APPENDIX 3.6-B: WATER USE ASSESSMENT

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This Technical Memorandum (TM) presents an analysis and evaluation of anticipated water use requirements for both the construction and operation of the Central Valley Wye alternatives. This TM also identifies current water use (most of which is agricultural) at the Central Valley Wye alternatives, and likely water supply sources to meet the anticipated high-speed rail (HSR) water demand for construction.

Executive Summary

The Central Valley Wye alternatives share termini at Henry Miller Road/Carlucci Road on the west, Ranch Road/State Route (SR) 99 on the north, and Avenue 19 near Madera Acres on the south. The alignments 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 this *Merced to Fresno Section: Central Valley Wye Draft Supplemental Environmental Impact Report (EIR)/Supplemental Environmental Impact Statement (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 the HSR would cross roads, railroads, and other transport facilities using overheads or underpasses thereby allowing the HSR to operate independently of other modes of transport. HSR rights-of-way would be fenced to prohibit public or vehicle access. The Central Valley Wye project footprint would consist primarily of the train right-of-way in an area typically 120 feet wide. Grade separations, traction power (electrical) facilities, and the four-track portions of the wye that allow for bidirectional travel would require additional right-of-way.

Analysts used the same water use factors (facilities and use rates) identified for the HSR project in the Fresno to Bakersfield Section to estimate water demand for construction and operation of the Central Valley Wye alternatives. Analysts then evaluated existing water use along each alignment alternative and compared it to the future estimated HSR demand. This comparison indicated that construction of the Central Valley Wye alternatives would result in a net decrease in annual water consumption where the construction activities occur. In these areas, construction demand for water would be an estimated 18 percent of existing water use.

Because the Central Valley Wye alternatives do not include any HSR stations or maintenance facilities, there would be no project-related demand for water during operation and maintenance of the selected Central Valley Wye alternative. Most of the land that would be utilized in the Central Valley Wye resource study area (RSA) is currently in agricultural use and the Central Valley Wye alternatives would permanently remove that land from agricultural production. Additionally, temporary construction easements (TCEs) would be required to support construction activities along the Central Valley Wye alternatives and would generally be located adjacent to active construction areas, thereby temporarily removing additional agricultural lands from production. It is assumed that once construction of the Central Valley Wye is completed, those agricultural lands affected by TCEs would be returned to agricultural use.

Because of this, and because the project would not require water after the construction period, annual water use for that land during project operations would be less than water use for the same land prior to the project.

Background

The California High-Speed Rail Authority (Authority), a state governing board formed in 1996, has responsibility for planning, designing, constructing, and operating the HSR. When completed, the HSR system would provide intercity, high-speed service on more than 800 miles of tracks throughout California, connecting the major population centers of Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego.

The HSR system, shown on the cover, is divided into 12 sections. The Central Valley Wye would connect the San Jose to Merced Section on the west to the Merced to Fresno Section on the

east. From there, it would connect to the Southern California HSR sections to the south and to the Merced to Sacramento HSR Section to the north. The project runs through portions of Merced and Madera counties; the exact length at build-out (57 to 61 miles) would depend on the alternative selected for the final alignment. The Central Valley Wye consists of four alternatives, one of which would be selected as the preferred alternative:

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

Beginning at Carlucci Road, the western boundary of the project, the RSA extends eastward along Henry Miller Road, SR 152, and Avenue 21. The northbound portions of the alignment alternatives then divert to the north along Road 13 and Road 18 to SR 99, ending at the intersection of SR 99 and Ranch Road in Merced County. The southbound portions of the alignment alternatives extend eastward to locations east of SR 99, then divert to the south and continue along the BNSF rail line, ending at Avenue 17 in Madera Acres, in Madera County.

Methodology

This analysis consisted of the following steps:

1. Reviewed existing relevant information, reports, and documents to identify project features and activities that would require significant water usage during both the construction and operation of this section of the HSR.
2. Identified the expected land requirements for the track alignments, as well as passenger loading estimates and staffing requirements for operating and maintaining each feature, during both construction and operation at full build-out operation.
3. Developed water demand estimates for both construction and long-term operation of the planned facilities and track alignments. The water demand estimate for construction is based on the estimated one-time, 5-year construction period concluding in 2022. The annual water use estimate is based on full build-out in 2040.
4. Determined existing water use at the sites where the HSR system would be constructed and operated. Parcel land use information was identified, and then county-specific water use rates developed from recent data were applied.
5. Identified available existing water supply and additional water supply sources, if needed, to provide the required water to each section feature, during both construction and long-term operation. A more detailed description of the approach for each step is provided below.

Identification of Project Features with Significant Water Usage

Relevant project documents were reviewed to identify project elements that would have significant water demand requirements. Based on this review, the project was determined to require significant water usage only during construction.

