

Appendix 3.6-B
Water Usage Analysis Technical Memorandum

This Technical Memorandum (TM) presents an analysis and evaluation of anticipated water use requirements for both the construction and operation of the California High-Speed Train (HST) for the Fresno to Bakersfield Section. This TM also identifies current water use at the proposed facility and track alignment locations, and likely water supply sources to meet the anticipated HST water demand for this section.

Executive Summary

The Fresno to Bakersfield Section runs through Fresno, Kings, Tulare, and Kern counties, and will be approximately 117 miles long. The major features that are to be part of the Fresno to Bakersfield Section include high-speed train (HST) stations in the cities of Fresno and Bakersfield and in the vicinity of Hanford (Kings/Tulare Regional Station) and the track alignment and associated right-of-way. One Heavy Maintenance Facility (HMF) may also be included as part of this section. Relevant sections of pertinent HST reports were reviewed to identify all facilities that would have significant water demand requirements. Based on this review, four facilities requiring significant operational water use were identified: the Fresno, Kings/Tulare Regional, and Bakersfield stations, and the one HMF that may be located in this section.

Water use factors and estimated usage rates were identified for the different facilities, as summarized in Table 1. These factors were used to estimate the future water demand for each facility and track alignment alternative for both construction activities and operation and maintenance at final build-out. Existing water use was then evaluated for all five proposed HMF locations, the BNSF alternative alignment, and the 10 other alignment alternatives; existing usage was also evaluated at each proposed station location. The existing water use estimates were then compared with the future estimated demand. This comparison indicates that construction of the Fresno to Bakersfield Section of the HST will result in net decrease in annual water consumption for the area impacted by the construction of the track and facilities, when annualized over a 5-year construction period. Operation and maintenance of the HST at final build-out also will result in a net decrease of water use over existing water use in/at the Project Footprint to less than 2% of the current water use. Water use will decrease at the track alignment and the HMF, but increase in the Fresno, Kings/Tulare Regional, and Bakersfield stations. The Fresno station location is within the study area of the Fresno Urban Water Management Plan (FUWMP), and through the FUWMP, the City of Fresno is developing an ongoing plan to meet the water demand for this and other users in the FUWMP study area (City of Fresno 2008). The City of Hanford has a 2010 Urban Water Use Plan that would be updated to include the proposed Kings/Tulare Regional Station, if selected (City of Hanford 2011 [June]). Similarly, the Bakersfield Urban Water Management Plan (BUWMP) is an ongoing plan developed to meet water demand in the city of Bakersfield study area (City of Bakersfield 2007).

Background

The California High-Speed Rail Authority (Authority), a state governing board formed in 1996, has responsibility for planning, designing, constructing, and operating the HST. When completed, the HST System will 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 HST System, shown on the cover, is divided into nine sections. The Fresno to Bakersfield Section, shown in Figure 1 (and highlighted on the cover), will connect to the Merced to Fresno Section to the north and the Bakersfield to Palmdale Section to the south. The Fresno to Bakersfield Section runs through Fresno, Kings, Tulare, and Kern counties and will be approximately 117 miles long.

Major features of the Fresno to Bakersfield Section include the Fresno, Kings/Tulare Regional, and Bakersfield stations; the track alignment and associated right-of-way; and possibly one HMF. Other, lesser facilities will include a maintenance-of-way facility, traction power supply stations, and switching and paralleling stations.

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 HST.
2. Identified the expected land requirements for the different station and HMF locations and 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 2020. The annual water use estimate is based on full build-out in 2035.
4. Determined existing water uses at the sites/stations where the HST 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. In addition, the irrigation districts that supply water to the HMF sites were contacted for specific historical water use data for each of the HMF sites.
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 all Project facilities that would have significant water demand requirements. Based on this review, four facilities requiring significant operational water usage were identified: the Fresno, Kings/Tulare Regional, and Bakersfield passenger stations, and the potential HMF.

The preferred alternative for the Fresno station is being evaluated. Two locations are currently being evaluated for a potential station between Fresno and Bakersfield: the Kings/Tulare Regional Station – East Alternative and the Kings/Tulare Regional Station – West Alternative. These station alternatives are located east and west of the city of Hanford, respectively. The Kings/Tulare Regional Station – West Alternative has an at-grade option and a below-grade option. Three locations within a few blocks of each other are being evaluated for the Bakersfield station: the Bakersfield Station – North Alternative, the Bakersfield Station – South Alternative, and the Bakersfield Station – Hybrid Alternative. The footprints and sizes of the station buildings are similar, but the overall layouts of the stations are dissimilar.

One HMF will be located either as part of the Merced to Fresno Section or as part of the Fresno to Bakersfield Section. Although it is not certain if an HMF will be included as part of the Fresno

to Bakersfield Section, this Technical Memorandum includes an analysis of the water use associated with an HMF for completeness. Five potential locations for the HMF have been identified along the Fresno to Bakersfield Section: Fresno Works – Fresno HMF Site; Kings County – Hanford HMF Site; Kern Council of Governments – Wasco HMF Site; Kern Council of Governments – Shafter East HMF Site; and Kern Council of Governments – Shafter West HMF Site.

The HMF will include a heavy rail vehicle maintenance area and a layover area. The HMF will require approximately 150 acres to accommodate all activities associated with the train fleet assembly, disassembly, and complete rehabilitation; and all on-board components of the train-sets. The facility will also include a maintenance shop, yard operations control center building, one traction power supply station, a train interior cleaning platform, and other support facilities. The HMF footprint is expected to cover the same area (150 acres) regardless of which of the five potential locations is chosen. However, the total site area associated with the five possible sites varies from 420 acres at the Kern Council of Governments – Wasco site to 590 acres at the Fresno Works – Fresno site. If an HMF is located in the Fresno to Bakersfield Section, a maintenance-of-way facility will likely be incorporated into the HMF. If an HMF is not located in the Fresno to Bakersfield Section, a separate maintenance-of-way facility will likely be included in this section. Maintenance-of-way facilities provide for equipment, materials, and replacement parts storage, support quarters, and staging areas for HST System maintenance personnel. The maintenance-of-way facility would be located immediately adjacent to the HST tracks, and would occupy approximately 26 acres. Significant water use is not anticipated for the maintenance-of-way facility.

The traction power supply station, and switching and paralleling stations will be unmanned, remotely operated facilities with no dedicated water supply; and as such, are not anticipated to require significant, if any, water use. Therefore, no water use analysis was performed for these facilities.

The 11 HST alternative alignments are the BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 1 Modified, Hanford West Bypass 2, Hanford West Bypass 2 Modified, Corcoran Elevated, Corcoran Bypass, Allensworth Bypass, Wasco-Shafter Bypass, Bakersfield South, and Bakersfield Hybrid alternatives. Analyses were performed for all proposed alignments and corresponding segments of the BNSF Alternative.

Estimating Future Water Demand Requirements for Fresno to Bakersfield Section

This section describes the relevant information and assumptions used to estimate the future water demand for each facility and track alignment alternatives. 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 report.

The process followed for estimating water demand for operation of each facility is summarized below.

- Identify facilities requiring water usage including stations, HMFs, and track alignments.
- Determine water use factors for each facility including:
 - size/footprint of buildings and overall site areas.
 - passenger/employee use for each station and facility.
 - facility functions and operation/maintenance requirements.

- Determine appropriate water use factors.
- Apply factors and estimate total water demand.

Operational water use factors were identified for the different facilities by obtaining information from similar facilities, such as Bay Area Rapid Transit (BART) and Los Angeles International Airport; from American Water Works Association (AWWA) manuals and research papers (AWWA 2001); and from the August 2008 FUWMP. The different water use factors were compared, and using professional engineering judgment the most appropriate annual water usage rate was selected.

HMF – Operational data from the Hayward BART facility (water rate usage of 31 gallons per employee per day) was selected as a basis for developing a water use factor for the HMF facility, as the facilities are similar in function (both perform heavy maintenance and cleaning for electrically powered train sets) and have similar precipitation conditions. Data from the Department of Water Resources State Climatologist shows similar average rainfall totals for Hayward (14.9 inches, Newark gage) and the potential HMF sites (12.5 inches, Merced gage). The number of train sets and employees for both the BART (actual numbers) and HST facilities (planned numbers) were compared and other climatic conditions (average temperature, humidity) and landscaping were considered, as well as the expected use of newer water recycling and reuse technologies at the HMF, and the water usage factor for the HMF was adjusted slightly downward to 30 gallons per employee per day. With the ongoing improvement in water recycling and reuse technologies likely to be employed at the HMF, it is likely that this water use factor may be conservatively high, but it is appropriate for use in this analysis.

Passenger Stations – Several approaches for estimating the future water demand for the Fresno, Kings/Tulare, and Bakersfield stations were examined, including estimating water demand on a per capita basis, as well as on a facility square foot basis. After comparing these methods, the method that yielded the most conservative results was chosen: that of applying gallons per capita per day use factors to the estimated number of passengers for the Fresno and Bakersfield stations; and applying water demands on the facility square foot basis for the Kings/Tulare Station. The factor used for the Fresno and Bakersfield stations was 5 gallons per capita per day for passengers. The factors used for the Kings/Tulare station were 150 gallons per day per 1,000 square feet for station building offices, 20 gallons per day per 1,000 square feet for the concourse area, 5 gallons per day per 1,000 square feet for parking structures, and landscaping irrigation of 1.5 acre-feet per acre per year (31 gallons per day per 1,000 square feet).

