

California High-Speed Rail Authority

Bakersfield to Palmdale

Project Section

Draft Project Environmental Impact Report/ Environmental Impact Statement

Appendix 3.6-B: Technical Memorandum: Water Usage Analysis for HSR Bakersfield to Palmdale Project Section

January 2020



The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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Memorandum

DATE: October 30, 2018

TO: Sean Calvin, Rail Delivery Partner

FROM: Grant Wilson, LSA Associates, Inc.

CC: Andrea Bean, LSA Associates, Inc., Autumn Galambos, LSA Associates, Inc., Hilary Haskell, LSA Associates, Inc.

SUBJECT: California High-Speed Rail Project Environmental Impact Report/Environmental Impact Statement Water Usage Analysis Technical Memorandum

EXECUTIVE SUMMARY

This technical memorandum presents an analysis and evaluation of anticipated water usage requirements for both the construction and operation of the Bakersfield to Palmdale Project Section of the California High-Speed Rail (HSR) System. This technical memorandum also identifies current water usage at the proposed facility sites and HSR Build Alternatives, as well as likely water supply sources to meet the anticipated HSR water demand for this project section.

The Bakersfield to Palmdale Project Section runs through Kern and Los Angeles counties, and would extend approximately 82 miles in length. The major features of the Bakersfield to Palmdale Project Section include track alignment and associated right-of-way, and stations. A Light Maintenance Facility (LMF) and/or Maintenance-of-Way facility (MOWF) may also be included as part of this project section. Relevant sections of pertinent HSR reports, including the *Operations and Maintenance Cost Model Documentation: 2016 BUSINESS PLAN* (California High-Speed Rail Authority [Authority] 2016a) and the *Summary of Requirements for Maintenance Facilities* (Authority 2016b) were reviewed to identify all facilities that would have significant water demand requirements. Based on this review, facilities that would require significant water demand include the proposed stations (Bakersfield Station—Hybrid Alternative, Bakersfield Station—F Street [Locally Generated Alternative], and Palmdale Station) and maintenance facilities (LMF and/or MOWF).

Water usage factors and estimated usage rates were identified for the alignment and facility alternatives, as summarized in the attached tables (Attachment A) and as detailed below. These water usage factors were used to estimate the future water demand for each facility and HSR Build Alternative for construction activities, as well as operation and maintenance at final build-out. Existing water usage was then evaluated for the HSR Build Alternatives (Alternatives 1, 2, 3, and 5), proposed station sites, and maintenance facility sites (Lancaster North B MOWF and Avenue M LMF Zone). The existing water usage estimates were then compared with the future estimated demand. This comparison indicates that construction of the Bakersfield to Palmdale Project Section of the HSR system would result in a net decrease in annual water consumption for the area impacted by the construction of the track and associated facilities compared to existing conditions when annualized over a five-year construction period. Operation and maintenance of the HSR system at final build-out would also result in a net decrease of water usage over existing water usage in the project footprint to less than 5 percent of the current water usage. Water usage would decrease at the HSR Build Alternatives, Bakersfield Station—F Street (Locally Generated Alternative), and Lancaster Avenue M LMF Zone, and would increase at the Bakersfield Station—Hybrid Alternative and the Lancaster North B MOWF based on water usage factors. Water usage factors for the HSR Build Alternatives

and maintenance facilities were obtained from the Rosamond Community Services District's June 2011 Urban Water Management Plan (RUWMP) and information from similar maintenance facilities. Information for the Bakersfield Station—Hybrid Alternative was obtained from the *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]). Information for the Bakersfield Station—F Street (Locally Generated Alternative) was obtained from the *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS* (November 2016). Water usage factors for the Palmdale Station were obtained from the Palmdale Water District 2016 Water System Master Plan (WSMP).

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 system. When completed, the HSR project would provide intercity HSR 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 is divided into nine sections. The Bakersfield to Palmdale Project Section, shown on Figure 1 (all figures provided in Attachment B) and highlighted on the cover, would connect to the Fresno to Bakersfield Project Section to the north and the Palmdale to Burbank Project Section to the south. The Bakersfield to Palmdale Project Section runs through Kern and Los Angeles counties and would extend approximately 82 miles in length.

Major features of the Bakersfield to Palmdale Project Section include the track and associated right-of-way, stations, and potentially an LMF and/or an MOWF. Other lesser facilities would include a Maintenance-of-Way facility, traction power supply stations, and switching and paralleling stations.

METHODOLOGY

This analysis consisted of the following steps:

1. Review of 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 system.
2. Identification of the expected land requirements for the stations, maintenance facilities, and HSR Build Alternatives, as well as staffing requirements for operating and maintaining each feature, during both construction and operation at final build-out.
3. Development of water demand estimates for both construction and long-term operation of the planned facilities and HSR Build Alternatives. The water demand estimate for construction is annualized over a five-year period and the annual water usage estimate is based on final build-out in 2040.
4. Determination of existing water usage at the sites where the HSR system would be constructed and operated. Parcel land use information was identified, and then specific water usage rates developed from recent data were applied.
5. Identification of 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 all project facilities that would have significant water demand requirements. Based on this review, the proposed stations and maintenance facilities would require significant operational water usage. The construction of tunnels for the track alignment would also require significant water usage; however, water usage would be temporary and would cease after construction is completed.

HSR Build Alternatives

The HSR Build Alternatives consist of track alignments, parts of which travel through tunnels and associated rights-of-way. Water is not anticipated to be used along the HSR Build Alternatives except at tunnels and portals.

The total tunnel length for each HSR Build Alternative was calculated as follows:

- **Alternative 1:** 46,385 feet
- **Alternative 2:** 46,385 feet
- **Alternative 3:** 51,005 feet
- **Alternative 5:** 46,385 feet

Stations

The Bakersfield to Palmdale Project Section would be served by stations in Bakersfield and Palmdale (Figures 2 and 3).

Two locations are being evaluated for a station in Bakersfield: the Bakersfield Station—Hybrid Alternative and the Bakersfield Station—F Street (Locally Generated Alternative). The Bakersfield Station—Hybrid Alternative analysis was completed in 2014 in the *Fresno to Bakersfield Project Section Final EIR/EIS* and technical studies. Therefore, this analysis is incorporated by reference into the Bakersfield to Palmdale Project Section. Since the approved 2014 Record of Decision, the Authority and the City of Bakersfield have agreed to consider an alternate station location at F Street (Bakersfield Station—F Street [Locally Generated Alternative]). This alternative is currently being evaluated through a Supplemental EIR/EIS for the Fresno to Bakersfield Project Section. This technical memorandum includes a summary of the analysis of water usage associated with the Bakersfield Station alternatives.

One location is being evaluated for a station in Palmdale. The station would consist of several facilities occupying approximately 50 acres. This technical memorandum includes analysis of the water usage associated with the Palmdale Station.

Maintenance Facilities

An LMF and/or an MOWF could potentially be located in the region as part of the Bakersfield to Palmdale Project Section. The LMF would provide for the overnight storage and light maintenance of trainsets and require approximately 160 acres for siting (Figure 4). The MOWF would house light maintenance and train dispatch functions, as well as the equipment and supplies for maintaining the HSR infrastructure, such as track, traction power, and signal systems (Figure 5). The MOWF would require approximately 84 acres for siting. Although it is not certain whether one or both facilities would be included as part of the Bakersfield to Palmdale Project Section, this technical memorandum includes an analysis of the water usage associated with an LMF and an MOWF.

Estimating Future Water Demand Requirements for the Bakersfield to Palmdale Project Section

Operational Water Demand Methodology

This section describes the relevant information and assumptions used to estimate the future water demand for each facility and HSR Build Alternative. Water demand estimates were developed for both construction activities and operation and maintenance at final build-out. Data tables summarizing key facility information and water demand estimates are included at the end of this technical memorandum.

The process followed in estimating water demand for the operation of each facility is summarized below:

- Identify facilities requiring water usage, including the HSR Build Alternatives, stations, and maintenance facilities

- Determine water usage factors for each facility, including:
 - Size/footprint of buildings and overall site areas
 - Passenger/employee use for each facility
 - Facility functions and operation and maintenance requirements
- Determine appropriate water usage factors
- Apply factors and estimate total water demand

Operational water usage factors were identified for the different facilities by obtaining information from similar facilities. The different water usage factors were compared, and the most appropriate annual water usage rate was selected as described below. The water usage factors and estimated future water demand for each facility are summarized in Table 1 (all tables attached).

HSR Build Alternatives

Water is not anticipated to be used along the HSR Build Alternatives except at tunnels and portals. Water would be required at tunnels and portal sites during operations for tunnel cleaning, fire and life safety, domestic needs, and general maintenance operations. The number, size, and end use of the facilities have not been fully established at this time. It is assumed that, at a minimum, restrooms, wash areas, and maintenance facilities would be included as part of the portal infrastructure. Water needs would be updated as the operation plans of the tunnel facilities are updated.

