results of water crossings are presented in Appendix H
- National Agriculture Imagery Program aerial imagery from 2010 and 2012
- Soil survey map unit descriptions (NRCS 2012a, 2012b, 2013c)
- Google Earth Pro aerial imagery from 1998, 2003–2006, and 2009–2015 (Google 2015)
- Climate and precipitation data (NRCS 2002)

4.2.1 Aerial Imagery Mapping Methods

Using ESRI ArcGIS 10 software, delineators interpreted 2012 to 2016 National Agriculture Imagery Program imagery, Google Earth aerial imagery from 1998 to 2017, and soil survey data to generate detailed land cover and preliminary wetland delineation mapping. A mapping scale of 1 inch = 200 feet (1:2,400) and a general minimum mapping unit for stand-alone wetlands of 0.25 acre were used.

When natural and constructed watercourses had an ordinary high water mark (OHWM) with a consistent width, they were mapped as line features and attributed with their average OHWM width. Watercourses wider than 40 feet, or with an irregular boundary, were mapped as polygons. The OHWM served as the WOUS jurisdictional boundary along most watercourses and non-wetland riparian features along banks of watercourses were mapped to the outer drip line for WOS only.

Ongoing updates to the original mapping were made as the delineators became aware of changes to the originally mapped aquatic features, such as agricultural ditches being removed and vernal pools being converted to vineyards. Changes to the mapped features were identified based on observations from more recent imagery and based on site visits by staff conducting field surveys in support of California Rapid Assessment Method (CRAM) data collection.

During the summer and fall of 2016, the 2011 Merced to Fresno delineation data was updated in the Central Valley Wye study area. This update consisted of reviewing each delineated feature and remapping or removing features that have changed over the past 5 years. This update was conducted by aerial photograph interpretation and viewing features from public rights-of-way.

During the verification process of late 2017 and early 2018, delineators worked with representatives from the USACE Sacramento District to refine WOUS boundaries. OHWM boundaries were established by viewing imagery depicting flooding in early 2017 and viewing LIDAR imagery. Wetlands in the OHWM were removed from watercourse features for WOUS mapping efforts but were retained for WOS and habitat maps. In addition, seasonal wetlands were mapped in agricultural areas based on visible ponding in the 2017 aerial imagery.

4.3 Field Survey Methods

Field surveys were conducted June 17–21, August 26–28, 2013, December 22 and 23, 2014, April 28–30, 2015, and August and September of 2016. Qualified delineators ground-truthed the pre-field survey aerial imagery mapping where site access was granted or where the features could be viewed from public roads. In addition, where site access was granted, delineators walked meandering transects to visually assess the WSA for the presence of additional wetland features. Transects were spaced 20–100 feet apart. The extents of all observed WOUS and WOS (including wetlands) and CDFW lakes and streambeds were identified and mapped using a handheld global positioning system unit with sub-meter accuracy. Representative photographs were taken of features to document physical characteristics. The landforms, vegetation, hydrology, and soil characteristics were noted. Survey data and personnel were recorded on data sheets. For properties where access was not granted, delineators conducted windshield surveys from public roads using binoculars to compare their field observations with signatures on the aerial imagery mapping.

Consultant delineators and representatives from the USACE Sacramento District conducted an additional field visit on December 5, 2017. Potential WOUS were viewed from public roads and revisions made to the mapping. All aerial imagery mapping was loaded onto GPS units and, where applicable, mapping was refined in the field.

4.3.1 Wetlands Delineation Methods

Wetlands in the WSA were delineated using the methods described in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE 2008a). All wetlands were described by using the classification system adopted by the Primary Wetlands Delineation Report (Authority and FRA 2012b). When property access was granted, wetland boundaries were determined by using paired data points in wetland and adjacent upland areas (Appendix C). The characteristic vegetation at each sample point was recorded, and soil pits were hand-excavated at each point to assess the presence of wetland hydrology and hydric soil indicators at the points. For large complexes of features, or repeated features of the same type, paired points were recorded at representative features but not at each individual feature. Hydrology, soils, and vegetation information at the data points was recorded on Wetland Determination Data Form, Arid West Region, data sheets (USACE 2008a: pages 121–122) (Appendix D). The boundaries of areas that were determined to meet all three federal wetland criteria were recorded as lines or polygons using a global positioning system unit, aerial imagery interpretation, or both. Wetland boundaries were extrapolated by following topographic contours, wetland vegetation boundaries, and clear hydrologic boundaries.