During project operation, the project would not require water. Also, the radio towers, traction power substations, and switching and paralleling stations are unmanned, remotely-operated facilities with no dedicated water supply and no water use requirements. Therefore, no water use analysis was required for the Central Valley Wye for the operation of the HSR system.

Estimating Future Water Demand Requirement for the Central Valley Wye

This section describes the relevant information and assumptions used to estimate the future water demand for each Central Valley Wye alternative. Water demand estimates were developed only for construction activities because no HSR stations or maintenance facilities would be constructed for the Central Valley Wye. As a result, there would be no water usage for operations of the Central Valley Wye. The different water use factors and estimated future water demand for

each facility is summarized in Table 1 in the following section. The process for estimating water demand for construction of each wye alternative included the following:

- Identification of the construction footprint for each of the four wye alternatives
- Identification of the different construction components associated with construction of the track, including:
  - Manufacturing concrete
  - Earthwork and soil conditioning
  - Dust suppression
  - Landscaping

Water usage estimates were developed for construction of the track based on anticipated project construction schedule. This schedule is discussed in more detail below in the "Water Supply to Serve Construction" section. The total estimated construction water usage was annualized over a 5-year construction period. This information is summarized in Table 2 in the following section.

Existing Water Use and Water Supply Sources

Existing land use information was evaluated for each Central Valley Wye alternative based on county parcel information and aerial photo agricultural interpretation. The predominant land use for each alternative is agricultural (ranging from 86 percent to 92 percent). Other land uses are residential, commercial, community facilities, and vacant or other. The land use factors to determine existing water use for land currently in residential, commercial, community facilities, and vacant and other uses are the same factors utilized in the Madera County Integrated Regional Water Management Plan (2008).

To determine water use for the agricultural areas, the same factors used for the Fresno to Bakersfield Section were applied to the Central Valley Wye. In addition, two California Department of Water Resources (DWR) documents containing detailed water use information for specific crops were consulted. One of those documents, *Crop Water Use in California*, Bulletin 113-4, April 1986, provided specific water use for individual crops. It also provided county-specific data for analysis of specific water rates for Merced and Madera Counties, where agricultural water use varies widely for different crops, such as 1.1 acre-feet per acre per year (ac-ft/ac/year) for grain compared to 6.7 ac-ft/ac/year for rice. Based on the data, the average water use for all crops in these two counties was reported as:

- Merced County – 3.8 ac-ft/ac/year
- Madera County – 3.6 ac-ft/ac/year

The second document consulted was the more recent DWR 2001 crop use water rates table, which also provided specific crop water use rates by county, showing a slight reduction in average water use from 1986 to 2000. In this table, water use varies from 1.4 ac-ft/ac/year for grain to 5.6 ac-ft/ac/year for rice. The average water use for all crops in these two counties was reported as:

- Merced County - 3.3 ac-ft/ac/year
- Madera County - 3.5 ac-ft/ac/year

These more recent water use rates were applied to the agricultural area for each of the four wye alternatives. The rates then were used to calculate existing water use for the project footprint of each alternative in each county. The resulting existing water use for each Central Valley Wye alternative is shown in Table 1.

Table 1 Existing Water Use by Alternative

Distance	Land Use	Acres	Water Use Factors (acre feet/acre/year)	Annual Water Use (acre feet/year)
SR 152 (North) to Road 13 Wye Alternative				
52 miles	Residential	98.6	3.2	315
	Commercial	11.2	1.9	21
	Community Facilities	53.6	1.9	102
	Agricultural	2,334		
	Merced County	759	3.3	2,505
	Madera County	1,575	3.5	5,512
	Vacant and Other	547	2.7	1,476
	Total	**3,044.1**		**9,932**
SR 152 (North) to Road 19 Wye Alternative				
55 miles	Residential	152.4	3.2	488
	Commercial	10.5	1.9	20
	Community Facilities	73.0	1.9	139
	Agricultural	2,583.1		
	Merced County	938.5	3.3	3,097
	Madera County	1,644.6	3.5	5,756
	Vacant and Other	610.1	2.7	1,647
	Total	**3,429.0**		**11,147**
Avenue 21 to Road 13 Wye Alternative				
53 miles	Residential	23.0	3.2	73
	Commercial	3.3	1.9	6
	Community Facilities	55.9	1.9	106
	Agricultural	2,347.1		
	Merced County	665.0	3.3	2,194
	Madera County	1,682.1	3.5	5,887
	Vacant and Other	240.1	2.7	648
	Total	**2,669.3**		**8,916**

Distance	Land Use	Acres	Water Use Factors (acre feet/acre/year)	Annual Water Use (acre feet/year)
SR 152 (North) to Road 11 Wye Alternative				
51 miles	Residential	70.1	3.2	224
	Commercial	9.9	1.9	19
	Community Facilities	23.0	1.9	44
	Agricultural	2,308.4		
	Merced County	773.1	3.3	2,551
	Madera County	1,535.3	3.5	5,374
	Vacant and Other	422.6	2.7	1,141
	Total	**2,833.9**		**9,352**

- Water use factors are taken from the Fresno Urban Water Management Plan, Table 6.4, except for agricultural use. Water use factors, except for agricultural use, are assumed to be the same for Madera and Merced counties.
- Areas of land use are calculated based on the wye alternatives plans.
- Agricultural water use factors were calculated using the water use rates provided in *Calculating California Cropping Patterns in 2050* (Howitt et al. 2008) and the land use data for crop types provided in DWR 2001 crop usage for counties.