Fire and life safety systems are also currently being evaluated by the Rail Delivery Partner and the Authority. In accordance with the National Fire Protection Association's NFPA 14, Chapter 7.10.1.1.1, the standpipe and hose system would have a flow rate of 500 gallons per minute at a duration of 60 minutes. To meet this requirement, the dry standpipe water supply system must have a capacity of at least 30,000 gallons. Not included in this estimate is the amount of water required to fill the dry standpipe system at the fire location, which may be several miles away from the storage tanks, if used.

Stations

The Bakersfield to Palmdale Project Section would be served by stations in Bakersfield and Palmdale. Table 1 includes the estimated operational water usage for the Bakersfield Station site alternatives and the Palmdale Station.

A summary of the methodology utilized in the *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]) to estimate operational water usage for the Bakersfield Station is provided. The Fresno to Bakersfield Project Section examined several approaches for estimating the future water demand for the Bakersfield Station. The method that yielded the most conservative results was chosen. This entailed applying 5 gallons per capita per day use factors to the estimated number of passengers for the Bakersfield Station.

Additionally, several approaches for estimating the future water demand for the Palmdale Station were examined. The method that yielded the most conservative results was also chosen. This entailed applying 5 gallons per capita per day use factors to the estimated number of passengers for the Palmdale Station, plus 0.03 gallon per square foot of landscape per day.

Maintenance Facilities

The Fresno to Bakersfield Project Section utilized operational data from the Hayward Bay Area Rapid Transit (BART) facility (water usage rate of 31 gallons per employee per day). The Hayward BART facility was selected as a basis for developing a water usage factor for the heavy maintenance facility (HMF) as the facilities are similar in function (both perform heavy maintenance and cleaning for electrically powered trainsets). The expected use of newer water recycling and reuse technologies at the HMF led to a water usage factor that was adjusted slightly downward to 30 gallons per employee per day. During the process of selecting an appropriate water usage factor for both the LMF and MOWF, it was determined that an LMF and an MOWF would house functions similar to those of the HMF but with smaller-scale facilities. However, a SMART operations and maintenance facility and a

maintenance-of-way facility in Sonoma County also closely resemble the types of facilities that would be housed at the LMF and the MOWF (Table 2). A *Final Supplemental Mitigated Negative Declaration and Supporting Initial Study* projected that the water usage rate for the SMART facility would be 50.6 gallons per employee per day (Sonoma-Marín Area Rail Transit 2012). The SMART water usage factor was selected as a basis for developing a water usage factor for the LMF and the MOWF, as utilizing this water usage rate for the maintenance facilities would provide conservative water usage estimates. As shown in Table 1, the estimated daily volume would be adjusted accordingly, as the water usage factor would be multiplied by a larger estimated daily workforce for the LMF (120 employees) and the MOWF (300 employees) compared to the SMART facilities (93 employees).

Construction Water Demand

The process for estimating the water demand related to construction of each facility and HSR Build Alternative is summarized below:

- Identify the construction footprint for each facility and HSR Build Alternative
- Identify the different construction components associated with both construction of the facilities and the track
 - Manufacturing of concrete
 - Earthwork and soil conditioning
 - Dust suppression
 - Landscaping and irrigation
 - Tunnel excavation

Water usage estimates were developed for the construction of stations, maintenance facilities, and track, based on engineer estimates. This is discussed in more detail below in the “Water Supply to Serve Construction” section. The total estimated construction water usage was annualized over a five-year period. This information is summarized in Tables 5 through 7.

Estimating Existing Water Usage

Land areas that would be impacted by the Bakersfield to Palmdale Project Section were identified for each of the HSR Build Alternatives (Figure 1), station sites (Figures 2 and 3) and maintenance facility sites (Figure 6).

Existing Water Demand Methodology

HSR Build Alternatives and Maintenance Facilities

To estimate existing water usage for the HSR Build Alternatives and maintenance facility sites, water usage factors from the RUWMP, adopted in June 2011, and crop-specific water usage rate tables published in 2010 by the California Department of Water Resources (DWR) were applied to the existing land uses. The preparation of Urban Water Management Plans (UWMP) is required by the California Urban Water Management Planning Act. UWMPs are developed under the guidance of the DWR through its *2015 Urban Water Management Plan Guidebook* (DWR 2015) and are to be updated every 5 years.

The Avenue M LMF Zone is located within the geographic area serviced by Los Angeles County Waterworks District 40 (LACWD), which is covered by the Antelope Valley Integrated Regional Water Management Plan (AVIRWMP). The Lancaster North B MOWF is located within the geographic area serviced by the Antelope Valley-East Kern Water Agency (AVEK), which is covered by its own UWMP. However, LACWD, AVEK, and the Rosamond Community Services District are all part of the Regional Water Management Group, which works together to create the AVIRWMP. Rosamond is located between two rain water gauges: (1) north of Palmdale and Lancaster, which share a water gauge with an annual average precipitation of 7.36 inches, and (2) south of the Mojave rain gauge, with an annual average precipitation of 6.63 inches. Given that the LACWD and AVEK UWMPs do

not contain land use-based water usage factors and that the Avenue M LMF Zone and Lancaster North B MOWF are located in a similar climate as that found in Rosamond, water usage factors from the RUWMP were applied to estimate existing water usage for these sites. These land use-based water usage factors were also utilized to estimate existing water usage for the alignment alternatives. While the alignments travel through many different terrains, the climates located throughout the alignments tend to experience annual precipitation either similar to that of Rosamond (e.g., Bakersfield, with 6.49 inches) or higher (e.g., Tehachapi, with 11.51 inches). Therefore, utilizing these factors for the alignment alternatives would provide conservative water usage estimates.

The RUWMP provides annual water usage factors in acre-feet per acre by land use type for single-family residential, multifamily residential, commercial, and industrial uses. No water usage factors were available in the RUWMP for institutional/governmental, recreational, or miscellaneous land uses. Given the public nature of institutional/governmental and recreational land uses, which include government offices, schools, bowling alleys, athletic fields, and theatres, an annual water usage rate of 2.6 acre-feet per acre for public areas from the RUWMP was applied to these categories. A conservative annual water usage rate of 1.10 acre-feet per acre was also applied to miscellaneous land uses, which include nonexempt properties such as buffer strips, nondedicated streets, or alleys that would likely have no water usage. This conservative rate was chosen because it was the smallest applied rate for a land use identified in the RUWMP above 0.

To calculate agricultural water usage, statewide crop-specific water usage rates were applied to crop-specific acreage from the *Kern County Department of Agriculture and Measurement Standards* (2014). Since the crop-specific statewide water usage rate table does not include water usage rates for arugula, mustard, and Swiss chard, water usage rates for broccoli, cabbage, and spinach were applied. The United States Department of Agriculture website categorizes arugula and mustard as part of Family Brassicaceae and identifies these crops as being related to cabbage and broccoli. Swiss chard is categorized by the United States Department of Agriculture as part of the Family Chenopodiaceae and is identified as being related to spinach. In addition, Oregon State University, Utah State University, and the University of Florida published information on their websites that determines these crops have similar water needs. Therefore, for the purpose of the water usage analysis, Kern County water usage rates for broccoli are applied to arugula and mustard, and Kern County water usage rates for spinach are applied to Swiss chard. Additionally the crop-specific statewide water usage rate for other deciduous trees was applied to the nursery outdoor plants category, which includes deciduous trees. A water usage rate was calculated for each crop type, with weighting applied to reflect each crop's percentage of total irrigated area within each alignment alternative (Table 4). An average crop water usage rate for each alternative alignment was then added to the agriculture category in Table 3.

The weighted average crop water usage rates by alignment alternative were calculated as follows:

- **Alternative 1:** 2.29 acre-feet/acre
- **Alternative 2:** 2.36 acre-feet/acre
- **Alternative 3:** 2.31 acre-feet/acre
- **Alternative 5:** 2.30 acre-feet/acre

Stations

A summary of the methodology utilized in the *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]) to estimate existing water usage for the Bakersfield Station site alternatives is provided below.

The proposed Bakersfield Station alternative sites are currently supplied with treated municipal water from the California Water Service Company. To estimate the existing water usage at the proposed Bakersfield Station alternative sites, land use for each parcel was identified. The proposed station footprint on these parcels was overlain to identify affected land use classifications. Water usage factors for each affected land use classification were applied to estimate current water usage for each station location. The proposed Bakersfield Station locations are within the area covered by the Bakersfield Urban Water Management Plan (BUWMP); however, the BUWMP does not contain land use water usage factors. In the absence of water demand factors from the BUWMP, the 2008 Fresno

Urban Water Management Plan (FUWMP) water usage factors were utilized. The FUWMP provides land use-based water demand projections for single-family residential, multifamily residential, commercial/institutional, industrial, and landscape irrigation uses. The FUWMP included water usage rates for 2005, 2010, and 2025; the 2010 water usage rates were applied to estimate current water usage. No water usage factors were available in the FUWMP for roadway/right-of-way/no data land uses. Therefore, an estimated water usage factor of 1.9 was applied, since it was determined that water usage on such land parcels would not be greater than that for commercial, industrial, or institutional land uses, which have a water usage factor of 1.9 (Authority 2014).