Track alignments – Water will not be used along the track alignments during operation of the system.

The different water use factors and estimated future water demand for each facility is summarized in Table 1.

The process followed for estimating the water demand related to construction of each facility and track alignments is summarized below.

- Identify the construction footprint for each facility and track alignment.
- Identify the different construction components associated with both the construction of the facilities and the track:
 - manufacturing of concrete.
 - earthwork and soil conditioning.
 - dust suppression.
 - Landscaping and irrigation.

Water usage estimates were developed for construction of the stations, HMF, and track based on anticipated Project construction schedule. 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 5-year construction period. This information is summarized in Table 2.

Existing water use and water supply sources

Land areas that will be impacted by the HST were identified for each of the track alignment alternatives (Figure 1), each of the five potential HMF locations (Figures 2 through 5), and for each of the station locations (Figure 6). As described earlier, the area of land acquired for the HMFs may be greater than the 150 acres required for the HMF footprint. The Authority has no current plans to change the existing land use on this additional acreage. Accordingly, this analysis focused on the 150 acres by extrapolating existing water use from the larger area and scaling the existing usage to the 150-acre site considered for development of an HMF (Figure 7). Four of the five potential HMF locations are predominantly served by untreated agricultural water; one proposed HMF location, the Fresno County HMF site, is supplied by a combination of potable/treated municipal water and untreated agricultural water (see Table 3A).

Alignments

Existing land use information was evaluated for the BNSF Alternative and each of the other 10 alignment alternatives. The predominant land use (almost 69%) for the BNSF Alternative is agricultural, with roadways/right-of-way/no data categories comprising over 8%, unknown land uses comprising 11%, and industrial land use comprising just over 4%. The majority land use for the Hanford West Bypass alternatives and the Corcoran Bypass, Corcoran Elevated, Wasco-Shafter Bypass, and Allensworth Bypass alternatives is agricultural (52% to 82%). The Bakersfield South (4% agricultural land use) and Bakersfield Hybrid (4% agricultural land use) alternatives have more urbanized land uses.

To determine an appropriate agricultural usage factor along the Fresno-Bakersfield Section, crop-specific water use rate tables published in 2001 by the California Department of Water Resources (DWR) were applied. Specific crop type data within each alignment alternative are not readily available, and many areas undergo a cycle of crop rotation. An average water rate was calculated for each county using the 2001 DWR data, with weighting applied to reflect a crop's percentage of total irrigated area within that county (see Table 4). The weighted average crop water usage rates by county are:

- Fresno County – 3.0 acre-feet per acre per year (ac-ft/ac/yr).
- Kern County – 3.3 ac-ft/ac/yr.
- Kings County – 3.2 ac-ft/ac/yr.
- Tulare County – 3.5 ac-ft/ac/yr.

These county-specific weighted average crop water usage rates were applied to the total agriculture land area identified for each of the four counties to calculate the water usage for the alignment footprints through each county. Water use factors for industrial, commercial, institutional, single-family residential and multi-family residential were taken from the FUWMP and applied to the total areas of each specific land use type identified for each track alignment. No water use factors were available in the FUWMP for roadways/ right-of-way/no data land uses, therefore an estimated water use factor of 1.9 was applied, since water use on such land parcels would not be greater than that for commercial, industrial or institutional land uses, which have a water use factor of 1.9. The water use factor applied to unknown land uses is the product of a weighted average for all known land uses within the portion of the alignment footprint analyzed.

Table 3B shows the water use factors applied to the BNSF Alternative and each of the 10 alternative alignments. Total annual water use for the BNSF Alternative alignment was calculated to be approximately 13,750 acre-feet per year (ac-ft/yr). The total annual water use for each alternative alignment, as well as the difference in water use associated with each alternative alignment (compared to the corresponding segment of the BNSF Alternative), were calculated, as follows:

- Hanford West Bypass 1: 2,830 ac-ft/yr (840 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Hanford West Bypass 1 Modified: 3,060 ac-ft/yr (620 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Hanford West Bypass 2: 2,780 ac-ft/yr (880 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Hanford West Bypass 2 Modified: 3,220 ac-ft/yr (440 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Corcoran Elevated: 1,180 ac-ft/yr (120 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Corcoran Bypass: 1,380 ac-ft/yr (90 ac-ft/yr more than the corresponding segment of the BNSF Alternative)
- Allensworth Bypass: 1,890 ac-ft/yr (200 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Wasco-Shafter Bypass: 2,230 ac-ft/yr (640 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Bakersfield South: 700 ac-ft/yr (40 ac-ft/yr less than the corresponding segment of the BNSF Alternative).
- Bakersfield Hybrid: 640 ac-ft/yr (90 ac-ft/yr less than the corresponding segment of the BNSF Alternative).

HMF sites – Specific water use information was requested from representatives of water providers for each potential HMF site. The information received for each potential HMF site is summarized below.

Fresno Works – Fresno HMF Site – This prospective HMF site is located in Fresno County. The site is mainly agricultural (59%), with substantial areas of industrial (20%) land uses. Single-family residential, commercial, institutional, and roadways/right-of-way/no data land uses each comprise less than 10% of the HMF site area. Water use factors for the non-agricultural land uses were taken from the FUWMP or calculated similarly to the track alignments as described above (refer to Table 3A). The water use factor for the agricultural portion of this site was based on a county-specific weighted crop average (refer to Tables 3A and 4) calculated from 2001 DWR data, as site-specific information regarding existing water use was only available for surface water and did not account for supplemental water supply from groundwater (for which data are not available). It is understood from information provided by Bill Stretch of the Fresno Irrigation District (Stretch, 2011, personal communication) that water for nonagricultural uses is provided by the City of Fresno municipal water supply and that surface water for agricultural uses is provided by the Fresno Irrigation District at an allotted rate of 0.468 ac-ft/ac/yr. He also confirmed that supplemental groundwater is commonly used by both agricultural and non-

agricultural users. Total annual water use for the potentially affected 586-acre area is 1,600 ac-ft/yr (refer to Table 3A). Hence, the water use factor in this area is 2.72 ac-ft/ac/yr, or 408 ac-ft/yr for a standard 150-acre site.

Kings County – Hanford HMF Site – This prospective HMF site is located within Kings County, and is more than 98% agricultural. Industrial and roadways/right-of-way/no data land uses comprise the balance of the HMF site area. Water use factors for the non-agricultural land uses were taken from the FUWMP or calculated in the same way as described above for the track alignments (refer to Table 3A). The water use factor for the agricultural portion of this site was based on a county-specific weighted crop average (refer to Tables 3A and 4) calculated from 2001 DWR data, as site-specific information regarding existing water use was only available for surface water and did not account for supplemental water supply by groundwater (for which data was not readily available). It is understood from discussions with Lakeside Irrigation Water District (Hemans, 2011, personal communication) that surface water for agricultural uses is largely provided by the Lakeside Irrigation Water District, at a rate of approximately 1.1 ac-ft/ac/yr, but that supplemental groundwater (including groundwater previously used in nearby dairy operations) also provides a large portion of water used on these land parcels. Crops in this area are grown on a rotational basis, and may include wheat, silage grain, corn, cotton, tomatoes and stevia, amongst others (Hemans, 2011, personal communication). The Kings County Water District provides water to numerous private ditch companies, which then distribute water to connected landowners; however, information regarding the quantities of such water provision to landowners within the prospective HMF sites was unavailable. The total annual water use for this 512-acre site is approximately 1,630 ac-ft/yr (refer to Table 3A). Hence, the water use factor within this area is 3.18 ac-ft/ac/yr, or 478 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Wasco HMF Site – This prospective HMF site is located within Kern County. The majority (nearly 98%) of the site is agricultural and is within a crop rotation area. The remaining small areas consist of the following land use categories: single-family residential, commercial, industrial, roadway/right-of-way/no data and unknown land uses.