Water is provided in the Central Valley Wye RSA by 10 public water suppliers that obtain their water primarily from the Central Valley Project or the Merced River. In addition, private groundwater wells are a major water supply source. Consistent with the agricultural nature of the RSA, water is used primarily for agriculture. The water suppliers and acreage that each supplier covers are shown below:

- San Luis-Delta Mendota Water Authority/1,100,000 acres
- Henry Miller Reclamation District/45,000 acres
- Central California Irrigation District/143,000 acres
- Chowchilla Water District/85,000 acres
- City of Chowchilla Department of Public Works/4,900 acres
- Le Grand-Athlone Water District/24,600 acres
- Merced Irrigation District/164,000 acres
- Madera County Maintenance District 33/Not Available
- Madera Valley Water Company/1,300 acres
- Madera Irrigation District/131,600 acres

The Central Valley Wye alternatives are located in or near the service areas of the suppliers listed above which rely predominately on surface water. In addition, the Central Valley Wye could also use groundwater for some of the construction-related activities. According to the United States Geological Surveys (USGS) California Water Sciences Center, while surface water for agriculture is used when it is available (via the Central Valley Project and Merced River), the San Joaquin Basin also relies heavily on groundwater. USGS estimates that groundwater accounts for approximately 33 percent of the annual supply of water used for both agricultural and urban purposes in the basin (USGS 2016). Existing water use within the Central Valley Wye project footprint, primarily for agriculture, is 8,916 acre-feet/year to 11,147 acre-feet/year, using both surface water and groundwater. Annual water use for construction would be 1,405 acre-feet/year (14.1 percent of existing water use) under SR 152 (North) to Road 13 Wye Alternative, 1,519 acre-feet/year (13.6 percent of existing water use) under SR 152 (North) to Road 19 Wye Alternative, 1,286 acre-feet/year (14.4 percent of existing water use) under Avenue 21 to Road 13 Wye Alternative, and 1,304 acre-feet/year (13.9 percent of existing water use) under SR 152 (North) to Road 11 Wye Alternative within the project footprint. Using the USGS estimate of 33 percent groundwater usage in the San Joaquin Basin, existing groundwater use within the public

utilities and energy RSA for irrigation would be 3,278 acre-feet/year under the SR 152 (North) to Road 13 Wye Alternative, 3,679 acre-feet/year under the SR 152 (North) to Road 19 Wye Alternative, 2,942 acre-feet/year under the Avenue 21 to Road 13 Wye Alternative, and 3,086 acre-feet/year under the SR 152 (North) to Road 11 Wye Alternative. Consequently, the amount of groundwater used for construction could be approximately 424 to 501 acre-feet/year, assuming 33 percent of the 1,286 to 1,519 acre-feet/year used for construction is drawn from groundwater sources. This amount of groundwater would be considerably less than the current estimated groundwater use within the project footprints. It is likely further that reductions in groundwater use for construction could be achieved though implementation of the Authority's Water Conservation Policy, which requires use of non-potable water, non-water dust suppressants, and other water conservation measures.

Water Supply to Serve Construction

The amount of water that would be used during construction was estimated for concrete work, earthwork and dust control, and irrigation for reseeding and landscaping for the track alignments (Table 2).

Analysts used industry construction standards to estimate the amount of concrete needed to construct track alignments and associated viaducts and bridges. These quantities were used to estimate the amount of concrete required for construction of elevated, retained fill, and below-grade sections of track required for each Central Valley Wye alignment (estimated at 21 to 28 cubic yards of concrete per foot of track). Water needed for concrete batch plants during track construction was estimated at 31 gallons per cubic yard of concrete.

Water demand for earthwork compaction was calculated for an optimum moisture content of 10 percent by volume and water demand for dust control was estimated to occur for 180 days at each section of the track. Lastly, water demand for seed germination and irrigation was estimated for 70 percent of the track right-of-way.