The water usage factor applied to unknown land uses was the product of a weighted average for all known land uses within the portion of the footprint analyzed. To determine an appropriate agricultural usage factor, crop-specific water usage rate tables published in 2001 by the DWR were applied. An average water rate was calculated for each county, with weighting applied to reflect a crop's percentage of the total irrigated area within that county. The Kern County-specific weighted average crop water usage rate was applied to the total agricultural land area identified for each of the Bakersfield Station alternatives to calculate the existing water usage (Authority 2014).

The proposed Palmdale Station site is currently supplied with treated municipal water from the Palmdale Water District. To estimate the existing water usage at the proposed Palmdale Station alternative site, land use for each parcel was identified. The proposed station footprint on these parcels was overlain to identify affected land use classifications. Water usage factors for each affected land use classification were applied to estimate current water usage for each station location. The Palmdale Water District 2016 WSMP provides land use-based water demand factors for low-density residential, medium-density residential, high-density residential, commercial, industrial, public, nonrecreational open space, and unknown uses. The area that would be displaced by the Palmdale Station site is designated as medium- to high-density residential. The WSMP only establishes water use factors for either medium- or high-density land uses. As such, for the purpose of conservatively estimating existing water usage, the medium-density factor 3,310 gallons per day (gpd)/acre (3.7 acre-feet/acre), which is the smaller water usage factor, was applied to the "Residential" category. No water usage factors were available in the WSMP for "Other," which includes water for street sweeping and other various limited-use meters at city and school facilities, as well as public space and nonrecreational open space. Therefore, the "Non-Recreational Open Space" estimated water usage factor of 1,360 gpd/acre (1.5 acre-feet/acre) was applied since the "Unknown" estimated water usage factor (330 gpd/acre) would likely underestimate water usage for some of the activities occurring under "Other." Additionally, the "Public" estimated water usage factor of 2,230 gpd/acre would likely overestimate water usage for some of the activities occurring under "Other," making the "Non-Recreational Open Space" water usage factor the more conservative factor to calculate the existing water usage at the Palmdale Station site.

Existing Water Usage

HSR Build Alternatives

Existing land use information was evaluated for the HSR Build Alternatives. The predominant existing land uses for all the HSR Build Alternatives consist of vacant/dry farm (approximately 71 to 72 percent), and agriculture/irrigated farm (approximately 11 to 12 percent).

Table 3 shows the water usage factors applied to the alignment alternatives. The total existing annual water usage rates for Alternatives 1, 2, 3, and 5 were calculated to be approximately 3,037.4 acre-feet per year, 3,193.9 acre-feet/year, 3,187.9 acre-feet/year, and 3,044.4 acre-feet/year, respectively.

The total existing annual water usage rates for each alignment alternative were calculated as follows:

- **Alternative 1:** 3,037.4 acre-feet/year
- **Alternative 2:** 3,193.9 acre-feet/year
- **Alternative 3:** 3,187.9 acre-feet/year
- **Alternative 5:** 3,044.4 acre-feet/year

Maintenance Facilities

Existing land use information was evaluated for the maintenance facility sites (Table 3). The existing land uses at the Avenue M LMF Zone are predominantly vacant/dry farm (approximately 85 percent), commercial (approximately 8 percent), and industrial/natural resources (approximately 6 percent), while the existing land uses at the Lancaster North B MOWF are predominantly vacant/dry farm (approximately 98 percent) and single-family residential (approximately 2 percent).

Table 3 shows the water usage factors applied to the Avenue M LMF Zone and the Lancaster North B MOWF. The total existing annual water usage for the Avenue M LMF Zone was calculated to be approximately 27.8 acre-feet/year. The total existing annual water usage for the Lancaster North B MOWF was calculated to be approximately 5.62 acre-feet/year.

The total existing annual water usage for the Avenue M LMF Zone and the Lancaster North B MOWF were calculated as follows:

- **Avenue M LMF Zone:** 27.8 acre-feet/year
- **Lancaster North B MOWF:** 5.6 acre-feet/year

Stations

Table 3 includes the estimated existing water usage for the Bakersfield Station site alternatives.

Total water usage for each station site has been estimated as follows:

- **Bakersfield Station—Hybrid Alternative:** 48 acre-feet/year¹
- **Bakersfield Station—F Street (Locally Generated Alternative):** 84.37 acre-feet/year
- **Palmdale Station:** 144.7 acre-feet/year

Comparison of Existing Water Usage to Estimated Future Demand

This section compares the estimated existing water usage at each of the facility sites and HSR Build Alternatives to the estimated future water demand for the proposed HSR facilities.

HSR Build Alternatives

Total existing water usage rates range from approximately 3,037.43 acre-feet/year to 3,193.9 acre-feet/year among the HSR Build Alternatives. As stated above, under Estimating Future Water Demand Requirements, water is not anticipated to be used along the HSR Build Alternatives except at tunnel and portal sites. The estimated water needs for the tunnel and portal sites have not been fully established and would be updated as operation plans for the tunnel facilities are updated. The HSR Build Alternatives, not accounting for the water needs of tunnels and portals, would result in a reduction in water usage from existing conditions ranging from approximately 3,037.4 acre-feet/year to 3,193.9 acre-feet/year.

Station

Current estimated water usage rates and estimated operational water usage rates for the Bakersfield Station site alternatives were obtained the *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]) and *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS*. Current estimated water usage for the Bakersfield Station—Hybrid Alternative is 47.8 acre-feet/year and for the Bakersfield Station—F Street (Locally Generated Alternative) is 84.37 acre-feet/year. Estimated future demand for either Bakersfield Station alternative is 52 acre-feet/year.

Current estimated water usage for the Palmdale Station is 144.7, and the estimated future demand is 80 acre-feet/year. Therefore, there is a potential increase in existing water usage for the Bakersfield Station—Hybrid Alternative of approximately 4.2 acre-feet/year, and a potential decrease in existing

¹ California High Speed Rail. 2014. *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum), April 2014.

water usage for the Bakersfield Station—F Street (Locally Generated Alternative) of approximately 32.37 acre-feet/year and for the Palmdale Station of approximately 64.7 acre-feet/year.

Maintenance Facilities

Current estimated water usage rates for the Avenue M LMF Zone and the Lancaster North B MOWF are approximately 27.8 acre-feet/year and approximately 5.62 acre-feet/year, respectively. Estimated future water demand for the Avenue M LMF Zone and the Lancaster North B MOWF is approximately 6.8 acre-feet/year and approximately 17 acre-feet/year, respectively. Therefore, there is a potential decrease in existing water usage for the Avenue M LMF Zone of approximately 21 acre-feet/year and a potential increase in existing water usage for the Lancaster North B MOWF of 11.38 acre-feet/year.

Water Supply Sources

Water Supply to Serve Construction

The amount of water estimated to be used during construction included estimates for concrete work, earthwork, dust control, irrigation for reseeded areas, and tunnel construction and excavation for the HSR Build Alternatives, stations, and maintenance facilities (Tables 5, 6, and 7).

HSR Build Alternatives and Maintenance Facilities

Engineers estimated the amount of water needed to construct the HSR Build Alternatives and maintenance facilities. Construction water usage estimates were based on water needed during concrete work, dust control, earthwork (fill), and irrigation. The units of measurements utilized for estimating water usage during concrete work, dust control, earthwork (fill), and irrigation are as follows:

- **Concrete Work:** 30 gallons per cubic yard of concrete
- **Dust Control:** 40,000 gpd (during cut and fill work)
- **Earthwork (Fill):** 41 gallons per cubic yard of compacted fill
- **Irrigation:** 700 gallons per landscape acre per day (until plants are established)

The track alignment was broken down into four segments. The estimated construction water usage for each segment is the same for all of the HSR Build Alternatives. The estimates include water needed for concrete work, dust control, earthwork (fill), and irrigation for the track and concrete work for the LMF and MOWF. Estimates for dust control, earthwork (fill), and irrigation for the LMF and MOWF would be determined during a later stage in the design process. Additionally, estimates for the tunneled portions of the HSR Build Alternatives were calculated separately and are discussed further in the sections to follow. The total water usage rates estimated for each of the segments were calculated utilizing the units of measurement described above, as follows (Table 5):

- **Segment 1:** 927 million gallons
- **Segment 2:** 306 million gallons
- **Segment 3:** 393 million gallons
- **Segment 4:** 1,175 million gallons

Tunnel Liner

Engineers estimated the amount of concrete needed to construct the concrete tunnel liners. The amount of water to be used at concrete batch plants during tunnel construction was estimated at 32 gallons per cubic yard of concrete.

The total amount of water usage estimated for the HSR Build Alternatives' tunnels based on tunnel volume is as follows (Table 6):

- **Alternative 1:** 17,772,914 gallons
- **Alternative 2:** 17,772,914 gallons
- **Alternative 3:** 18,840,115 gallons
- **Alternative 5:** 17,772,914 gallons

Tunnel Portal

Engineers estimated the amount of concrete needed to construct the 18 concrete tunnel portals. The amount of water to be used at concrete batch plants during tunnel construction was estimated at 32.025 gallons per cubic yard of concrete. The total amount of water usage estimated for the HSR Build Alternatives, based on a volume of 500 cubic yards per portal, is 288,234 gallons.