4.3.2 Watercourse Delineation Methods

Other waters in the WSA were delineated using the methods described in *A Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region of the Western United States* (Lichvar and McColley 2008) and USACE Regulatory Guidance Letter No. 05-05 (USACE 2005), where appropriate. These guidance materials provide an approach for identifying the lateral limits of jurisdictional other waters using stream geomorphology and vegetation response to the dominant stream discharge (Lichvar and McColley 2008). Indicators of the OHWM that were evaluated in the field include, but are not limited to, natural lines impressed on banks, stain lines, depositional features, shelving, changes in soil character, changes in vegetation, destruction of terrestrial vegetation, and the presence of litter and debris.

5 RESULTS

Aerial imagery interpretation and field investigations in the WSA identified a total of 215.93 acres of WOUS. This acreage consists of 15.24 acres of wetlands (i.e., vernal pool, seasonal wetland, and palustrine forested wetland) and 200.69 acres of other WOUS (i.e., constructed basin, constructed watercourse, natural watercourses) as presented in Table 5-1. WOUS mapped in the Merced to Fresno delineation area, are shown on the delineation maps in Appendix C and were checked to be present in a 2016 and 2017 data update. Detailed information for these features is found in the Primary Wetlands Delineation Report (Authority and FRA 2012b).

Section 5.1, Wetlands Occurring in the Wetland Study Area, provides descriptions of wetland types and acreages in the WSA. Section 5.2, Other Waters of the United States. Occurring in the Wetland Study Area, describes other WOUS and acreages in the WSA.

Table 5-1 Acreages of Potential Waters of the United States in the Wetland Study Area

Wetlands and Other Waters	Acreage in Wetland Study Area
Wetlands	
Vernal pool	1.52
Seasonal wetland	13.38
Palustrine forested wetland	0.34
Wetlands subtotal	15.24
Other waters	
Constructed basin	34.45
Constructed watercourse	81.67
Natural watercourse	84.57
Other waters subtotal	200.69
Total waters of the United States	215.93

Source: Calculations generated using ESRI ArcGIS versions 10.1, 10.2, and 10.3 from data generated by field surveys and aerial imagery interpretation during 2010–2017.
Total wetlands and other waters acreage figures shown in this table may differ slightly from the corresponding acreage figures shown in Appendix C because of rounding differences.

5.1 Wetlands Occurring in the Wetland Study Area

Three wetland types were identified in the WSA: vernal pool, seasonal wetland, and palustrine forested wetland. Characteristics of these wetlands are described in the following subsections.

5.1.1 Vernal Pool

Fourteen individual vernal pool wetlands, totaling 1.52 acres, were mapped in the WSA. The individual vernal pools are concentrated in two areas of vernal pool complexes. The first area is in a California annual grassland parcel at the corner of Avenue 21 and Road 21 east of Highway 99. It consists of 16 small, shallow to deep vernal pools. The other area is in an agricultural field that is plowed regularly. The parcel is on the west side of Road 24 and contains two large, deep vernal pools.

5.1.2 Seasonal Wetland

Thirty-one seasonal wetlands, totaling 12.38 acres, were mapped in the WSA. These wetlands are scattered throughout the WSA and usually are located in agricultural areas or on the outer edge of other wetlands and other water types. The seasonal wetlands are characterized by shallow standing water or shallow groundwater and dominated mostly by species that can occur in a variety of wetland and non-wetland habitats. Property owners did not grant access to any of the parcels with seasonal wetlands; therefore, mapping of these wetlands was accomplished using aerial imagery and views from public roads.