Water use factors for industrial, commercial and agricultural land uses were based on discussions with water providers, as detailed below. Water use factors for the other non-agricultural land uses were taken from the FUWMP or calculated in the same way as described above for the track alignments (refer to Table 3A). The northern portion of the site is within the Wasco-Shafter Irrigation District (WSID), and the southern portion is within the North Kern Water Storage District (NKWSD). Groundwater is also used to supplement surface water provided by the NKWSD & WSID. A small portion of the site is within the area served by the City of Wasco municipal water supply. Discussions with NKWSD indicate that this area has historically been used to grow roses, but under the current economy, hay, grain, and cotton are more commonly grown (Munn, 2011, personal communication). Information provided by WSID (Ezell, 2011, personal communication), based on his discussions with landowners, indicate that between 4.0 and 4.25 ac-ft/ac/yr of water is used for crops in this area, and around 1 ac-ft/ac/yr is used for industrial land uses. An agricultural water use factor of 4.15 and an industrial water use factor of 1.0 were therefore used for this HMF site. The total annual water use for this 416-acre site is approximately 1,720 ac-ft/yr (refer to Table 3A). Hence, the water use factor within this area is 4.13 ac-ft/ac/yr, or 620 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Shafter East HMF Site – This prospective HMF site is located within Kern County, immediately east of the proposed HST alignment and existing BNSF railroad. Over 85% of the HMF site is in agricultural use as permanent almond tree orchards, over 10% is industrial, and small areas of unknown or “roadway/right-of-way/no data” land uses make up the balance. Water use factors for the non-agricultural land uses were taken from the FUWMP or calculated in the same way as described above for the track alignments (refer to Table 3A). The water use factor for the agricultural portion of this site was based on discussions

with the water suppliers regarding water required for almond orchards, as detailed below. Surface water for agricultural uses is supplied by the NKWSD and WSID. The site is within a NKWSD "improvement area" with an average of 1 acre-feet per acre (ac-ft/ac) delivery (Dana Munn, April 6, 2011, personal communication). The balance of water required for agricultural purposes in this area is likely obtained through deep groundwater wells. Information provided by WSID (Jerry Ezell, pers. comm. April 14, 2011), based on his discussions with landowners, indicate that approximately 4.0 ac-ft/ac/yr of water is used for almond orchards in this area, therefore a water use factor of 4.0 was applied to the agricultural portion of this site. Total annual water use for this 495-acre site is approximately 1,850 ac-ft/yr (refer to Table 3A). Hence, the water use factor within this area is 3.73 ac-ft/ac/yr, or 560 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Shafter West HMF Site – This prospective HMF site is within Kern County and is adjacent to the Shafter East site, on the western side of the proposed HST alignment. Over 97% of the HMF site is in agricultural use as permanent almond tree orchards, with small areas of single-family residential, industrial or "roadway/right-of-way/no data" land uses making up the balance. Water use factors for the non-agricultural land uses were taken from the FUWMP or calculated in the same way as described above for the track alignments (refer to Table 3A). The water use factor for the agricultural portion of this site was based on discussions with the water suppliers regarding water required for almond orchards, as detailed below. Surface water for agricultural uses is supplied by NKWSD and WSID

The site is in an NKWSD "improvement area" with an average of 1 ac-ft/ac delivery (Dana Munn, April 6, 2011, personal communication). The balance of water required for agricultural purposes in this area is likely obtained through deep groundwater wells. Information provided by WSID (Jerry Ezell, pers. comm. April 14, 2011), based on his discussions with landowners, indicate that approximately 4.0 ac-ft/ac/yr of water is used for almond orchards in this area, therefore a water use factor of 4.0 was applied to the agricultural portion of this site. Total annual water use for this 476-acre site is approximately 1,880 ac-ft/yr (refer to Table 3A). Hence, the water use factor within this area is 3.96 ac-ft/ac/yr, or 593 ac-ft/yr for a standard 150-acre site.

The HMF site may not have a readily available connection to a municipal water supply. Locations that would likely have a connection to a municipal water supply include the Kern Council of Governments–Shafter East HMF site, which is located within the city's municipal water service area; and the Kern Council of Governments–Shafter West HMF site, which is located within the city's planning area. Since each site has onsite groundwater supply well(s), it is reasonable to assume that groundwater would be the water supply source for each HMF facility, unless the facility is connected to a municipal supply line. Wellhead treatment systems for onsite groundwater supply wells would likely be employed to ensure that sufficient water quality is achieved.

Stations – The proposed Fresno and Bakersfield station locations are currently supplied with treated municipal water from the City of Fresno Water Division and the California Water Service Company, respectively. For the proposed Kings/Tulare Regional station location alternatives, the majority of the affected area (89 to 99%) is in agricultural use and served by agricultural water districts.

To estimate the existing water use at the proposed Fresno and Bakersfield station locations, land use for each parcel was identified (refer to Figures 8 through 11 for existing land use at the stations). The proposed station footprint on these parcels was overlain to identify affected land use classifications. Water use factors for each affected land use classification were applied to estimate current water usage for each station location, based on FUWMP water use factors or calculated in the same way as described above for the track alignments. This information is summarized in Table 3C.

Water use factors from the FUWMP, adopted in August 2008, were used. Urban Water Management Plans are required by the California Urban Water Management Planning Act and are developed under the guidance of the California Department of Natural Resources through their *Guidebook for Preparation of a 2005 Urban Water Management Plan* (California Department of Natural Resources 2005). Urban Water Management Plans are to be updated every 5 years. The FUWMP addresses current and projected future water supply availability and reliability through the year 2030. The Fresno Station site currently being evaluated is located within the geographical area covered by the FUWMP. The FUWMP provides land use-based water demand projections for single family residential, multi-family residential, commercial/institutional, industrial, landscape irrigation uses.

The proposed Bakersfield station locations are within the area covered by the BUWMP; however, the BUWMP does not contain land use water use factors. Given the relative climatological similarities between Bakersfield and Fresno, the water use factors from the FUMWP were applied to land uses in the Bakersfield area. The FUWMP included water use rates for 2005, 2010, and 2025; the 2010 water use rates were applied to estimate current water usage.

The majority (89 to 99%) of the proposed Kings-Tulare Regional Station site alternatives are under agricultural use. A county-specific weighted average for all crop types was used to determine a water use factor for agricultural portions of the proposed Kings-Tulare Regional Station site locations, based on 2001 data (DWR 2001) as shown in Table 4.

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

- Fresno Station: 39 ac-ft/yr.
- Kings Tulare Regional Station – East Alternative: 80 ac-ft/yr.
- Kings Tulare Regional Station – West Alternative, at-grade option: 147 ac-ft/yr.
- Kings Tulare Regional Station – West Alternative, below-grade option: 147 ac-ft/yr.
- Bakersfield Station – North Alternative: 38 ac-ft/yr.
- Bakersfield Station – South Alternative: 38 ac-ft/yr.
- Bakersfield Station – Hybrid Alternative: 48 ac-ft/yr.

Comparison of Existing Water Usage to Estimated Future Demand

This section compares the estimated existing water usage at each facility location and track alignment to the future estimated water demand for the future facilities.

- **Fresno Station** – Current estimated water usage is 39 ac-ft/yr, and estimated future demand is 47 ac-ft/yr.
- **Kings/Tulare Regional Station** – Current estimated water usage is 80 to 147 ac-ft/yr, and estimated future demand is 55 ac-ft/yr.
- **Bakersfield Station** – Current estimated water use is 38 to 48 ac-ft/yr, and estimated future demand is 52 ac-ft/yr.
- **Tracks alignments** – Estimated existing water usage for the BNSF Alternative footprint is 13,750 ac-ft/yr. The estimated water usage for the Corcoran Bypass footprint would increase the total by about 90 ac-ft/yr. The proposed decrease in existing water use (compared to the equivalent segment of the BNSF Alternative) for each of the other nine alternatives ranged from 40 ac-ft/yr (Bakersfield South) to 880 ac-ft/yr (Hanford West Bypass 2). No water usage associated with the permanent track alignments is anticipated. There will be no demand for water for landscaping, operations, or maintenance along the track alignment.

- **HMFs** – Current estimated water usage for the five HMF locations ranges from 1,600 ac-ft/yr (Fresno Works – Fresno HMF Site) to 1,880 ac-ft/yr (Kern Council of Governments – Shafter West HMF Site). For a 150-acre site, current water usage would range from 408 to 620 ac-ft/yr. Estimated future water demand, regardless of the HMF location, is 50 ac-ft/yr for a 150-acre site.

Water Supply to Serve Construction

The amount of water that would be used during construction was estimated for concrete work, earthwork, dust control, and irrigation for reseeded areas for the stations, HMF and/or track alignments (Table 2).

Track alignments – The total length of each alternative alignment and the length of elevated, retained fill and below-grade track for each alignment are as follows:

- The BNSF Alternative is 117 miles long with 28 miles of elevated track, 12 miles of retained fill, and 1 mile of below-grade profile.
- Hanford West Bypass 1 is 28 miles long with 4 miles of elevated track and 1 mile of retained fill.
- Hanford West Bypass 1 Modified is 28 miles long with 4 miles of elevated track and 2 miles of below-grade profile.
- Hanford West Bypass 2 is 28 miles long with 5 miles of elevated track and 1 mile of retained fill.
- Hanford West Bypass 2 Modified is 28 miles long with 5 miles of elevated track, 1 mile of retained fill, and 2 miles of below-grade profile.
- Corcoran Elevated is 10 miles long with 4 miles of elevated track and 4 miles of retained fill.
- Corcoran Bypass is 10 miles long with 1 mile of elevated track and 2 miles of retained fill.
- Allensworth Bypass is 21 miles long with 1 mile of elevated track and 2 miles of retained fill.
- Wasco-Shafter Bypass is 21 miles long with 3 miles of elevated track and 1 mile of retained fill.
- Bakersfield South is 12 miles long with 10 miles of elevated track.
- Bakersfield Hybrid is 12 miles long with 10 miles of elevated track.

ARUP engineers estimated the amount of concrete needed to construct stations, HMFs, track alignments, and associated facilities for the BNSF alternative. 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 alternative alignment (estimated at 21 to 28 cubic yards of concrete per foot of track). The amount of water to be used at concrete batch plants during track construction was estimated at 31 gallons per cubic yard of concrete. The volume of earthwork required for the rail embankments was calculated based on the length of at-grade track. Water demand for earthwork compaction was calculated for an optimum moisture content of 10% by volume. Water demand for dust control at the track right-of-way was estimated to occur for 180 days at each section of the track. Water demand for seed germination was also estimated for 70% of the track right-of-way.

