APPENDIX 3.6-C: WATER USE ASSESSMENT

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This appendix presents an analysis and evaluation of anticipated water use requirements for both construction and operation of the California High-Speed Rail (HSR) System for the San Jose to Central Valley Wye Project Extent (project). This appendix also identifies current water use (most of which is agricultural) within the project footprints, and available water supply sources to meet the anticipated HSR water demand for construction.

Executive Summary

The project alternatives share termini at Scott Boulevard on the north and Henry Miller Road/Carlucci Road on the east. The alignments would cross urban and rural areas in unincorporated Santa Clara, San Benito, and Merced Counties. Volume 3 of the environmental impact report (EIR)/environmental impact statement (EIS) provides detailed design drawings that support the descriptions of the alternatives.

The project would be grade-separated, meaning that the HSR would cross roads, railroads, and other transport facilities using overpasses or underpasses, allowing it to operate independently of other modes of transportation. HSR rights-of-way would be fenced and access controlled to prohibit public or vehicle access. The project footprint for each alternative would consist of the permanent HSR right-of-way, station, and maintenance facility areas. Grade separations and traction power electrical facilities would require additional right-of-way.

Analysts estimated water demand for construction and operation of the project alternatives. Analysts then evaluated existing water use along each project alternative and compared the existing water use to the estimated demand for construction and operation of the alternatives. Existing water consumption was estimated based on the current land uses within the project footprint and a water consumption factor for each type of land use. This comparison indicated that construction and operation of the project alternatives would result in a net decrease in annual water consumption compared to the current use of the land. Construction demand for water would be an estimated 10 percent of the existing annual water use of the land within the right-of-way for Alternative 1, 9 percent for Alternative 2, 10 percent for Alternative 3, and 9 percent for Alternative 4.

The alternatives include HSR stations at San Jose and downtown Gilroy or east Gilroy, a maintenance of way facility (MOWF) south or east of Gilroy and a maintenance of way siding (MOWS) near Turner Island Road. Therefore there would be project-related demand for water for station and maintenance facility operations in addition to water demand for construction of the alignment, stations, and maintenance facilities. A portion of the land that would be permanently utilized for construction of the alignment in areas of Santa Clara, San Benito, and Merced Counties is currently in agricultural use and construction of the alternatives would permanently remove land from agricultural production. Additionally, temporary construction easements (TCE) would be required to support construction activities and would generally be located adjacent to active construction areas, temporarily removing additional agricultural lands from production. Once construction of the project is completed, agricultural lands affected by TCEs would be returned to agricultural use.

Background

The California High-Speed Rail Authority (Authority), a state governing board formed in 1996, has responsibility for planning, designing, constructing, and operating the California HSR System. Its mandate is to develop an HSR system that coordinates with the state's existing transportation network, which includes intercity rail and bus lines, regional commuter rail lines, urban rail and bus transit lines, highways, and airports. The California 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 California HSR System would be implemented in two phases. Phase 1 would connect San Francisco to Los Angeles and Anaheim via the Pacheco Pass and the Central Valley. The sequence of system phasing would first connect the Silicon Valley to the San Joaquin Valley for initial operating section service in 2025. The San Jose to Merced Project Section (of which the San Jose to Central Valley Wye Project Extent is a part) would connect the San Francisco to San Jose Project Section on the north to the Merced to Fresno Project Section on the east. The project runs through portions of Santa Clara, San Benito, and Merced Counties. The project is divided into five subsections: San Jose Diridon Station Approach, which begins at Scott Boulevard; Monterey Corridor; Morgan Hill and Gilroy; Pacheco Pass; and San Joaquin Valley (which ends at Carlucci Road in an unincorporated area of Merced County).

Methodology

Analysts completed the following steps to estimate potential water needs required under the project alternatives and available water supplies:

1. Reviewed existing relevant information, reports, and documents to identify project features and activities that would require significant water usage during construction and operation.
2. Identified the expected land requirements (acreage) and land uses that would be permanently converted from use for construction of right-of-way, stations, and maintenance facilities for each alternative.
3. Developed water demand estimates for construction of the alignment, stations, and maintenance facilities for each alternative.
4. Developed water demand estimates for operation of stations and maintenance facilities.
5. Calculated the existing water use of the land for construction of the alternatives. Water use factors (acre-feet of water used per acre of land per year) were applied to each land use except for agricultural use; county-specific water use rates were developed from recent county-specific data and were applied to the amount of agricultural land for each county.
6. 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 operation.