Table 2 Construction Water Use by Alternative and Activity

Length of Construction	Construction Activity	Water Use		
		Annual Construction Use (acre-feet/year)	Total 5-Year Construction Use	
			Acre-Feet	Million Gallons
SR 152 (North) to Road 13 Wye Alternative				
52 miles	Concrete Work	8	38.5	13
	Earthwork	243	1213.4	395
	Dust Control	942	4,708.2	1,534
	Landscaping	213	1,065.3	347
	Total	**1,405**	**7,025.4**	**2,289**
SR 152 (North) to Road 19 Wye Alternative				
55 miles	Concrete Work	9	46.2	15
	Earthwork	209	1,045.3	341
	Dust Control	1,061	5,303.7	1,728
	Landscaping	240	1,200.1	391
	Total	**1,519**	**7,595.3**	**2,475**

Length of Construction	Construction Activity	Water Use		
		Annual Construction Use (acre-feet/year)	Total 5-Year Construction Use	
			Acre-Feet	Million Gallons
Avenue 21 to Road 13 Wye Alternative				
53 miles	Concrete Work	7	35.8	12
	Earthwork	266	1,330.1	433
	Dust Control	826	4,128.2	1,345
	Landscaping	187	934.1	304
	Total	**1,286**	**6,428.3**	**2,095**
SR 152 (North) to Road 11 Wye Alternative				
51 miles	Concrete Work	7	34.5	11
	Earthwork	222	1,110.5	362
	Dust Control	877	4,383.4	1,428
	Landscaping	198	991.8	323
	Total	**1,304**	**6,520.3**	**2,125**

- Estimates based on Engineering Footprints
- Annual water use is per year for 5-year construction period.
- Total earthwork and concrete volumes are estimated from conceptual engineering submittal multiplied by the factors developed by the Fresno to Bakersfield Section for each item of work.

Table 3 provides a comparison of annual existing water use and construction water use for the four Central Valley Wye alternatives. As shown, construction of any one of the four alternatives would result in a net decrease in annual water use for that portion of the RSA. Specifically, the table shows that annual water use during construction would be approximately 14 percent of existing annual water use. In other words, current annual water use is substantially greater than would be required for project construction. It is noted that construction water use is not continuous, as needs are often sporadic and a function of the particular construction activities at the time.

As a result, construction demand is frequently offset by water supply system storage, so there would not be a noticeable drop in pressure or flow during construction-related activities. Also, construction contractors sometimes provide water storage on-site, and replacement water can be planned for periods of low demand. These activities also alleviate potential surges in water demand.

Table 3 Annual Construction Water Use Summary

Wye Alternative	Annual Water Use (acre-feet per year)		
	Existing Use	Construction Use	Percentage of Existing Use
SR 152 (North) to Road 13 Wye	9,932	1,405	14.1
SR 152 (North) to Road 19 Wye	11,147	1,519	13.6
Avenue 21 to Road 13 Wye	8,916	1,286	14.4
SR 152 (North) to Road 11 Wye	9,352	1,304	13.9

1. Water use factors taken from the Fresno Urban Water Management Plan, Table 6.4 with the exception of agricultural use. Water use factors, except for agricultural use, are assumed to be the same for Santa Clara, San Benito, Merced, Madera and Fresno Counties.
2. Areas of land use are calculated based on Central Valley Wye project footprint.
3. Agricultural water use factors were calculated using the water use rates provided in *Calculating California Cropping Patterns in 2050* (Howitt, et al. 2008) and the land use data for crop types provided in DWR 2001 crop usage for counties.
4. Park and recreational water use data are small and will not be used in the water use analysis
5. No water use factors were available for Roadways/ROW/No Data land uses; therefore an estimated water use factor of 1.9 was applied, as it is likely that water use on such land would not be more than it would for commercial, industrial or institutional land uses.

Water Supply Sources for Operation of the Central Valley Wye

As previously stated, water would not be required for operation of any of the Central Valley Wye alternatives. Also, there would not be a demand for water for landscaping or other maintenance of the alternatives.

Conclusions

Construction of the Central Valley Wye of the HSR would result in net decrease in annual water consumption to approximately 14 percent of the existing water usage for the project footprint, as summarized in Table 3.

Most of the land utilized in the Central Valley Wye RSA is currently in agricultural use, where per-acre water demand ranges from 3.3 to 3.5 acre-feet per year. The Central Valley Wye would permanently remove that land from agricultural production. Additionally, TCEs would be required to support construction activities along the Central Valley Wye and would generally be located adjacent to active construction areas, thereby temporarily removing additional agricultural lands from production. It is assumed that once construction of the Wye is completed, those agricultural lands affected by TCEs would be returned to agricultural use.

Therefore, because an estimated 2,308 to 2,583 acres of land would be permanently taken out of agricultural production, and the project would not require water after the construction period, annual water use for that land during project operation would be less than water use for the same land prior to the project.

References

DWR	California Department of Water Resources
SLDMWA	San Luis and Delta-Mendota Water Authority
USGS	U.S. Geological Survey
WCP	Water Conservation Plan

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