Tunnel Excavation

Engineers estimated the amount of water needed to excavate the HSR Build Alternatives' tunnels. The amount of water usage for tunnel excavation was determined by excavation type. Water demand for drill, blast, and sequential excavation methods was estimated at 20 gallons per minute and for tunnel boring machines was estimated at 50 gallons per minute.

The total water usage estimated for tunnel excavation for each HSR Build Alternative based on tunnel length is as follows (Table 7):

- **Alternative 1:** 78,703,200 gallons
- **Alternative 2:** 78,703,200 gallons
- **Alternative 3:** 86,119,200 gallons
- **Alternative 5:** 78,703,200 gallons

Construction of the Bakersfield to Palmdale Project Section of the HSR system would result in a net decrease in annual water consumption for the area impacted by the construction of the HSR track and associated facilities compared to existing consumption, when annualized over a five-year period. This would be due to the change from agriculture, industrial, and other land uses with more water-intensive activities to less water-intensive construction activities. Specifically, it is estimated that the water usage during construction of the HSR Build Alternatives and maintenance facilities would be approximately 58.8 percent (1,785.3 acre-feet/year needed for construction usage, compared to 3,037.4 acre-feet/year for current existing usage) of the existing water demand on an annual basis for the project footprint. In other words, the current annual water usage for locations displaced by the project is greater than the water usage needs for project-related construction in the same area. It is important to note that construction water demand is not a continuous flow demand by the supplier, and water usage is often sporadic and a function of particular construction activities occurring at the time. Water for construction of the proposed project could be supplied from existing surface or groundwater supply systems. Water trucks would also provide water for dust control, compaction needs and mix-water in rural and undeveloped areas. Access to construction water sources in remote areas may require the drilling of wells, if water trucks are not used, however, this would be decided during the construction phase of the project by the contractor.

Stations

A summary of the methodology utilized in the *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]) and *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS* to estimate construction water usage for the Bakersfield Station site alternatives is provided below. Engineers estimated the amount of concrete needed for the Bakersfield Station buildings and parking structures at the passenger stations from the proposed structure footprints and building characteristics. The engineers estimated the amount of water needed for concrete from the concrete demand (31 gallons per cubic yard of concrete). Use of water for dust control at the Bakersfield Station was estimated to occur for 400 days. Irrigation used for post-construction site stabilization was calculated for landscaped areas at the passenger stations.²

Engineers estimated construction water use for the Palmdale Station to be 20,000 gpd for 18 months.

² California High Speed Rail. 2014. *Fresno to Bakersfield Section Final EIR/EIS* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum). April.

The total water usage estimated for each station alternative is as follows (Table 5):

- **Bakersfield Station—Hybrid Alternative:** 33 million gallons
- **Bakersfield Station—F Street (Locally Generated Alternative):** 34.72 million gallons
- **Palmdale Station:** 10.95 million gallons

Water Supply Sources for Operation of the Bakersfield to Palmdale Project Section Facilities

This section describes water supply sources for each facility location and HSR Build Alternative.

HSR Build Alternatives

Possible points of connection for tunnel water supply, as well as the associated water districts, are listed below:

1. **North Connection:** Edison Highway and Morning Drive (Bakersfield), East Niles Community Service District, existing 14" water pipeline
2. **Middle Connection A:** Between Tunnels 7 and 8 (Tehachapi), City of Tehachapi existing 12" water pipeline
3. **Middle Connection B:** Abajo Avenue and Orchard Street (Tehachapi), Tehachapi-Cummings County Water District, existing 18" water pipeline
4. **South Connection:** Astoria Avenue between 60th Street W and 55th Street W (Rosamond), Antelope Valley-East Kern Water Agency, existing 33" water pipeline

Where domestic water pipelines are not available at the portal locations, potable water would need to be stored on-site in approved water storage tanks.

Stations

The Bakersfield Station site alternatives and the Palmdale Station site are currently served by their respective municipal water supply agencies. It is anticipated that any of the stations would connect to the existing municipal systems. Water supply assessments are required (Senate Bills 221 and 610) for developments of more than 500 homes (which is equivalent to 250 acre-feet/year). Because the stations are expected to require less than 250 acre-feet/year, water supply assessments would not be needed for these facilities, and no other special actions to secure water from the local agencies would be needed.

Maintenance Facilities

The Avenue M LMF Zone and the Lancaster North B MOWF are located in or near the service areas of the following water supply districts: AVEK, the Los Angeles County Waterworks District 40, the Palmdale Water District, the California Water Service Company – Antelope Valley District, and the Rosamond Community Services District. The Avenue M LMF Zone would be served by municipal water from Los Angeles County Waterworks District 40, and the Lancaster North B MOWF would be supplied by AVEK. Groundwater is also used as a water supply source throughout this area. The water supply source(s) for the maintenance facility sites cannot be determined with certainty at this time. The potable water supply sources for the maintenance facility sites would be determined during a later stage in the design process [language addressing groundwater data, if relevant, would be drafted after we receive information on the location.] If groundwater is available at the site, the project could utilize the groundwater supply however, it is more likely the maintenance facility sites would be connected by pipeline to a municipal water supply.

Similar to the stations, because the LMF and the MOWF are expected to require less than 250 acre-feet/year, water supply assessments would not be needed for these facilities, and no other special actions to secure water from the local agencies would be needed.

CONCLUSIONS

The construction phase of the Bakersfield to Palmdale Project Section of the HSR system would result in a net decrease in annual water consumption of approximately 52 percent of the existing water usage for the project footprint. This information is summarized in Table 8.

In addition, operation and maintenance of the HSR system at final build-out would result in a net decrease of water usage rates over existing water usage rates within the project footprint to less than 5 percent of the current water usage. Water usage would decrease at the HSR Build Alternatives, the Bakersfield Station—F Street (Locally Generated Alternative), the Palmdale Station, and the Avenue M LMF Zone, but would increase at the Bakersfield Station—Hybrid Alternative and the Lancaster North B MOWF.

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Attachments: A: Tables 1–8
B: Figures 1–6

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ATTACHMENT A
TABLES

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Table 1 Water Demand Summary

Facility	Daily Use	Method	Use Factor (gpd/employee)	Estimated Daily Volume (gpd)	Annual Water usage (ac-ft/yr)
HMF	1,500 employees	BART data	31	46,500	52
		HMF value	30	45,000	50
LMF	120 employees	Adjusted SMART data value	50.6	6,072	6.8
MOWF	300 employees	Adjusted SMART data value	50.6	15,180	17
OMF and MOWF	119 employees	SMART data	50.6	4,700	5.3
Bakersfield Station—Hybrid Alternative	9,200 passengers (2035 estimate)	Fresno to Bakersfield Project Section Station Methodology	5 gal/passenger	46,000	52
Bakersfield Station—F Street (Locally Generated Alternative)					
Palmdale Station	11,240 passengers 534,453 sf (landscape)	Gallons per passenger per day (cleaning and toilets), plus gallons per sf per day (landscape)	5 gpd/passenger 0.03 gpd/sf	72,234	80

¹ Facility daily employee use for the LMF and MOWF is from a California High-Speed Rail Authority *Internal Memorandum-Information Provided from Operations and Maintenance team (Network Rail) for Purposes of EIS/EIR Clearance* (April 2016).

² Data for the HMF and Bakersfield Station—Hybrid Alternative is from the *Final EIR/EIS Fresno to Bakersfield Section* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]).

³ Data for the Bakersfield Station—F Street (Locally Generated Alternative) is from the *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS* (November 2016).

ac-ft/yr = acre-feet per year

BART = Bay Area Rapid Transit

EIR/EIS = Environmental Impact Report/Environmental Impact Statement

gpd = gallons per day

HMF = heavy maintenance facility

LMF = Light Maintenance Facility

MOWF = maintenance-of-way facility

OMF = operations and maintenance facility

sf = square feet

SMART = Sonoma-Marin Area Rail Transit

TBD = To be determined

Table 2 Maintenance Facility Comparisons

Light Maintenance Facility and Maintenance of Infrastructure Facility (square feet)	Operations and Maintenance Facility and Maintenance-of-Way Facility
Support and Administration	Support and Administration
Maintenance Building	Vehicle Maintenance Building
Wheel True Building	N/A
Maintenance-of-Way Building	Maintenance-of-Way Shop
Car Wash Building	Train Washing Station
Service and Inspection Building	Service and Inspection Platform

Source: California High-Speed Rail Authority, Operations and Maintenance Cost Model Documentation: 2016 BUSINESS PLAN (2016a); Sonoma-Marín Area Rail Transit, Final Supplemental Mitigated Negative Declaration and Supporting Initial Study (2012).
N/A = Not Applicable