Passenger Stations – The amount of concrete needed for the station buildings and parking structures at the passenger stations was estimated by ARUP engineers from proposed structure footprints and building characteristics. The amount of water needed for concrete was estimated from the concrete demand (31 gallons per cubic yard of concrete). Water for dust control at the Fresno, Bakersfield, and Kings/Tulare stations was estimated to occur for 400 days. Irrigation used for post-construction site stabilization was calculated for landscaped areas at the passenger stations.

HMF – The amount of concrete needed to construct the HMF shop building was estimated by ARUP engineers from the structure footprint and building characteristics. Parking at the HMF consists of surface parking and not within concrete parking structures. Water for dust control was estimated to occur for 400 days. Irrigation for seed germination was also calculated for a portion of the 150 acre HMF site. It was estimated that 25% of the HMF would be reseeded.

Construction of the Fresno to Bakersfield Section of the HST will result in a net decrease in annual water consumption for the area impacted by the construction of the track and facilities, when annualized over a 5-year construction period. Specifically, it is estimated that the water usage during the construction of the Fresno to Bakersfield Section of the HST System will be only 6% (868 ac-ft/yr needed for construction compared to 14,689 ac-ft/yr for current existing water usage) of the existing water usage on an annual basis for the Project Footprint. In other words, current annual water usage at locations the Project will displace is far greater than the water Project-related construction will require annually in the same place. It is important to note that construction water demand is not a continuous flow demand on the supplier and often water usage is sporadic and a function of the particular construction activities going on at the time. Construction demand is frequently offset by water supply system storage so other users do not notice a drop in pressure or flow. Contractors sometimes also use a small volume of water storage onsite during construction to eliminate lengthy trips for water trucks to reach a water source such as a municipal fire hydrant.

Water Supply Sources for Operation of the Fresno to Bakersfield Section Facilities

This section describes water supply sources for each facility location and track alignment. The Fresno and Bakersfield Station areas are currently served by their respective municipal water supply agencies. It is anticipated that both stations will connect to the existing municipal systems. The at-grade and below-grade options of the Kings/Tulare Regional Station – West Alternative are inside the City of Hanford's urban growth area (sphere of influence) and water service area, and these station alternatives would rely on the city for water service to the station. The Kings/Tulare Regional Station – East Alternative is outside of the City of Hanford water service area, and therefore the station may pump and treat groundwater for use as a potable supply.

Water supply assessments are required (SB 221 and 610) for developments of more than 500 homes (which is equivalent to 250 ac-ft/yr). Because the stations and HMF are expected to require less than 250 ac-ft/yr, water supply assessments will not be needed for these facilities, and no other special action to secure water from the local agencies will be needed.

The HMF sites are located in or near the service areas of the following water supply districts: City of Fresno Water Division and the Fresno Irrigation District (Fresno Works – Fresno), City of Hanford Utility Division and Lakeside Irrigation Water District (Kings County – Hanford), City of Wasco Water Division and the Shafter-Wasco Irrigation District (Kern Council of Governments – Wasco), and North Kern Water Storage District (Kern Council of Governments – Shafter East and Shafter West). Groundwater is also used as a water supply source throughout this area. The

water supply source(s) for the respective HMF locations cannot be determined with certainty at this time. The potable water supply source for each HMF location will be determined during a later stage of the design process. However, as groundwater is available at all five sites, the most probable option for the Project is to utilize the groundwater supply, unless the HMF location is connected by pipeline to a municipal water supply.

Conclusions

The construction phase of the Fresno to Bakersfield Section of the HST will result in a net decrease in annual water consumption to only 6% of the existing water usage for the Project Footprint; this information is summarized in Table 5.

Operation and maintenance of the HST at final build-out also will result in a net decrease of water usage over existing water usage in/at the Project Footprint to less than 2% of the current water usage. Water usage will decrease at the track alignment and the HMF locations, but increase in the Fresno, Kings/Tulare Regional, and Bakersfield stations. The Fresno station location is within the study area of the FUWMP, and through the FUWMP, the City of Fresno is developing an ongoing plan to meet the water demand for this and other users in the FUWMP study area. The City of Hanford has a 2010 Urban Water Use Plan that would be updated to include the proposed Kings/Tulare Regional Station – West Alternative, if it is selected (City of Hanford 2011). Similarly, the BUWMP is an ongoing plan developed to meet water demand within the city of Bakersfield study area.

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Figures and Tables

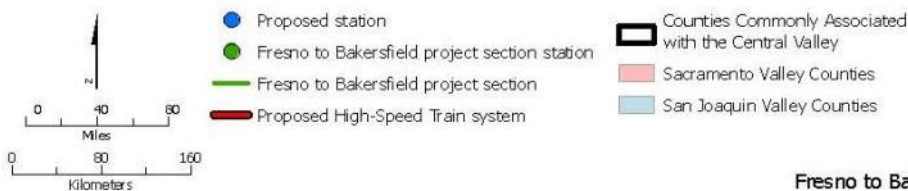
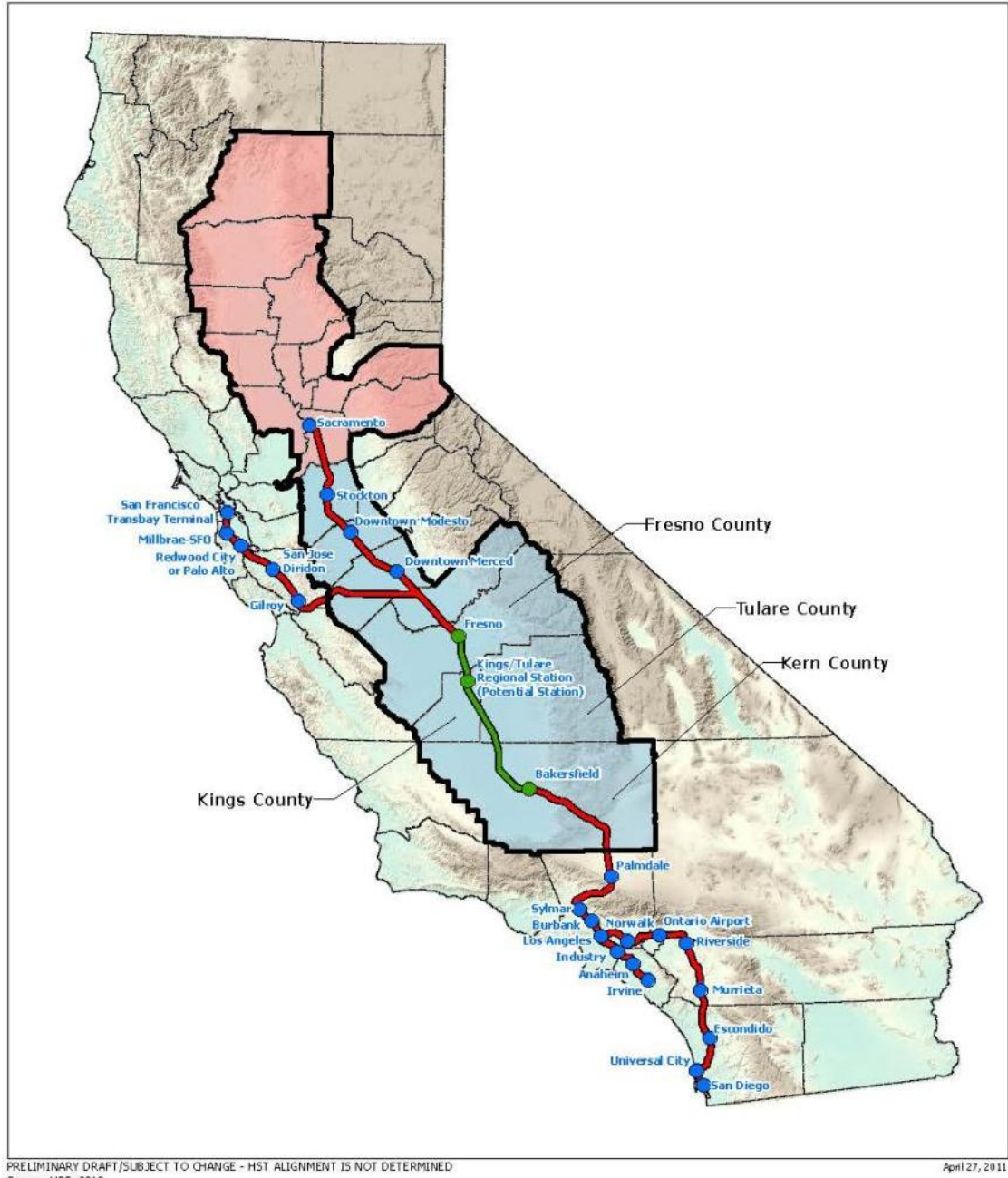
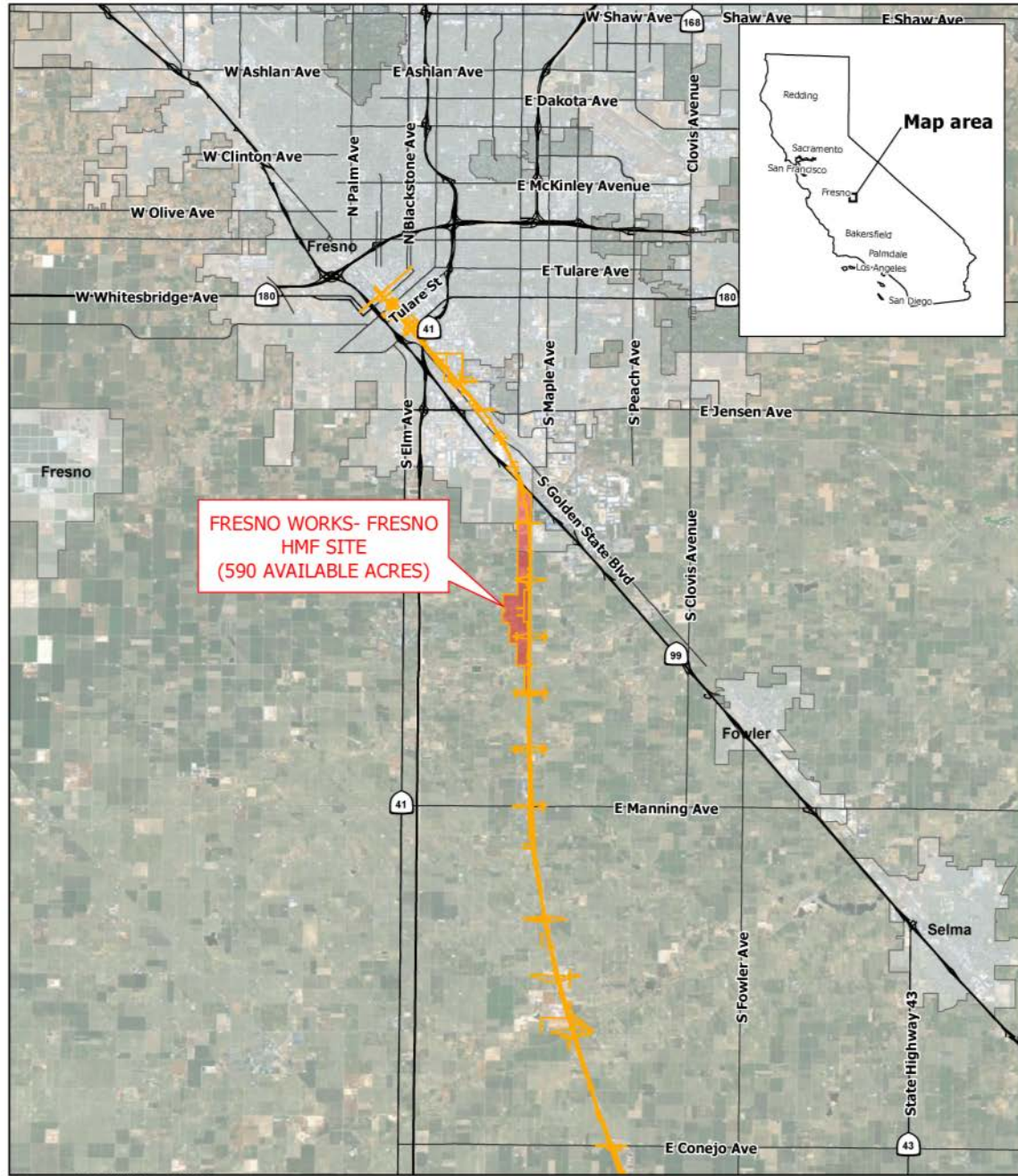