The following subsections provide a more detailed description of the approach for each step.

Identification of Project Features with Significant Water Usage

During construction, water would be required for construction activities including preparation of cement, concrete work, earthwork and soil conditioning, fugitive dust suppression, landscaping, and operation of tunnel boring machines (TBM). Operation would require water for operation of stations and maintenance facilities. Radio towers, traction power substations, and switching and paralleling stations would be unmanned, remotely operated facilities with no dedicated water supply and no water use requirements. Water use factors and estimated existing water demand for permanently converted land for each alternative is summarized in Table 1.

Estimating Future Water Demand Requirement for the Project

Water demand estimates were developed for construction activities and for operations including two stations (San Jose Diridon Station and Downtown Gilroy or East Gilroy Station), one LMF/MOIF near Gilroy (South Gilroy or East Gilroy LMF/MOIF), and one MOWS near Turner Island Road. The process for estimating water demand for construction of each alternative included the following:

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

Analysts developed water usage estimates for construction of the track, stations, maintenance facilities, and tunnels based on the anticipated project construction schedule.

Water Use Assessment

Existing Water Use and Water Supply Sources

Analysts evaluated existing land use information for each project alternative based on city and county general plan land use data. The predominant land use for each project alternative is agricultural (ranging from 37 percent to 46 percent) and parks, recreational, and open space (ranging from 46 percent to 48 percent). Other land uses are categorized as residential, commercial, industrial, public facilities, and transportation land for the purposes of this analysis. The land use factors to determine existing water use for land currently in residential, commercial, public facilities, parks, recreational, and open space, and transportation land uses are the same factors utilized in the Fresno Urban Water Management Plan (City of Fresno 2008). Analysts obtained water use for agricultural land in Santa Clara, San Benito, and Merced Counties from the California Department of Water Resources (California Department of Water Resources) (DWR 2005, 2006, 2007, 2008, 2009, 2010, 2017).

To determine water use for the agricultural areas, analysts obtained applied water rates (acre-feet of water per acre of land) and irrigated acres for each crop type were obtained from the DWR database (DWR 2017). Data tables were available for calendar years 1998 through 2010. In the table, water use varies from less than 1 acre-foot per acre per year for grain to 5.6 acre-feet per acre per year for rice. Acre-feet per acre per year for each crop type and the number of irrigated acres for each crop type for calendar years 2005 through 2010 were averaged to calculate the average acre-feet per acre per year for Santa Clara, San Benito, and Merced Counties. Analysts calculated the average water rate for all crops in these three counties for calendar years 2005 to 2010 as:

Acre-foot of water

An acre-foot of water is the volume equal to a sheet of water 1 acre in area and 1 foot in depth.

- Santa Clara County—2.8 acre-feet per acre per year
- San Benito County—1.9 acre-feet per acre per year
- Merced County—3.7 acre-feet per acre per year

Analysts applied the most recent available DWR water use data to the agricultural area for each county for each alternative. 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 alternative is shown in Table 1.

Table 1 Existing Water Use by Project Alternatives

Distance	Land Use	Acres[1]	Water Use Factor (acre-feet /year)	Annual Water Use (acre-feet/year)
Alternative 1				
89.6 Miles	Low/Medium Density Residential	49	3.2	155
	High Density Residential	4	3.2	14
	Mixed-Use	15	3.2	49
	Commercial	87	1.9	166
	Industrial	113	2.7	304
	Public Facilities	123	1.9	233
	Parks/ Recreation/Open Space	1,443	2.7	3,897
	Agricultural	1,133	N/A	N/A
	Santa Clara County	*267*	*2.8*	748
	San Benito County	*81*	*1.9*	153
	Merced County	*786*	*3.7*	2,907
	Transportation	29	2.7	77
	Total	**2,996**	**N/A**	**8,704**
Alternative 2				
89.3 Miles	Low/Medium Density Residential	106	3.2	340
	High Density Residential	7	3.2	22
	Mixed-Use	24	3.2	75
	Commercial	105	1.9	199
	Industrial	156	2.7	421
	Public Facilities	126	1.9	239
	Parks/ Recreation/Open Space	1,511	2.7	4,079
	Agricultural	1,235	N/A	N/A
	Santa Clara County	335	2.8	937
	San Benito County	114	1.9	217
	Merced County	786	3.7	2,907
	Transportation	32	2.7	87
	Total	**3,301**	**N/A**	**9,525**