Table 3 Existing Water Usage—Track Alignment Alternatives, LMF, and MOWF

Alignment	Existing Land Use Category	Permanent Impacts (ac)	Percentage ⁶	Water Usage Factors (ac-ft/ac) ¹	Annual Water Usage (ac-ft)
Alternative 1	Agriculture/Irrigated Farm ²	645.81	11.0%	2.29	1,478.9
	Commercial	114.72	2.0%	2.25	258.1
	Government/Institutional ³	76.39	1.3%	2.60	198.6
	Industrial/Natural Resources	334.16	5.7%	1.10	367.6
	Miscellaneous – N/A ⁴	386.34	6.6%	1.10	425
	Recreational ³	4.05	0.1%	2.60	10.5
	Residential – Single-Family	65.15	1.1%	3.90	254.1
	Residential – Multifamily	17.85	0.3%	2.50	44.6
	Vacant Land	4,215.25	71.9%	0.00	–
	Total (ac)	5,859.72	100.0%	–	3,037.4
Alternative 2	Agriculture/Irrigated Farm ²	697.66	11.8%	2.36	1,646.5
	Commercial	113.60	1.9%	2.25	255.6
	Government/Institutional ³	73.06	1.2%	2.60	190
	Industrial/Natural Res	336.20	5.7%	1.10	369.8
	Miscellaneous – N/A ⁴	384.39	6.5%	1.10	422.8
	Recreational ³	4.05	0.1%	2.60	10.5
	Residential – Single-Family	65.29	1.1%	3.90	254.6
	Residential – Multifamily	17.65	0.3%	2.50	44.1
	Vacant Land	4,211.42	71.3%	0.00	–
	Total (ac)	5,903.32	99.9%	–	3,193.9
Alternative 3	Agriculture/Irrigated Farm ²	680.78	11.5%	2.31	1,572.6
	Commercial	114.72	1.9%	2.25	258.1
	Government/Institutional ³	87.63	1.5%	2.60	227.8
	Industrial/Natural Resource	294.33	5.0%	1.10	323.8
	Miscellaneous – N/A ⁴	419.5860251	7.1%	1.10	461.5

Alignment	Existing Land Use Category	Permanent Impacts (ac)	Percentage ⁶	Water Usage Factors (ac-ft/ac) ¹	Annual Water Usage (ac-ft)
	Recreational ³	4.05	0.1%	2.60	10.5
	Residential – Single-Family	74.11	1.3%	3.90	289
	Residential – Multifamily	17.85	0.3%	2.50	44.6
	Vacant Land	4,222.09	71.4%	0.00	–
	Total (ac)	5,915.15	100.1%	–	3,187.9
Alternative 5	Agriculture/Irrigated Farm ²	674.84	11.7%	2.3	1,552.1
	Commercial	118.81	2.1%	2.25	267.3
	Government/Institutional ³	79.73	1.4%	2.60	207.3
	Industrial/Natural Res	311.18	5.4%	1.10	342.3
	Miscellaneous – N/A ⁴	330.38	5.7%	1.10	363.4
	Recreational ³	3.23	0.1%	2.60	8.4
	Residential – Single-Family	64.44	1.1%	3.90	251.3
	Residential – Multifamily	20.90	0.4%	2.50	52.3
	Vacant Land	4143.91	72.1%	0.00	–
	Total (ac)	5,747.42	100.0%	–	3,044.4
Avenue M LMF Zone	Agriculture/Irrigated Farm ²	0.00	0%	–	0
	Commercial	9.07	8.4%	2.25	20.4
	Government/Institutional ³	0.00	0%	2.60	0
	Industrial/Natural Resource	6.72	6.2%	1.10	7.4
	Miscellaneous – N/A ⁴	0.00	0%	1.10	0
	Recreational ³	0.00	0%	2.60	0
	Residential – Single-Family	0.00	0%	3.90	0
	Residential – Multifamily	0.00	0%	2.50	0
	Vacant Land	91.97	85.3%	0.00	0
Total (ac)	107.76	99.9%	–	27.8	
Lancaster North B MOWF	Agriculture/Irrigated Farm ²	0.00	0%	–	0
	Commercial	0.00	0%	2.25	0

Alignment	Existing Land Use Category	Permanent Impacts (ac)	Percentage ⁶	Water Usage Factors (ac-ft/ac) ¹	Annual Water Usage (ac-ft)
	Government/Institutional ³	0.00	0%	2.60	0
	Industrial/Natural Resource	0.00	0%	1.10	0
	Miscellaneous – N/A ⁴	0.00	0%	1.10	0
	Recreational ³	0.00	0%	2.60	0
	Residential – Single-Family	1.44	1.7%	3.90	5.6
	Residential – Multifamily	0.00	0%	2.50	0
	Vacant Land	83.89	98.3%	0.00	0
	Total (ac)	85.33	100%	–	5.6
Bakersfield Station— Hybrid Alternative ⁵	Single-Family	1.00		3.5	2
	Multifamily	0.1		6.2	0.8
	Commercial	3		1.9	6
	Industrial	8		1.9	15
	Institutional	4		1.9	8
	Agricultural	0		3.3	0
	Roadways/Right-of-Way/No Data	4		1.9	7
	Unknown	5		2.0	9
Total	25.1			47.8	
Bakersfield Station—F Street (Locally Generated Alternative) ⁷	Single-Family	0.00		3.5	0.00
	Multifamily	0.00		6.2	0.00
	Commercial	7.50		1.9	14.25
	Industrial	13.88		1.9	26.37
	Institutional	8.17		1.9	15.52
	Agricultural	0.00		2.91	0.00
	Roadways/Right-of-Way/No Data	14.86		1.9	28.23
	Unknown	N/A		N/A	N/A
Total	44.41		–	84.37	

Alignment	Existing Land Use Category	Permanent Impacts (ac)	Percentage ⁶	Water Usage Factors (ac-ft/ac) ¹	Annual Water Usage (ac-ft)
Palmdale Station ⁸	Total Residential	16.82		3,310 gpd/ac ⁹ (3.7 ac-ft/ac)	62.2
	Single-Family	6.22		–	–
	Multifamily	10.60		–	–
	Commercial	25.39		1,260 gpd/ac (1.4 ac-ft/ac)	35.6
	Industrial	11.18		1,070 gpd/ac (1.2 ac-ft/ac)	13.3
	Institutional	0.50		–	0
	Landscape	0		–	0
	Agricultural	0		–	0
	Roadways/Right-of-Way/No Data	13.79		–	0
	Other ⁸	22.33		1,360 gpd/ac ¹⁰ (1.5 ac-ft/ac)	33.6
	Total	90.01		–	144.7

¹ Water usage factors taken from the Rosamond Community Services District Urban Water Management Plan (June 2011), except as noted otherwise.

² Water usage factors for agricultural land uses derived from the DWR's Irrigated Crop Acres and Water Usage Information Statewide (2010 data), except as noted otherwise. See Table 4 for more details.

³ No water usage factors were available for institutional/governmental or recreational land uses. Therefore, the public areas water usage factor of 2.6 was applied, as it seems likely that water usage on such land parcels would be of a public nature.

⁴ No water usage factors were available for miscellaneous land uses. Therefore an estimated water usage factor of 1.9 was applied, as it was the smallest applied rate besides 0 and the identified miscellaneous land uses would not use a lot of water.

⁵ Water usage factors for the Bakersfield Station—Hybrid Alternative were obtained from the *Final EIR/EIS Fresno to Bakersfield Section* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]).

⁶ Percentages may not add up to 100 percent due to rounding.

⁷ Water usage factors for the Bakersfield Station—F Street (Locally Generated Alternative) were obtained from the *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS* (November 2016).

⁸ Water usage factors for the Palmdale Station were obtained from the Palmdale Water District 2016 Water System Master Plan (December 2016).

⁸ "Other" includes water for street sweeping and other various limited-use meters at city and school facilities, as well as public space and nonrecreational open space.

⁹ The area that would be displaced by the station footprint is designated as medium- to high-density residential. The Urban Water Management Plan only establishes water use factors for either medium- or high-density land uses. As such, we have assumed a minimum water consumption for the purposes of establishing the existing consumption rates, and used the medium-density factor for the land uses that would be within the station footprint.