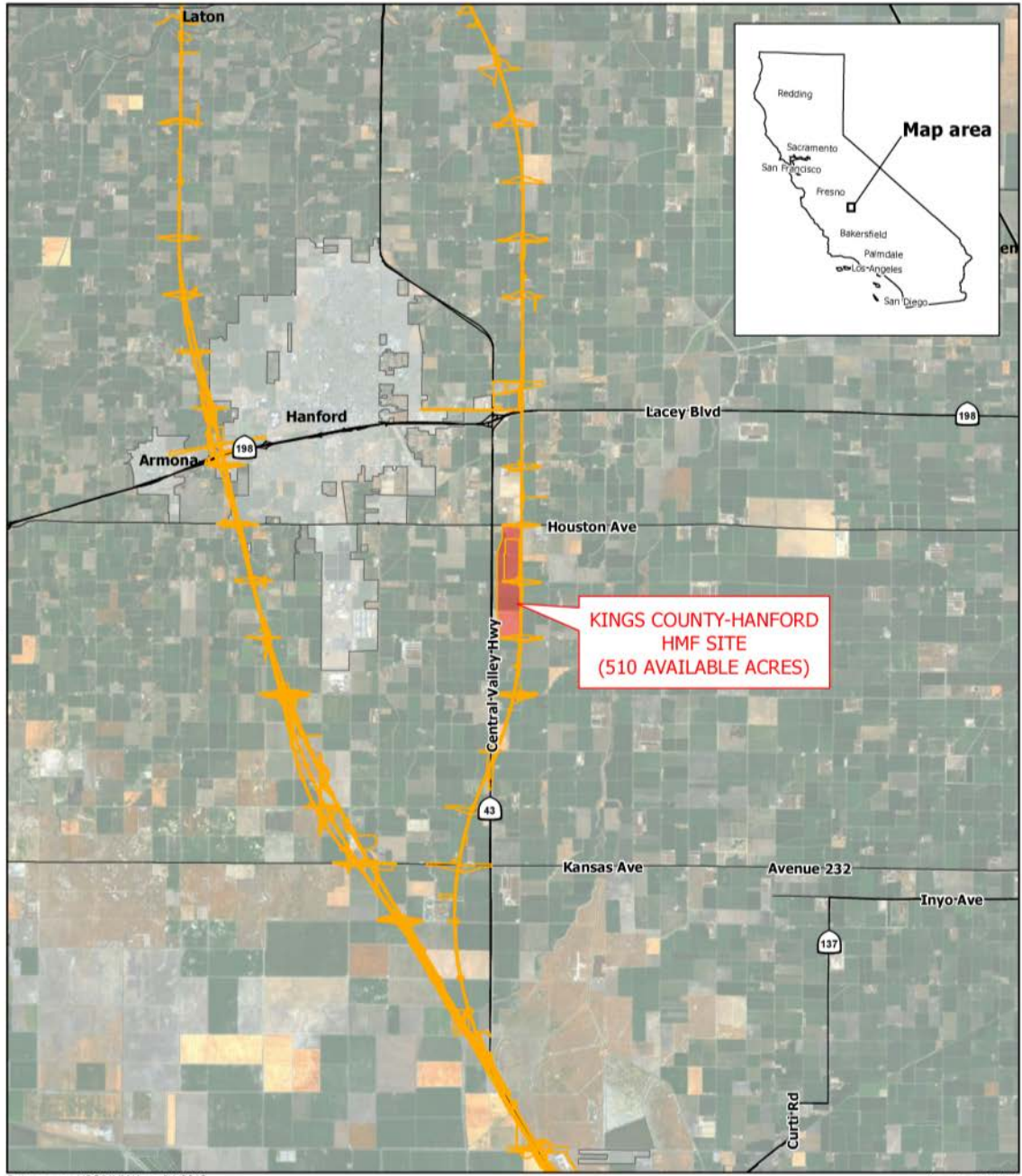
Figure 1
 Fresno to Bakersfield HST Section



Data source: URS/HMM/Arup JV, 2013. Image source: ESRI. November 20, 2013

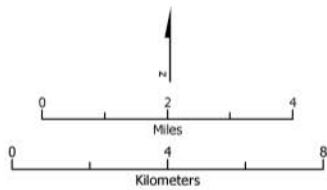


Figure 2
 Proposed Fresno Works-Fresno HMF Site



Data source: URS/HMM/Arup JV, 2013.
Image source: ESRI

November 20, 2013



- Road
- Impact footprint
- Potential heavy maintenance facility (HMF)