Distance	Land Use	Acres[1]	Water Use Factor (acre-feet /year)	Annual Water Use (acre-feet/year)
Alternative 3				
88.1 Miles	Low/Medium Density Residential	51	3.2	164
	High Density Residential	4	3.2	14
	Mixed-Use	1	3.2	3
	Commercial	43	1.9	82
	Industrial	77	2.7	209
	Public Facilities	31	1.9	59
	Parks/ Recreation/Open Space	1,426	2.7	3,850
	Agricultural	1,418	N/A	N/A
	Santa Clara County	489	2.8	1,369
	San Benito County	143	1.9	272
	Merced County	786	3.7	2,907
	Transportation	32	2.7	87
	Total	**3,084**	**N/A**	**9,016**
Alternative 4				
88.9 Miles	Low/Medium Density Residential	86	3.2	276
	High Density Residential	4	3.2	13
	Mixed-Use	28	3.2	90
	Commercial	112	1.9	212
	Industrial	125	2.7	338
	Public Facilities	15	1.9	28
	Parks/ Recreation/Open Space	1,459	2.7	3,938
	Agricultural	1,145	N/A	N/A
	Santa Clara County	287	2.8	804
	San Benito County	72	1.9	137
	Merced County	786	3.7	2,907
	Transportation	28	2.7	76
	Total	**3,001**	N/A	8,817

Sources: City of Santa Clara 2010; City of San Jose 2011; County of Santa Clara 1994, 2016; City of Morgan Hill 2016; City of Gilroy 2002, 2005; County of Merced 2013; County of San Benito 2016; City of Fresno 2008; California Department of Water Resources 2005, 2006, 2007, 2008, 2009, 2010, 2017; HNTB 2018a.

[1] Acres of land use are calculated based on the permanent right-of-way for track alignment, stations, and maintenance facilities for each alternative.

The Santa Clara Valley Water District supplies water to all of Santa Clara County. Water demand in 2015 was 260,000 acre-feet per year. Water demand in 2040 is projected to be 435,100 acre-feet per year. Water is distributed in incorporated areas of Santa Clara County by the San Jose Water Company, San Jose Municipal Water System, City of Morgan Hill Water Division, and City of Gilroy Public Works. Local sources include natural groundwater recharge and surface water

supplies, including surface water rights held by the Santa Clara Valley Water District and the San Jose Water Company, and also use of recycled water within Santa Clara County. Residential water use is the primary water use in Santa Clara County. Many residents in rural and unincorporated areas of Santa Clara County rely on private groundwater wells for drinking water (SCVWD 2015).

The San Benito County Water District provides water to primarily agricultural customers in unincorporated areas of San Benito County. In 2015 the U.S. Bureau of Reclamation water allocation to the San Benito County Water District was 43,800 acre-feet of which 8,250 acre-feet was designated for municipal and industrial uses and 35,550 was designated for agricultural uses (County of San Benito 2016a).

Water is provided in unincorporated areas of Merced County by public water suppliers that obtain their water primarily from the Central Valley Project operated by U.S. Bureau of Reclamation, the California Aqueduct operated by the DWR, or from private groundwater wells that are also a major water supply source in unincorporated areas of Merced County. Consistent with the agricultural nature of Merced County, water is used primarily for agriculture in the Pacheco Pass and San Joaquin Valley Subsections. The water suppliers and acreage that each supplier covers in western Merced County are:

- San Luis/Delta-Mendota Water Authority—1,100,000 acres
- Henry Miller Reclamation District/San Luis Canal Company—45,000 acres
- Grassland Water District—51,537 acres
- Central California Irrigation District—143,000 acres
- Del Puerto Water District-- 52,800 acres (9,000 acres in Merced County)