5.1.3 Palustrine Forested Wetland

Six palustrine forested wetlands, totaling 0.34 acre, were mapped in the WSA. Palustrine forested wetlands are associated with natural watercourses and occasionally are in constructed basins and constructed watercourses. This wetland type consists of a well-developed overstory of mature trees, a shrub layer, and an herbaceous understory. Data points DP-A, DP-C, and DP-E were collected in palustrine forested wetlands. Data points DP-A and DP-C were established from a public road. Data point DP-E was accessed and a soil pit was excavated. Property owners did not grant access for any other parcels in the WSA with palustrine forested wetlands.

Palustrine forested wetlands in the WSA are dominated by dense woody and herbaceous vegetation. Typically, the overstories are dominated by Fremont cottonwood (*Populus fremontii*), valley oak, black willow (*Salix gooddingii*), and polished willow (*Salix laevigata*). The observed understories are composed of vine and small shrub species such as mulefat (*Baccharis salicifolia*), narrowleaf willow (*Salix exigua*), and California wild grape (*Vitis californica*) and herbaceous species such as Santa Barbara sedge (*Carex barbarae*) and common rush (*Juncus effusus*). The palustrine forested wetlands where the data points were established contained overstory stands of Fremont cottonwood, a shrub understory of narrowleaf willow, and an herbaceous understory dominated by California mugwort (*Artemisia douglasiana*).

Palustrine forested wetland hydrology is associated mainly with river and stream channels. The dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and other wetlands. Wetland hydrology indicators observed at data points include drift deposits and a positive FAC-Neutral test.[7] Because of the lack of access to these parcels, wetland data were obtained from public roads, except at DP-E (Appendix D).

The surface soil layer observed at DP-E had a sandy loam texture. It met the criteria for hydric soil indicator redox dark surface (USACE 2008a: pages 50-52).

5.2 Other Waters of the United States in the Wetland Study Area

Three other WOUS types were mapped in the WSA: constructed basins, constructed watercourses, and natural watercourses. These other waters are described in the subsections that follow.

5.2.1 Constructed Basins

A total of 90 constructed basins, encompassing 34.45 acres, were mapped in the WSA. The constructed basins consist of stormwater basins and agricultural tailwater ponds that appear to have year-round, or nearly year-round, standing water. Some of these features function as irrigation water storage ponds, which are fed by pumped water. They generally have less than 5 percent cover by hydrophytic vegetation.

5.2.2 Constructed Watercourses

A total of 240 constructed watercourses, encompassing 81.67 acres, were mapped in the WSA. Constructed watercourses include artificial drainage ditches and irrigation canals. Constructed watercourses may occur as unvegetated features or as vegetated features that are regularly maintained (i.e., vegetation is periodically removed to maintain flow capacity).

[7] As described by the USACE (2008a: page 84), the FAC-neutral test is performed by compiling a list of dominant plant species across all plant strata in the community, and dropping from the list any species with a Facultative indicator status (i.e., FAC, FAC–, and FAC+). The FAC-neutral test is met if more than 50 percent of the remaining dominant species are rated FACW or OBL.

5.2.3 Natural Watercourses

A total of 24 natural watercourses, encompassing 84.57 acres, were mapped in the WSA. Natural watercourses include Santa Rita Slough, Wood Slough, San Joaquin River, Fresno River, Eastside Bypass, Ash Slough, Chowchilla River, Dry Creek, Berenda Slough, Berenda Creek, and Schmidt Creek. These watercourses may have perennial, intermittent, or ephemeral water flows and generally have less than 5 percent cover by hydrophytic vegetation.

5.3 Preliminary Jurisdictional Determination for Waters of the United States, Including Wetlands in the Wetland Study Area

According to USACE Regulatory Guidance Letter 08-02, the permit applicant may elect to use a PJD to voluntarily waive or set aside questions regarding CWA jurisdiction over a particular site, usually in the interest of allowing the landowner, permit applicant, or other “affected party” (as defined in Regulatory Guidance Letter 08-02 and 33 C.F.R. § 331.2) to move ahead expeditiously and obtain CWA Section 404 permit authorization where the applicant determines that doing so is in their best interest.