Figure 3
Proposed Kings County-Hanford HMF Site

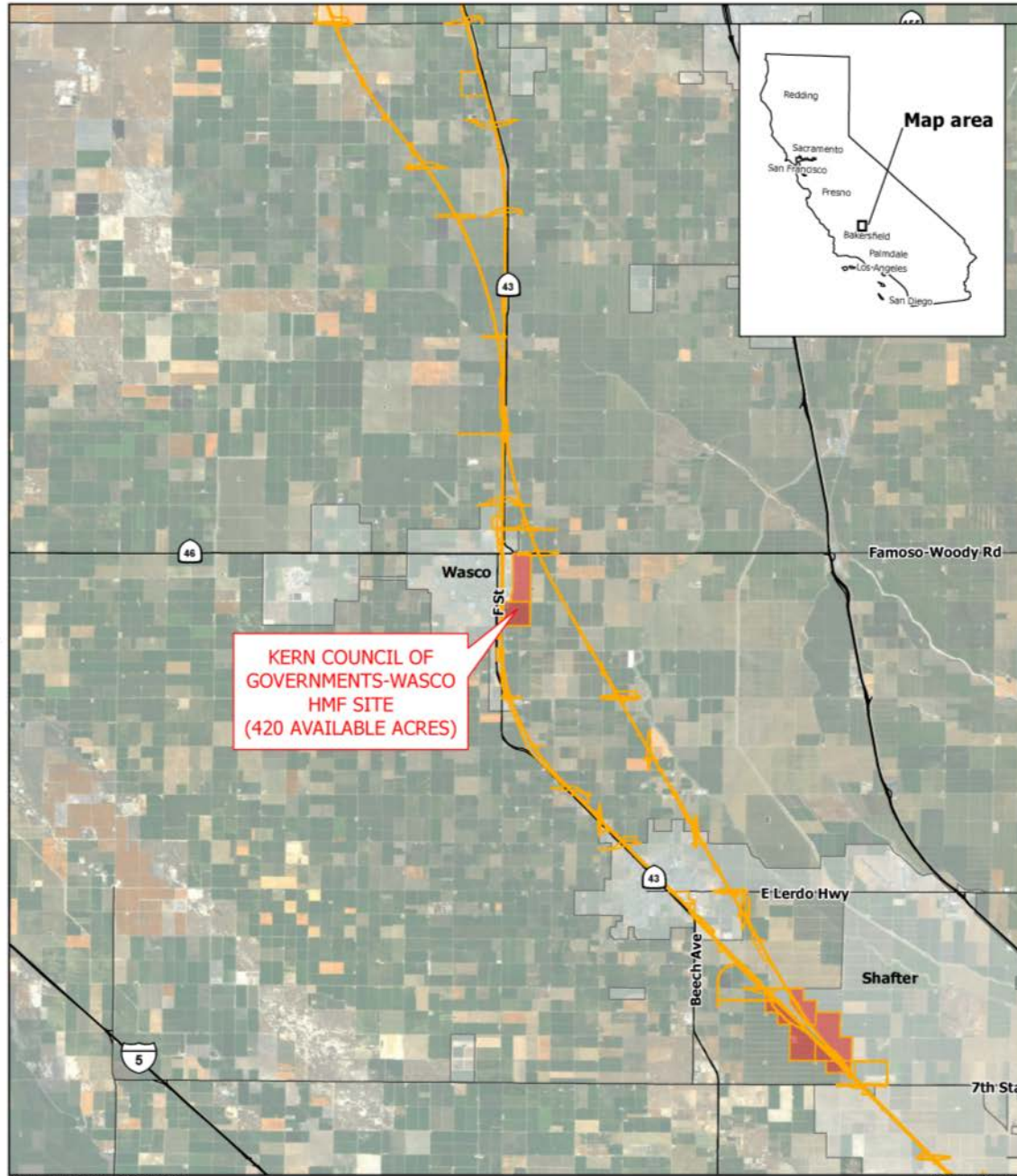


Figure 4
Proposed Kern Council of Governments-Wasco HMF Site

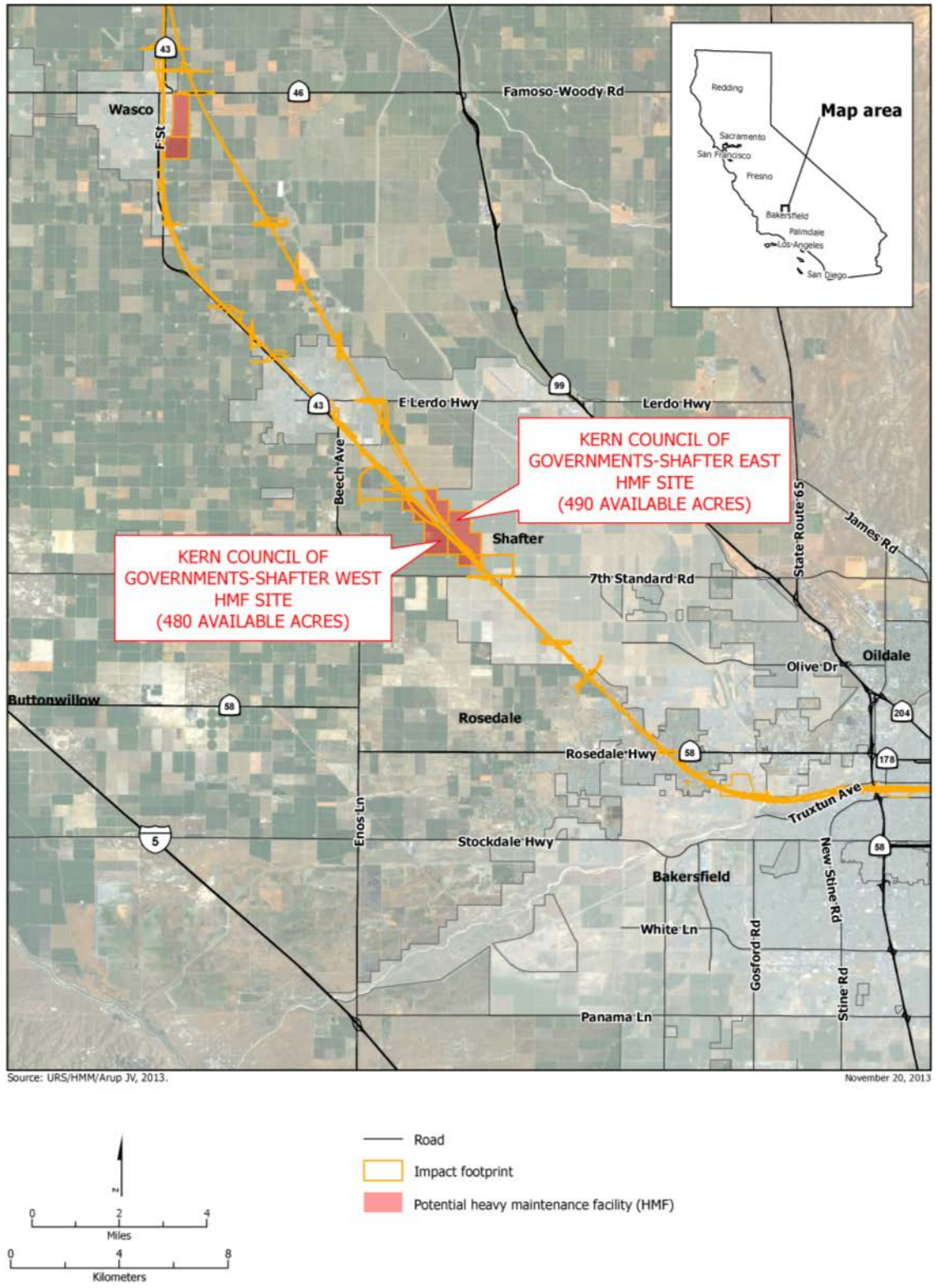
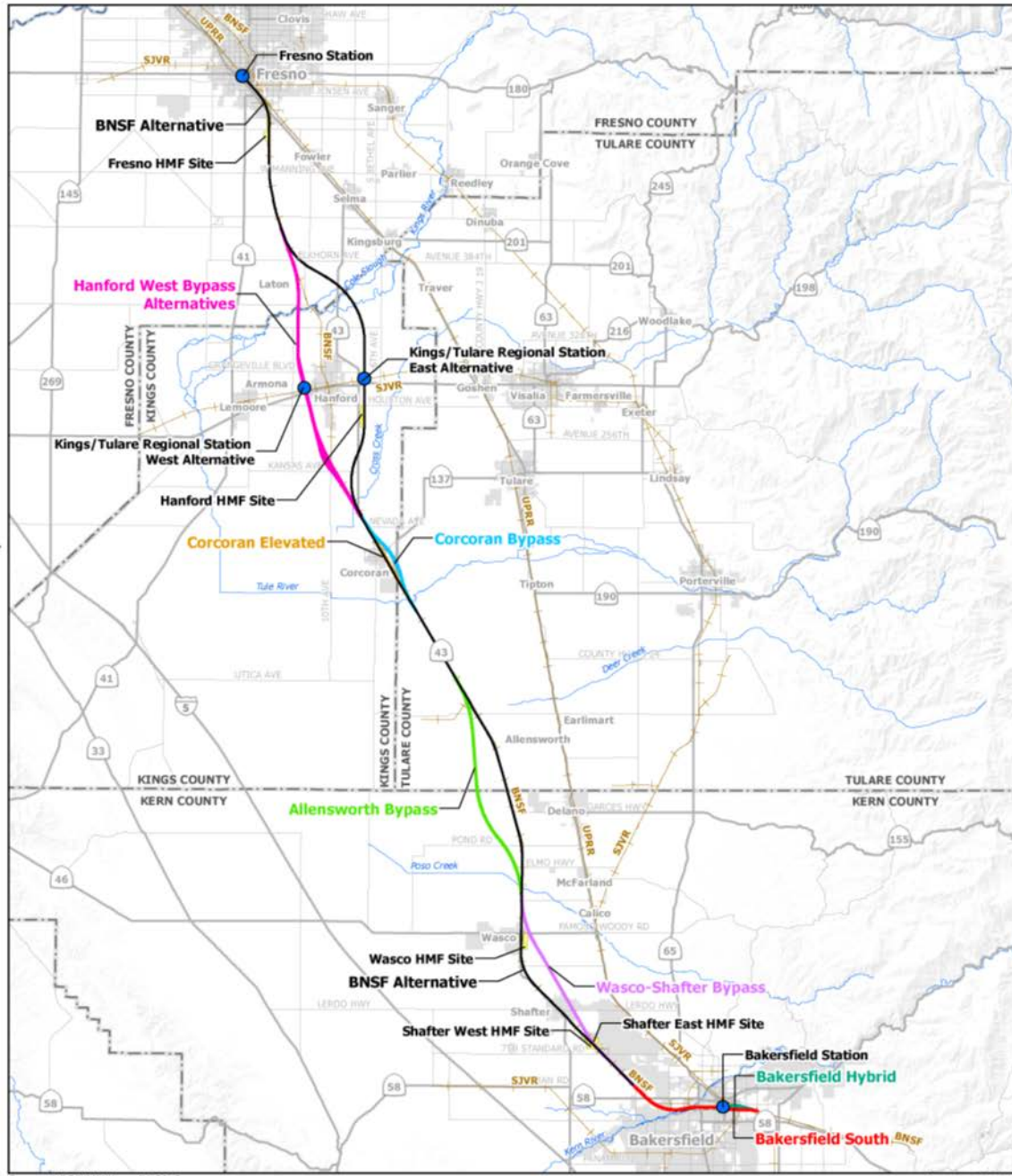


Figure 5
 Proposed Kern Council of Governments – Shafter East and Shafter West HMF sites



Source: URS/HMM/Arup JV, 2013.