¹⁰ The water usage factor for the "Other" land use category is conservatively estimated to be 1,360 gpd/ac, which is the mid-range factor for all the additional land use categories.

ac = acre(s)

ac-ft = acre-feet

ac-ft/ac = acre-feet per acre

ac-ft/ac/yr = acre-feet per acre per year

ac-ft/yr = acre-feet per year

gpd = gallons per day

DWR = California Department of Water Resources

EIR/EIS = Environmental Impact Report/Environmental Impact Statement

LMF = Light Maintenance Facility

MOWF = Maintenance-of-Way Facility

N/A = not applicable

Table 4 Crop Water Usage—Track Alignment Alternatives

Alternative	Crop Type	Applied Water (ac-ft/ac) ¹	Total (ac) ²	Total Percentage of Each Crop Category ⁴	Weighted Applied Water Factor	
Alternative 1	Citrus and Subtropical	3.12	182.04	25.7%	0.80	
	Deciduous Fruit and Nut	3.3	1.77	0.3%	0.01	
	Grain and Hay	1.39	54.74	7.7%	0.11	
	Pasture	5.05	1.07	–	0.00	
	Truck, Nursery and Berry ³					
	Arugula	1.51	18.85	2.7%	0.04	
	Carrot	1.51	37.31	5.3%	0.08	
	Garlic	2.81	7.01	1.0%	0.03	
	Lettuce Leaf	1.51	18.85	2.7%	0.04	
	Mustard	1.51	18.85	2.7%	0.04	
	Outdoor Plants	3.30	1.02	0.1%	0.00	
	Onion (Dry)	2.81	1.71	0.2%	0.01	
	Pepper (Fruiting)	1.51	0.82	0.1%	0.00	
	Potato	2.34	293.03	41.4%	0.97	
	Spinach	1.51	18.85	2.7%	0.04	
Swiss Chard	1.51	11.65	1.6%	0.02		
Vineyard	1.86	39.44	5.6%	0.10		
	Total (Acres)	–	707.01	99.8%	2.29	
Alternative 2	Citrus and Subtropical	3.12	221.68	28.9%	0.90	
	Deciduous Fruit and Nut	3.3	1.77	0.2%	0.01	
	Grain and Hay	1.39	55.57	7.2%	0.10	
	Pasture	5.05	1.07	0.1%	0.01	
	Truck, Nursery and Berry ³					
	Arugula	1.51	18.85	2.5%	0.04	
	Carrot	1.51	40.70	5.3%	0.08	
	Garlic	2.81	8.29	1.1%	0.03	
	Lettuce Leaf	1.51	18.85	2.5%	0.04	
	Mustard	1.51	18.85	2.5%	0.04	

Alternative	Crop Type	Applied Water (ac-ft/ac) ¹	Total (ac) ²	Total Percentage of Each Crop Category ⁴	Weighted Applied Water Factor	
	Outdoor Plants	3.30	1.02	0.1%	0.00	
	Onion (Dry)	2.81	1.71	0.2%	0.01	
	Pepper (Fruiting)	1.51	0.82	0.1%	0.00	
	Potato	2.34	317.76	41.4%	0.97	
	Spinach	1.51	18.85	2.5%	0.04	
	Swiss Chard	1.51	11.65	1.5%	0.02	
	Vineyard	1.86	30.18	3.9%	0.07	
	Total (Acres)	-	767.62	100%	2.36	
Alternative 3	Citrus and Subtropical	3.12	182.04	25.7%	0.80	
	Deciduous Fruit and Nut	3.3	1.77	0.3%	0.01	
	Grain and Hay	1.39	53.37	7.5%	0.10	
	Pasture	5.05	1.07	0.2%	0.01	
	Truck, Nursery and Berry ³					
	Arugula	1.51	21.05	3%	0.05	
	Carrot	1.51	37.31	5.3%	0.08	
	Garlic	2.81	7.01	1%	0.03	
	Lettuce Leaf	1.51	21.05	3%	0.05	
	Mustard	1.51	21.05	3%	0.05	
	Outdoor Plants	3.30	1.02	0.1%	0.00	
	Onion (Dry)	2.81	1.71	0.2%	0.01	
	Pepper (Fruiting)	1.51	0.82	0.1%	0.00	
	Potato	2.34	284.84	40.3%	0.94	
	Spinach	1.51	21.05	3%	0.05	
	Swiss Chard	1.51	12.76	1.8%	0.03	
	Vineyard	1.86	39.44	5.6%	0.10	
Total (Acres)	-	707.36	100.1%	2.31		

Alternative	Crop Type	Applied Water (ac-ft/ac) ¹	Total (ac) ²	Total Percentage of Each Crop Category ⁴	Weighted Applied Water Factor	
Alternative 5	Citrus and Subtropical	3.12	182.04	25.7%	0.80	
	Deciduous Fruit and Nut	3.3	1.77	0.3%	0.01	
	Grain and Hay	1.39	54.74	7.7%	0.11	
	Pasture	5.05	1.07	0.2%	0.01	
	Truck, Nursery and Berry ³					
	Arugula	1.51	18.85	2.7%	0.04	
	Carrot	1.51	37.31	5.3%	0.08	
	Garlic	2.81	7.01	1%	0.03	
	Lettuce Leaf	1.51	18.85	2.7%	0.04	
	Mustard	1.51	18.85	2.7%	0.04	
	Outdoor Plants	3.30	1.02	0.1%	0.00	
	Onion (Dry)	2.81	1.71	0.2%	0.01	
	Pepper (Fruiting)	1.51	0.82	0.1%	0.00	
	Potato	2.34	293.03	41.4%	0.97	
	Spinach	1.51	18.85	2.7%	0.04	
	Swiss Chard	1.51	11.65	1.6%	0.02	
Vineyard	1.86	39.44	5.6%	0.10		
Total (Acres)		-	707.01	101%	2.30	

¹ Water factors taken from the DWR's Irrigated Crop Acres and Water Usage Information Statewide (2010 data), except as noted otherwise.

² Kern County Department of Agriculture and Measurement Standards, Specific Crop Type Data (2014), unless otherwise noted.

³ No water usage factors were available for arugula, mustard, and Swiss chard; therefore, water usage rates for broccoli, cabbage, and spinach, respectively, were applied due to similar water needs.

⁴ Percentages may not add up to 100 percent due to rounding.

Crop Type

Citrus and Subtropical
Deciduous Fruit and Nut
Grain and Hay
Pasture
Truck, Nursery and Berry
Vineyard

Commodity

Lemon, Orange, Tangerine, Seedless Tangerine
Apple
Oat and Wheat
Alfalfa
Arugula, Broccoli, Cabbage, Carrot, Garlic, Lettuce Leaf, Mustard, Outdoor Plants, Onion (Dry), Pepper (Fruiting), Potato, Spinach, Swiss Chard
Grape

ac = acre

ac-ft/ac = acre-feet per acre

DWR = California Department of Water Resources

Table 5 Construction Water Usage Summary—Track Alignment Alternatives, LMF, and MOWF

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Usage (ac-ft/yr) ¹
Alignment, LMF, and MOWF				
Segment 1	Concrete Work	9	28	5.6
	Dust Control (tracks)	6	20	4
	Earthwork	897	2,754	550.8
	Irrigation (tracks)	15	45	9
	<i>Subtotal</i>	927	2,847	569.4
Segment 2	Concrete Work	5	16	3.2
	Dust Control (tracks)	4	11	2.2
	Earthwork	290	890	178
	Irrigation (tracks)	8	23	4.6
	<i>Subtotal</i>	307	940	188
Segment 3	Concrete Work	2	6	1.2
	Dust Control (tracks)	5	16	3.2
	Earthwork	375	1,151	230.2
	Irrigation (tracks)	11	33	6.6
	<i>Subtotal</i>	393	1,206	241.2
Segment 4	Concrete Work	4	12	2.4
	Dust Control (tracks)	10	32	6.4
	Earthwork	1139	3,497	699.4
	Irrigation (tracks)	22	68	13.6
	<i>Subtotal</i>	1175	3,609	721.8
Total		2,802	8,602	1,720.4

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Usage (ac-ft/yr) ¹
Station				
Bakersfield Station—Hybrid Alternative ²	Concrete Work	6	18	4
	Dust Control (tracks)	27	82	16
	Irrigation (tracks)	0.4	1	0.2
	Total	33	101	20
Bakersfield Station—F Street (Locally Generated Alternative) ³	Concrete Work	2.24	6.72	1.31
	Dust Control (tracks)	31.36	96.32	19.23
	Irrigation (tracks)	1.12	3.55	.75
	Total	34.72	106.59	21.29
Palmdale Station ⁴	Concrete Work	N/A	N/A	N/A
	Dust Control (tracks)	N/A	N/A	N/A
	Irrigation (tracks)	N/A	N/A	N/A
	Total	10.95	33.6	6.72

¹ Annualized water usage is for a five-year construction period.

² Construction water usage rates for the Bakersfield Station—Hybrid Alternative were obtained from the *Final EIR/EIS Fresno to Bakersfield Section* (Appendix 3.6-B: Water Usage Analysis Technical Memorandum [April 2014]).

³ Construction water usage rates for the Bakersfield Station—F Street (Locally Generated Alternative) were obtained from the *Fresno to Bakersfield Section Administrative Draft Supplemental EIR/EIS* (November 2016).