PJDs do not make an official determination of jurisdictional waters *and* are nonbinding advisements that potential WOUS (including wetlands) *may* be present in a site and therefore should be assumed jurisdictional by USACE. A PJD is not appealable under the USACE appeal process because it is not an official jurisdictional determination. If a PJD is issued by the USACE, an Approved Jurisdictional Determination can always be requested by the applicant later, if necessary. PJDs cannot be used for determining whether a site has no aquatic features, no potential jurisdictional WOUS (including wetlands), geographically isolated waters and wetlands, or some jurisdictional and some nonjurisdictional waters.

A PJD was issued by the USACE Sacramento District in November 2011 for aquatic resources (121.87 acres of wetlands and 319 acres of other waters) in the greater Merced to Fresno Section study area. Additionally, a PJD was requested in January 2013 for the PP1 supplemental study area. A new PJD was issued by the USACE Sacramento District in September 2013 for aquatic resources (129.07 acres of wetlands and 311.60 acres of other waters) in the greater Merced to Fresno Section including the PP1 supplemental (Appendix I). Although a portion of the Central Valley Wye overlaps the Hybrid Alignment study area, the WSA defined in this report does not include any of the overlapping areas.

5.4 Wetland Functions

This section informally and qualitatively identifies the habitat functions provided by each of the wetland habitats mapped in the WSA. The identified functions are based on the Hydrogeomorphic Approach (USACE 2008b). No attempt was made to assign an index value (i.e., 0.0 to 1.0) to represent the level of wetland condition for each function, as is required as part of a formal Hydrogeomorphic Approach functional assessment. The intention of the habitat function identification is to assist in future mitigation planning for the HSR. The Hydrogeomorphic Approach is based on combining variables that are typically structural measures or indicators that are associated with one or more ecosystem functions. Functions normally fall into one of three major categories: (1) hydrologic (e.g., storage of surface water), (2) biogeochemical (e.g., removal of elements and compounds), and (3) physical habitat (e.g., topography, depth of water, number and size of trees) (USEPA 1998).

The Hydrogeomorphic Approach identifies seven geomorphic settings of wetlands as guidance for the identification of regional subclasses that function similarly. These are the riverine, depressional, slope, mineral soil flat, organic soil flat, estuarine fringe, and lacustrine fringe settings, some of which occur in the WSA. Settings differ by dominant sources of water and hydrodynamics (e.g., flow rates and fluctuations of water within the wetland) (USEPA 1998). The identified functions of each habitat type are provided in Table 5-2. An assessment of the WSA using the *California Rapid Assessment Method for Wetlands* (Collins et al. 2008) was conducted in summer 2016.

Table 5-2 Functions of Wetland Habitat Types in the Wetland Study Area

Wetland Habitat Type	HGM Class	Flow Regime	Function(s)
Vernal pool	Depressional	Floodflow detention	Flood flow alteration, sediment stabilization, sediment/toxic retention, nutrient removal/transformation, wildlife diversity/abundance, aquatic diversity/abundance
Seasonal wetland	Depressional	Floodflow detention	Groundwater recharge/discharge, wildlife diversity/abundance, aquatic diversity/abundance
Palustrine forested	Riverine	Subsurface and overland flow	Groundwater recharge/discharge, flood flow alteration, sediment stabilization, sediment/toxic retention, nutrient removal/transformation, wildlife diversity/abundance, aquatic diversity/abundance, recreation

Source: USEPA, 1998; USACE, 2008b
HGM = Hydrogeomorphic Approach

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CADWR	California Department of Water Resources
CAL FIRE	California Department of Forestry and Fire Protection
Cal. Water Code	California Water Code
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
C.F.R.	Code of Federal Regulations
ESRI	Environmental Systems Research Institute
FRA	Federal Railroad Administration
NRCS	Natural Resources Conservation Service
SCS	Soil Conservation Service
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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