November 20, 2013

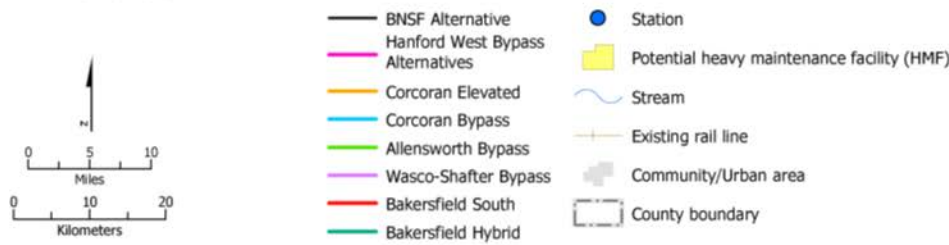


Figure 6
 Fresno to Bakersfield Section proposed station locations

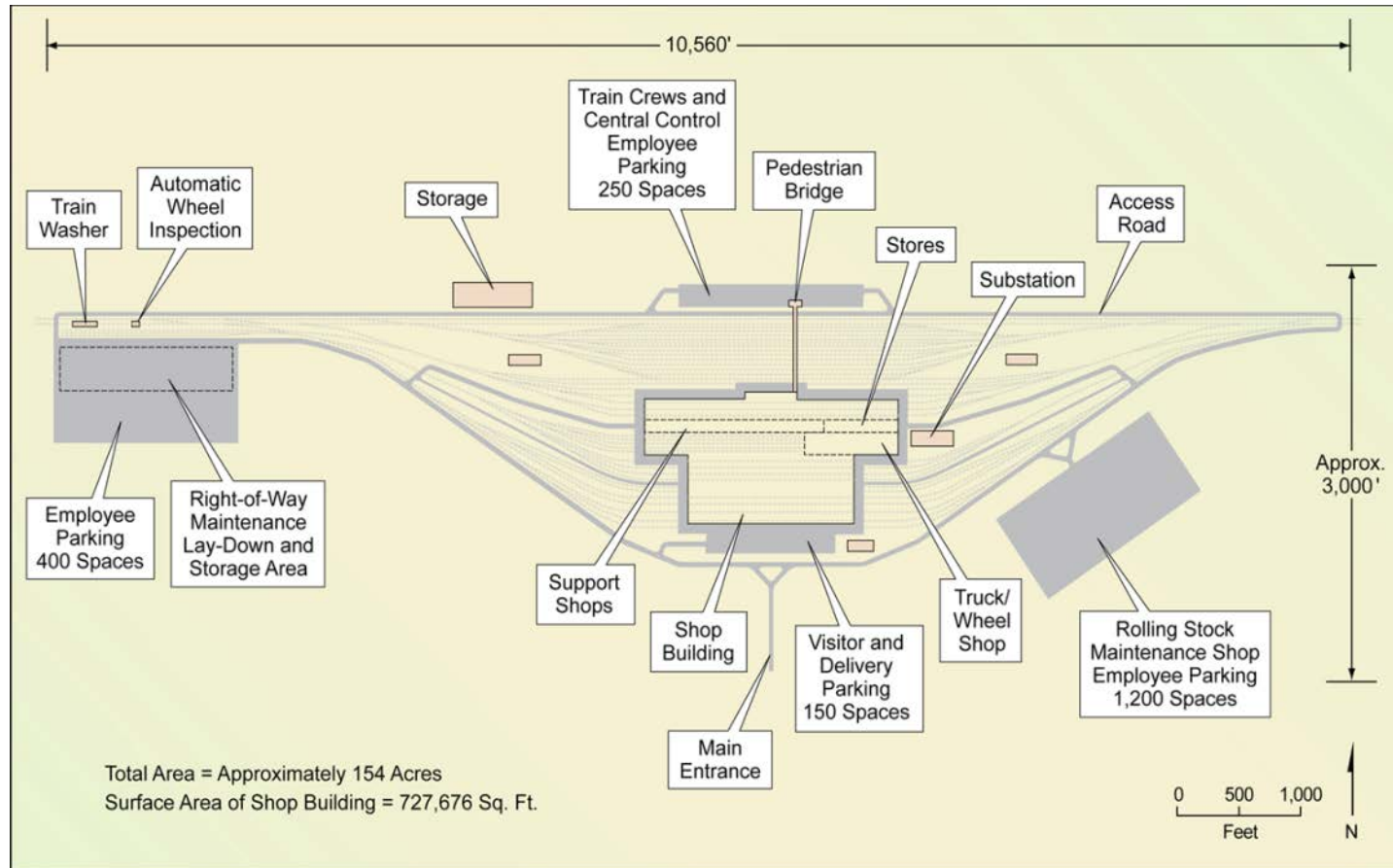
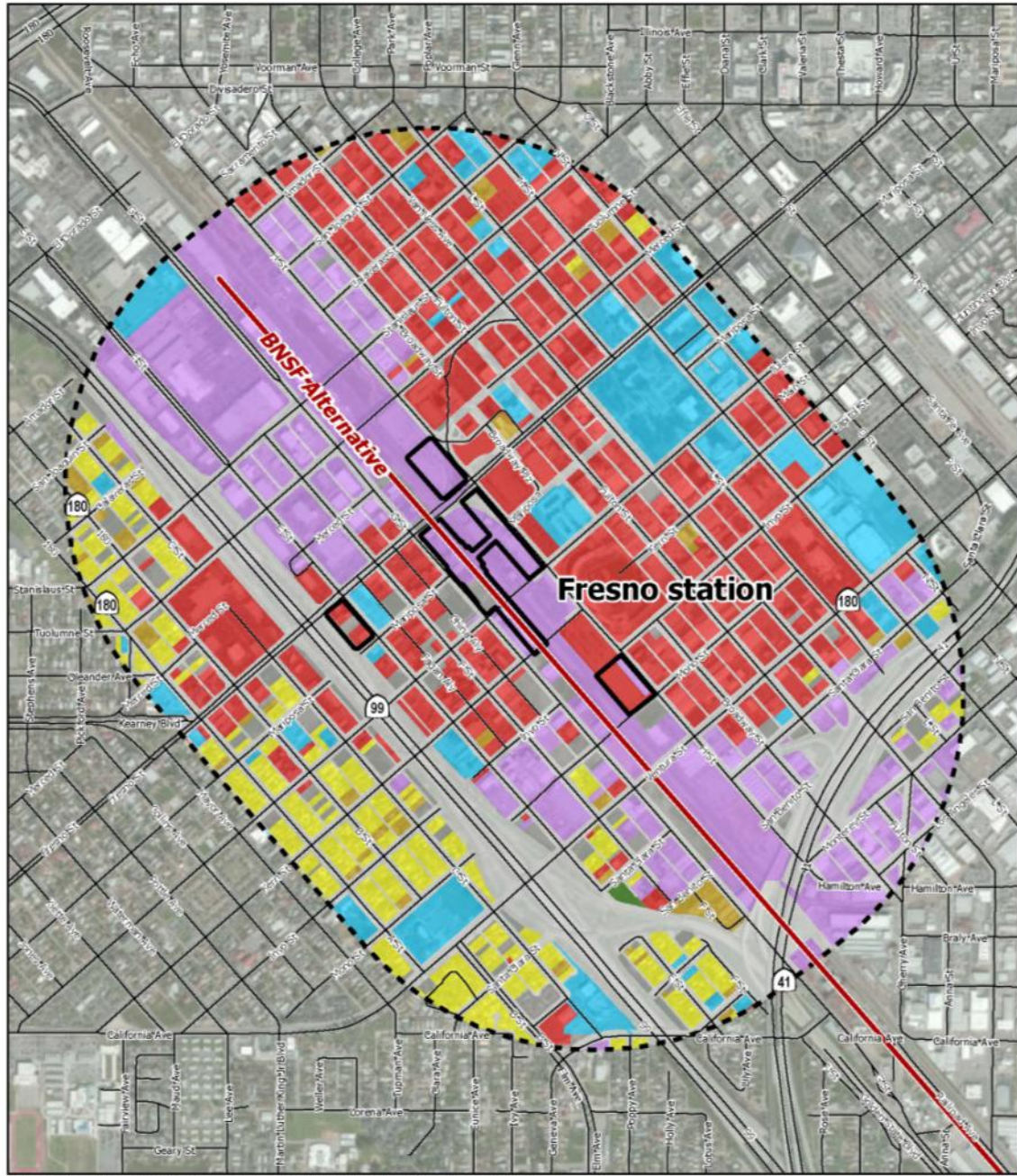
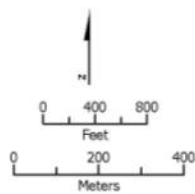