⁴ Construction water usage rates for the Palmdale Station were obtained from engineering estimates (January 2017).

ac-ft/yr = acre-feet per year

LMF = Light Maintenance Facility

MG = million gallons

MOWF = Maintenance-of-Way Facility

Table 6 Tunnel Liner Construction Water Usage Summary—Concreting

Tunnel Number	Tunnel Length (ft)	Shotcrete Volume (cy)	Final Liner Volume (cy)	Water Consumed for Tunnel Shotcrete and Final Liner (U.S. Gallons)	Total Volume (ac-ft)	Annualized Water Usage (ac-ft/yr) ¹
Alternative 1, 2 and 5						
1	1,500	9,492	30,820	1,290,992	4	0.8
2	1,630	10,314	33,491	1,402,855	4	0.8
3	2,000	12,656	41,093	1,721,312	5	1.0
4	6,000	6,118	92,444	3,156,448	10	2.0
5	1,750	1,784	26,963	920,623	3	0.6
6	5,250	5,353	80,889	2,761,900	8	1.6
7	8,200	7,268	51,879	1,894,183	6	1.2
8	13,248	11,742	83,816	3,060,245	9	1.8
9	9,500	8,420	60,103	2,194,449	7	1.4
Total	49,078	73,147	501,498	18,403,006	56	11.2
Alternative 3						
1	1,500	9,492	30,820	1,290,992	4	0.8
2	1,630	10,314	33,491	1,402,855	4	0.8
3	2,000	12,656	41,093	1,721,312	5	1.0
4	6,000	6,118	92,444	3,156,448	10	2.0
5	1,750	1,784	26,963	920,623	3	0.6
6	5,250	5,353	80,889	2,761,900	8	1.6
7	8,200	7,268	51,879	1,894,183	6	1.2
8	13,441	11,913	85,037	3,104,824	10	2.0
9	13,000	11,522	82,247	3,002,952	9	1.8
Total	52,771	76,420	524,863	19,256,088	59	11.8

¹ Annualized water usage is for a five-year construction period.

ac-ft/yr = acre-feet per year

cy= cubic yard(s)

ft = feet

U.S. = United States

Table 7 Tunnel Portal Construction Water Usage Summary – Mining

Tunnel Number	Tunnel Length (ft)	Duration to Mine (days)	Water Usage (U.S. gallons)	Total Volume (ac-ft)	Annualized Water Usage (ac-ft/yr) ¹
Alternatives 1, 2, and 5					
1	1,500	150	4,320,000	13	2.6
2	1,630	163	4,694,400	14	2.8
3	2,000	200	5,760,000	18	3.6
4	6,000	300	8,640,000	27	5.4
5	1,750	88	2,534,400	8	1.6
6	5,250	263	7,574,400	23	4.6
7	8,200	182	13,104,000	40	8.0
8	13,248	294	21,168,000	65	13.0
9	9,500	211	15,192,000	47	9.4
Total	49,078	1,851	82,987,200	255	51.0
Alternative 3					
1	1,500	150	4,320,000	13	2.6
2	1,630	163	4,694,400	14	2.8
3	2,000	200	5,760,000	18	3.6
4	6,000	300	8,640,000	27	5.4
5	1,750	88	2,534,400	8	1.6
6	5,250	263	7,574,400	23	4.6
7	8,200	182	13,104,000	40	8.0
8	13,441	299	21,528,000	66	13.2
9	13,000	289	20,808,000	64	12.8
Total	52,771	1,934	88,963,200	273	54.6

¹ Annualized water usage is for a five-year construction period.

ac-ft = acre-feet

ac-ft/yr = acre-feet per year

ft = feet

U.S. = United States

Table 8 Water Usage Summary

Facility Type	Facility Name	Annual Water Usage (acre-feet)
Existing Water Usage		
Track Alignment	Alternative 1	3,037.40
	Alternative 2	3,193.90
	Alternative 3	3,187.90
	Alternative 5	3,044.40
	CCNM Design Option	-0.15
LMF	Avenue M LMF Zone	27.80
MOWF	Lancaster North B MOWF	5.60
Stations	Bakersfield Station—Hybrid Alternative	47.80
	Bakersfield Station—F Street (Locally Generated Alternative)	84.37
	Palmdale Station	144.70
Minimum Use Total		3,263.15
Construction Water Usage¹		
Track Alignment and Maintenance Facilities ²	HSR Build Alternatives, LMF, and MOWF	1,720.40
Tunnel Liner	Alternative 1	11.20
	Alternative 2	11.20
	Alternative 3	11.80
	Alternative 5	11.20
	CCNM Design Option	0.01
Tunnel Portal	HSR Build Alternatives	0.90
Tunnel Excavation	Alternative 1	51.00
	Alternative 2	51.00
	Alternative 3	54.60
	Alternative 5	51.00
	CCNM Design Option	0.01
Stations	Bakersfield Station—Hybrid Alternative	20.20
	Bakersfield Station—F Street (Locally Generated Alternative)	21.28
	Palmdale Station	6.72
Maximum Use Total		1,815.72
Estimated Water Usage – Final Build-Out		
LMF ¹	Avenue M LMF Zone	6.80
MOWF ¹	Lancaster North B MOWF	17.00

Facility Type	Facility Name	Annual Water Usage (acre-feet)
Stations	Bakersfield Station—Hybrid Alternative	52.00
	Bakersfield Station—F Street (Locally Generated Alternative)	
	Palmdale Station	80.00
Maximum Use Total		155.8
Total Change		-1,291.80

¹ Construction water usage is annualized for a five-year construction period, except as noted otherwise.

² Maximum Use Total utilizes the combination of facility alternatives with the highest demand, not including stations.

LMF = Light Maintenance Facility

MOWF = Maintenance-of-Way Facility

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ATTACHMENT B

FIGURES

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Figure 1 Bakersfield to Palmdale HSR Section