The project alternatives are located in or near the service areas of these suppliers, which rely predominantly on surface water, as they extend through western Merced County. In addition, groundwater could be used for some construction-related activities. According to the U.S. Geological Survey (USGS) California Water Sciences Center, while surface water for agriculture is used when it is available (via the Central Valley Project), 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 agricultural water use for irrigation in Merced County was 1,374 million gallons per day (mgd) (1.5 million acre-feet per year) in 2010, including 981 mgd (1.1 million acre-feet per year) of surface water (71 percent) and 393 mgd (0.4 million acre-feet per year) of groundwater (29 percent) (USGS 2017). Existing groundwater use within the project footprint for irrigation in Merced County is estimated at 918 acre-feet per year for all project alternatives.

Annual water use for construction for each alternative is summarized in Table 2. Annual water use for construction would be approximately 868 acre-feet per year for Alternative 1, 842 acre-feet per year for Alternative 2, 912 acre-feet per year for Alternative 3, and 887 acre-feet for Alternative 4. These values represent between 9 and 10 percent of the current water usage.

Construction Water Use

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

Table 2 Concrete, Tunnel Boring, and 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
Alternative 1			
89.6 miles	Concrete Batch Plants (Pacheco Tunnel)	17	83
	Concrete batch plants (Project Section)	57	285
	Tunnel boring[2]	366	1,829
	Construction water use[3]	428	2,141
	Total	**868**	**4,339**
Alternative 2			
89.3 miles	Concrete Batch Plants (Pacheco Tunnel)	17	83
	Concrete batch plants (Project Section)	60	300
	Tunnel boring[2]	366	1,829
	Construction water use[3]	399	1,993
	Total	**842**	**4,205**
Alternative 3			
88.1 miles	Concrete Batch Plants (Pacheco Tunnel)	17	83
	Concrete batch plants (Project Section)	61	304
	Tunnel boring[2]	366	1,829
	Construction water use[3]	468	2,339
	Total	**912**	**4,555**
Alternative 4			
88.9 miles	Concrete Batch Plants (Pacheco Tunnel)	17	83
	Concrete batch plants (Project Section)	51	253
	Tunnel boring[2]	366	1,829
	Construction water use[3]	453	2,261
	Total	**887**	**4,426**

Source: Authority 2017a; 2017b, 2017c HNTB 2018a

[1] Annualized water use is based on a total of 784 working days of tunnel boring machine operation.

[2] Construction water use includes water used for on-site concrete work, earthwork, dust control, and landscaping.

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, at-grade, retained fill, and below-grade sections of track, bridges, and other structures required for each project alternative (HNTB 2018a). Analysts estimated the water needed for preparation of concrete at 31 gallons per cubic yard of concrete, and estimated the water use for construction including concrete work, earthwork, dust control, and irrigation based on the number of water trucks included in the on-site vehicle construction schedule for each project alternative.

Table 3 provides a comparison of annual existing water use and construction water use for the project alternatives. As shown, construction of any one of the project alternatives would result in a net decrease in annual water use for that portion of the project. Current annual water use is therefore greater than the annual water use would be required for project construction.

It is noted that construction water use is not continuous, because needs are sporadic and a function of the particular construction activities at the time. Water would be supplied to construction work sites by water tanker truck or by temporary pipeline. As a result, construction demand is frequently offset by a water supply system storage, so there would not be a noticeable drop in public utility water pressure or flow during construction-related activities. Also, the construction contractors could provide water storage on-site, and replacement water can be planned for periods of low demand. These activities would reduce potential surges in water demand to utility customers.

Table 3 Annual Construction Water Use Summary by Alternative

County	Annual Water Use (acre-feet per year)		
	Existing Use	Construction Use	Percent of Existing Use
Alternative 1			
Santa Clara County	4,043	494	12
San Benito County	1,729	22	1
Merced County	2,931	351	12
Total	**8,703**	**868**	**10**
Alternative 2			
Santa Clara County	4,799	477	10
San Benito County	1,811	21	1
Merced County	2,915	343	12
Total	**9,525**	**842**	**9**
Alternative 3			
Santa Clara County	4,241	512	12
San Benito County	1,844	31	1
Merced County	2,931	369	13
Total	**9,016**	**912**	**10**

County	Annual Water Use (acre-feet per year)		
	Existing Use	Construction Use	Percent of Existing Use
Alternative 4			
Santa Clara County	4,172	497	12
San Benito County	1,714	30	2
Merced County	2,931	361	12
Total	**8,817**	**887**	10

Sources: City of Santa Clara 2010; City of San Jose 2011; County of Santa Clara 1994, 2016; City of Morgan Hill 2016; City of Gilroy 2002, 2005; County of Merced 2013; County of San Benito 2016a, 2016b; City of Fresno 2008; California Department of Water Resources 2005, 2006, 2007, 2008, 2009, 2010 2017; and HNTB 2018a.