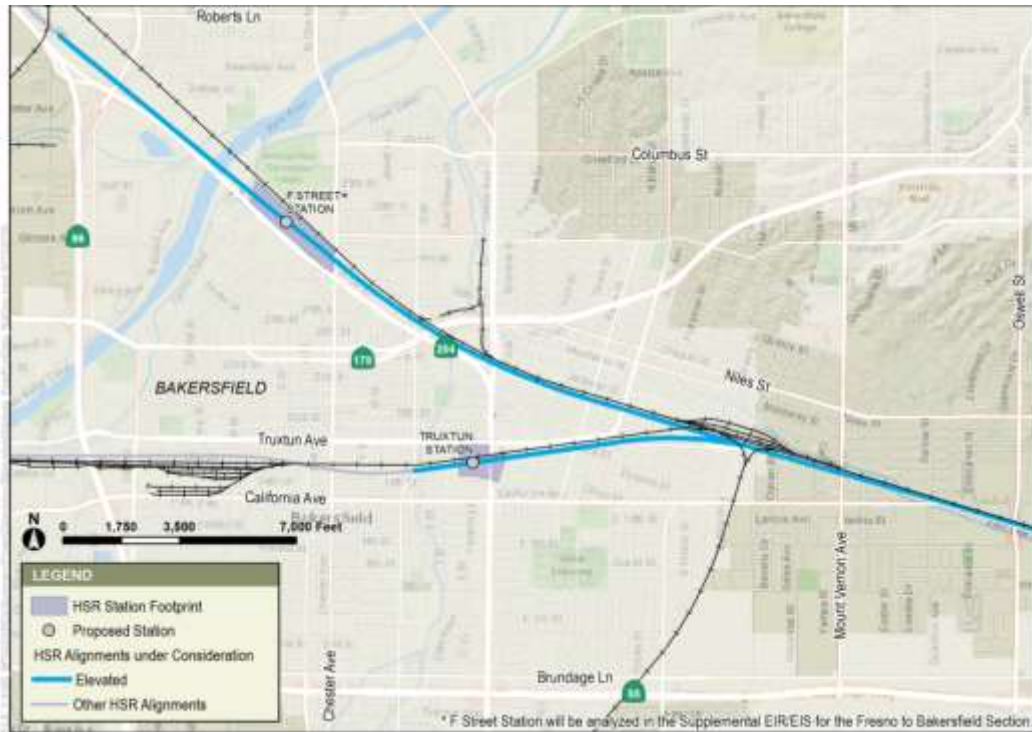


Figure 2 Bakersfield to Palmdale HSR Bakersfield Station Alternatives

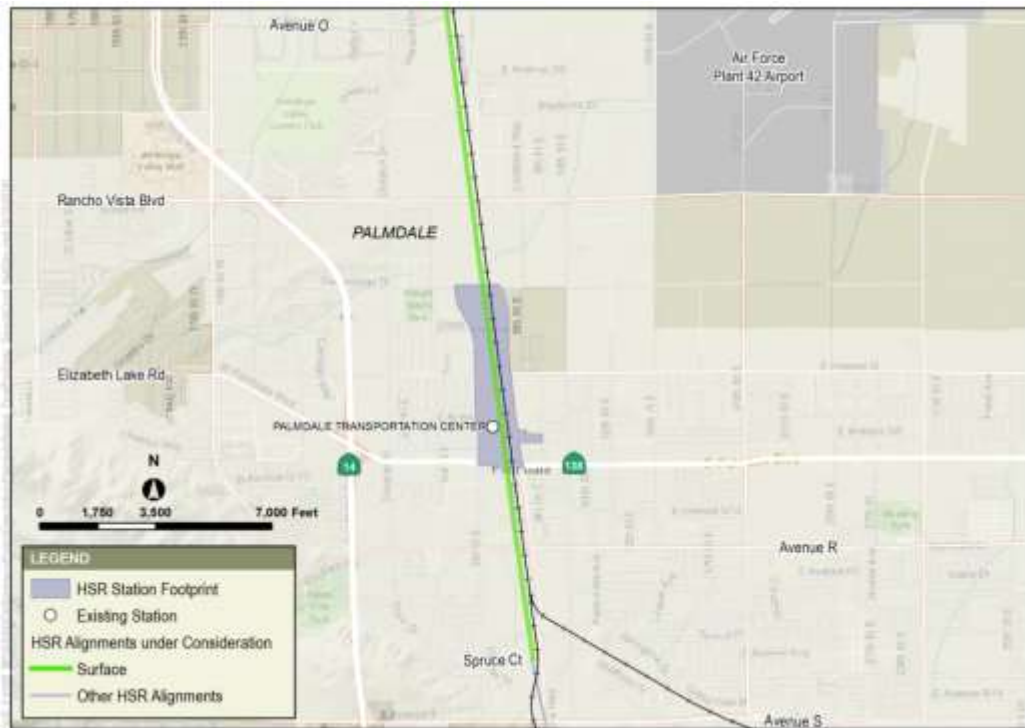


Figure 3 Bakersfield to Palmdale HSR Palmdale Station

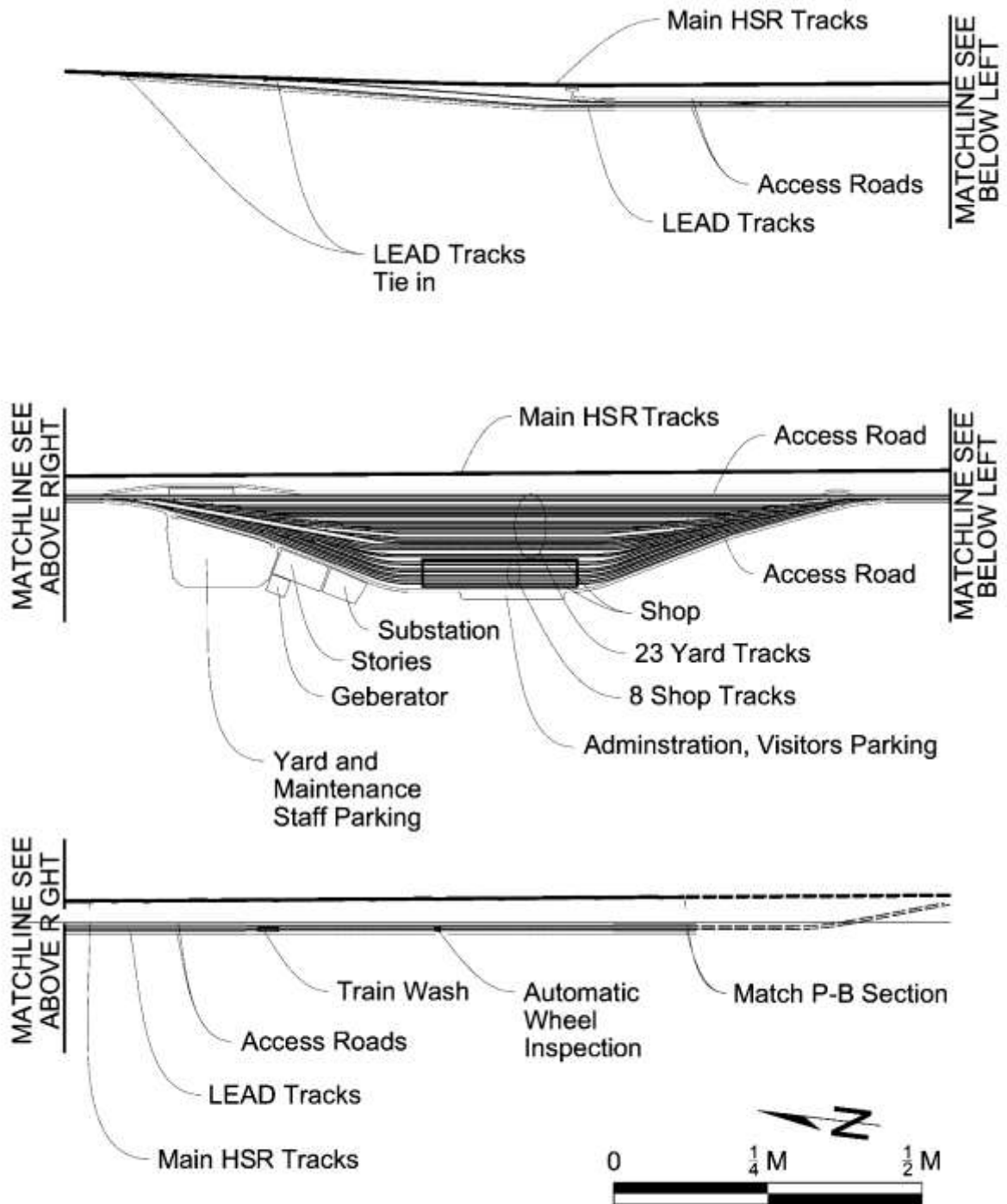


Figure 4 Typical LMF Layout

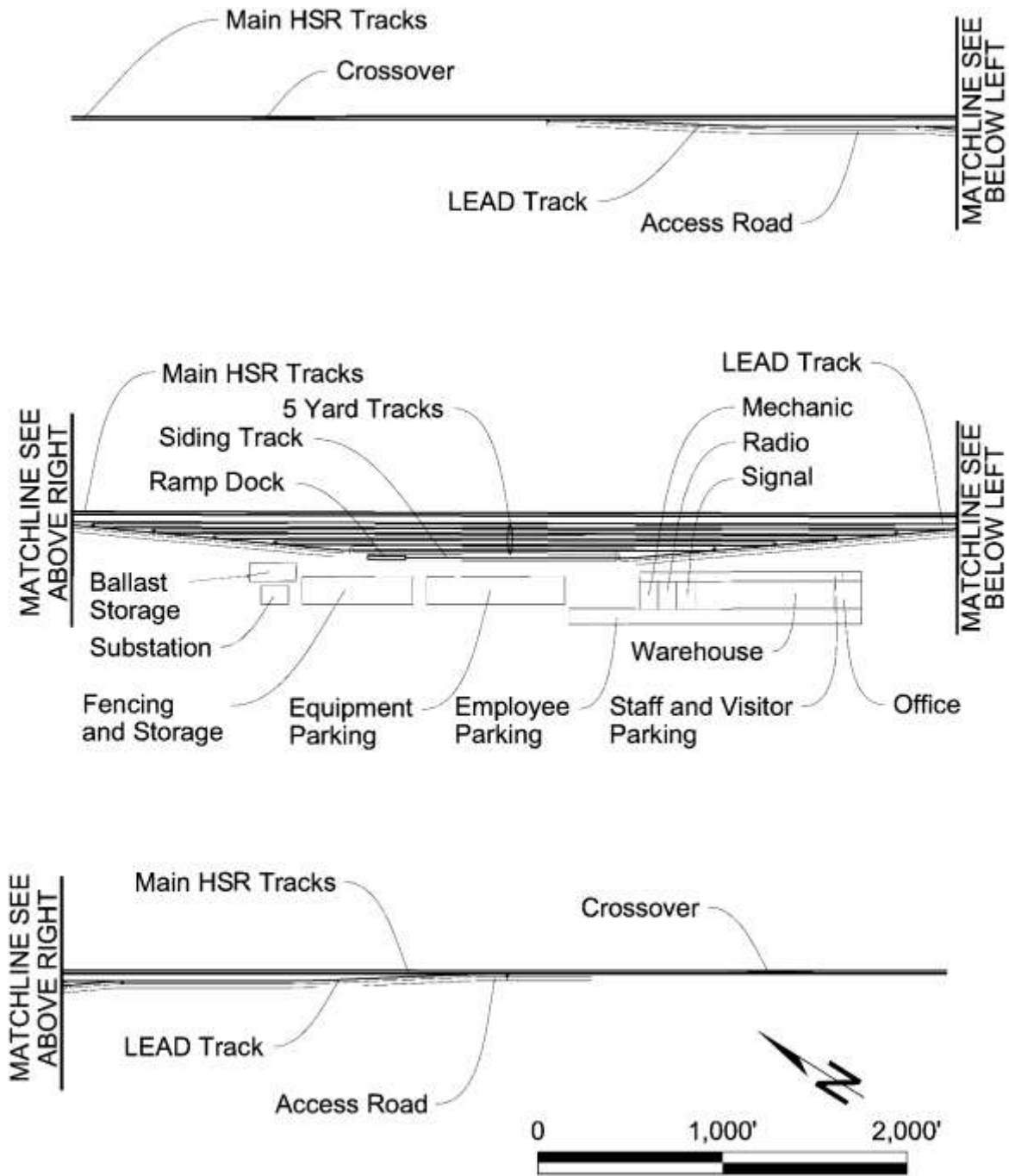


Figure 5 Typical MOWF Layout

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