Operations Water Use

Water would also be required for operation of stations and maintenance facilities for the project alternatives. The San Jose Diridon Station would include restroom facilities and drinking water fountains. The estimated average potable water demand for the San Jose Diridon Station would be 24,200 gallons per day (gpd). Approximately two-thirds of this water use (16,025 gpd) would be anticipated for use within the station, while the remaining third (8,650 gpd) would be for outdoor use. Water consumption for operation of the Downtown Gilroy Station would be approximately 15,800 gpd based on the estimated station and grounds square footages. The East Gilroy Station would use approximately 15,350 gpd; an estimated 10.500 gpd would be used within the Downtown Gilroy station and 5,330 gpd would be used for outdoor use. For the East Gilroy Station approximately 10,200 gpd potable water would be used within the station and the remaining 5,200 gpd would be used outdoors. The total water consumption for both the San Jose Diridon Station and the Downtown Gilroy Station would be 40,000 gpd, and for the San Jose Diridon Station and the East Gilroy Station water consumption would be 39,500 gpd. Approximately two-thirds of the water for operation of the two stations would be potable water consumption.

Water consumption for operation of the MOWF and the MOWS would be required for personnel, including operation of drinking fountains, restrooms, kitchen/canteens, showers, and other potable uses. Potable water consumption would be approximately 84,000 gpd at the MOWF and 98,000 gpd at the MOWS, for a total of 182,000 gpd of potable water for both maintenance facilities. Water consumption would also be required for the MOWF and the MOWS for use by road and rail-mounted equipment including rail-grinding train runs and other maintenance activities. Water used for maintenance activities at the MOWF and the MOWS would not need to be of drinking water quality. Nonpotable water use is estimated as 1,000 gpd for operation of the MOWF and 1,000 gpd for operation of the MOWS (Authority 2017b, 2017c). Annual total water consumption for operation of the MOWF and the MOWS for potable and industrial uses would be 184,000 gpd, of which 182,000 gpd would be for potable uses and 2,000 gpd would be for nonpotable uses.

Conclusions

Construction of the project alternatives would result in net decrease in annual water consumption relative to existing water consumption within the project footprints. The decrease would be greatest under Alternative 2 (requiring 9 percent of existing use for construction), followed by Alternative 1 (requiring 10 percent of existing use), Alternative 3 (requiring 10 percent), and Alternative 4 (requiring 10 percent), as summarized in Table 3. Between 38 percent and 46 percent of the land that would be utilized for construction of the project alternatives is currently in

agricultural use. Per-acre water demand for agricultural land in Merced County was estimated at 3.7 acre-feet per year per acre of agricultural land, for San Benito County 1.9 acre-feet per year per acre, and for Santa Clara County 2.8 acre-feet per year per acre. Construction of the project would permanently remove the land from agricultural production, resulting in a reduction in water use for the converted land. Additionally, TCEs would be required to support construction activities along the project and would generally be located adjacent to active construction areas. These TCEs would temporarily remove additional agricultural lands from production, also resulting in a further temporary reduction in water consumption during the construction period. It is assumed that once construction of the project is completed, those agricultural lands affected by TCEs would be returned to agricultural use.

Water consumption for operation of the two stations would be approximately 40,000 gpd and for operation of the maintenance facilities in the project would be approximately 184,000 gpd for a total of 224,000 gpd (250 acre-feet per year). This is approximately 2.9 percent of existing water use for Alternative 1, 2.6 percent of existing water use for Alternative 2, 2.8 percent of existing water use for Alternative 3, and 2.8 percent of existing water use for Alternative 4. Construction and operation of the project would therefore reduce water consumption for all project alternatives.

References

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

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