Figure 7
Typical heavy maintenance facility layout



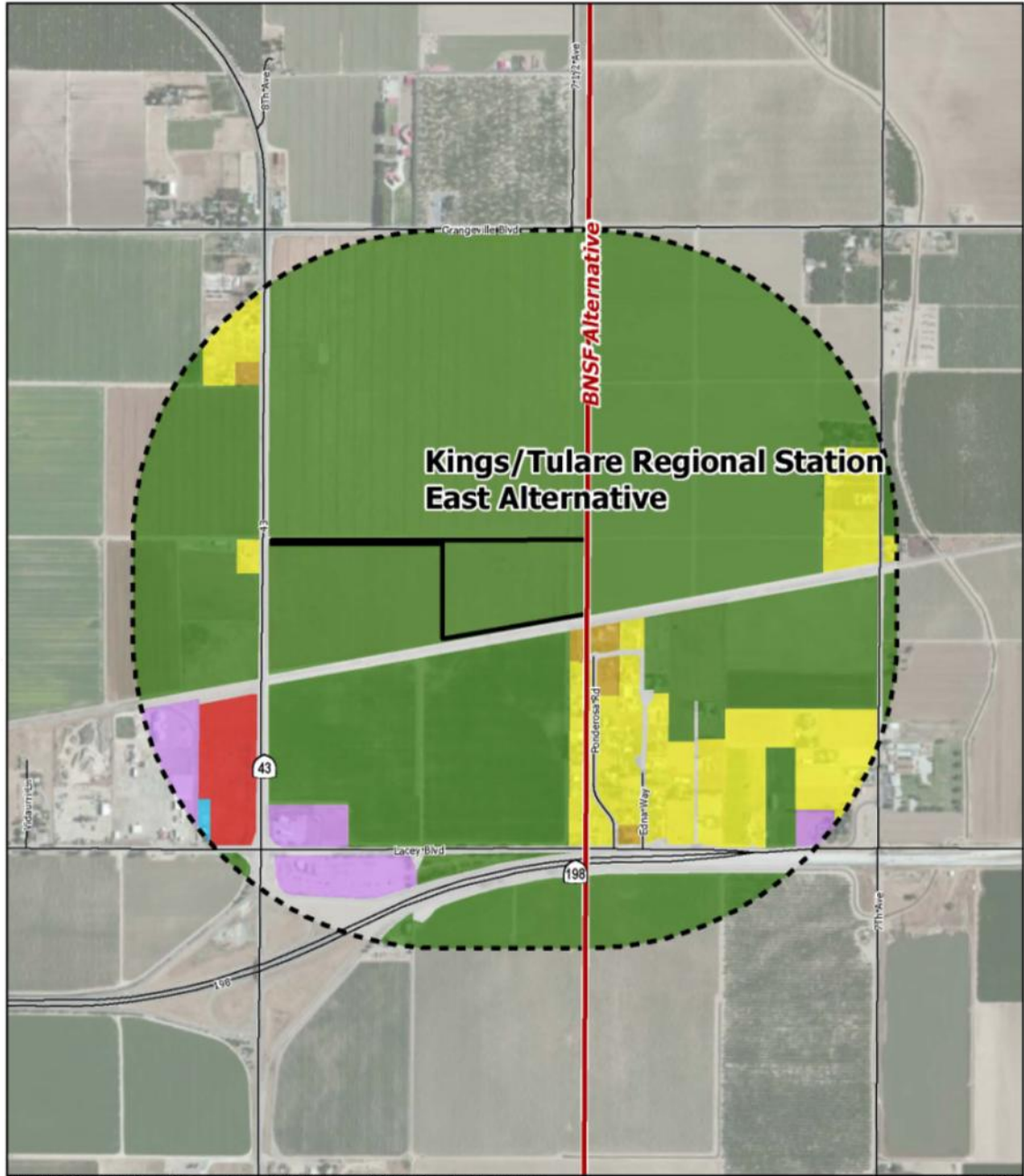
Source: URS/HMM/Arup JV, 2013; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009; City of Fresno, 2009
 Imagery source: ESRI

October 25, 2013.



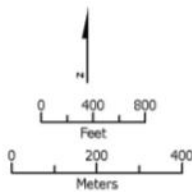
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|-----------------------------|---------------------------|--------------------|
| Alternative alignments | Land use | Industrial |
| Footprint of station | Mobile home | Community facility |
| Half-mile buffer of station | Residential single-family | Agriculture |
| | Residential multi-family | Transportation |
| | Commercial | Uncategorized |

Figure 8
 Existing land use: Fresno station



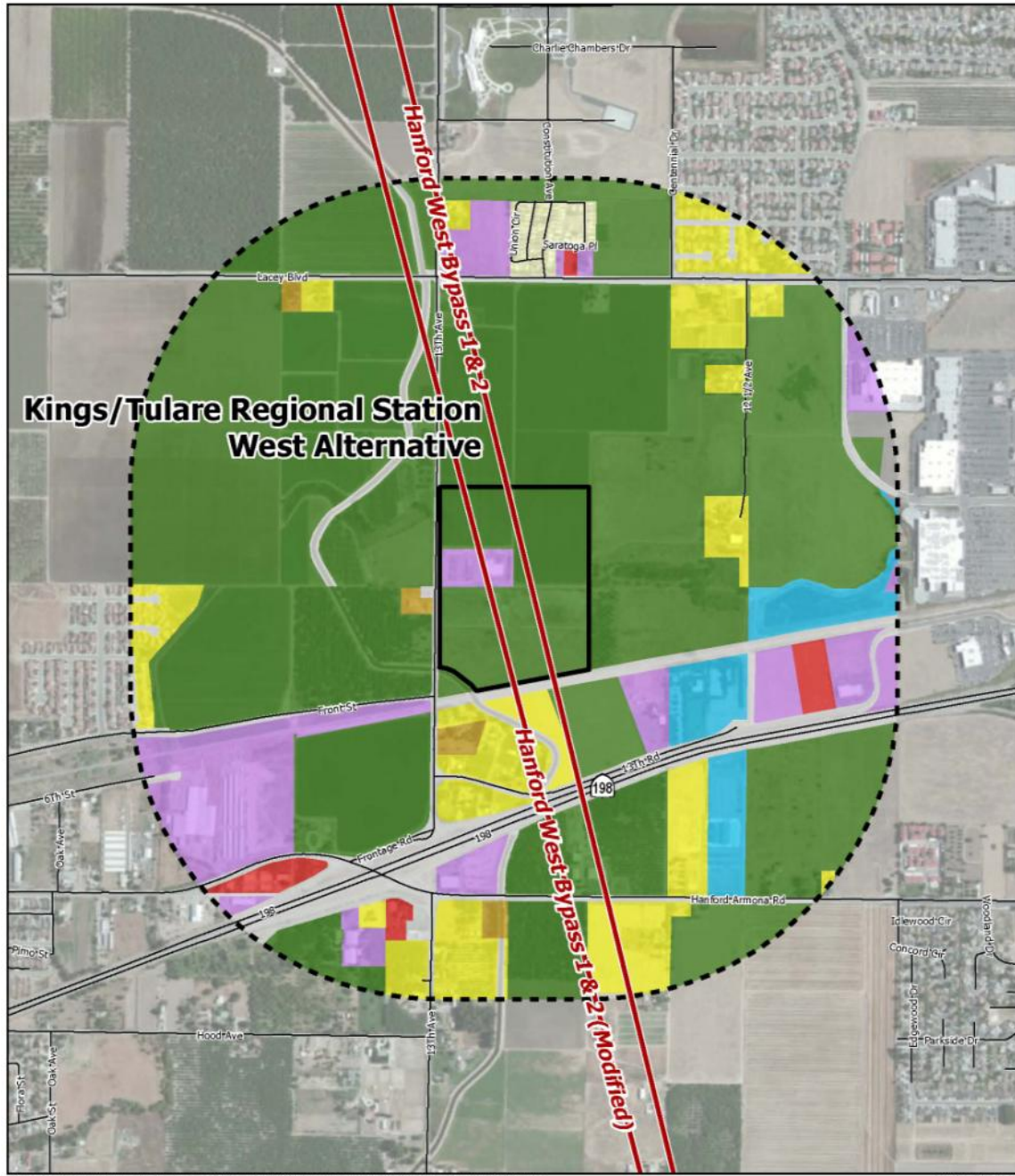
Source: URS/HMM/Arup JV, 2013; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009; City of Fresno, 2009
 Imagery source: ESRI

October 25, 2013.

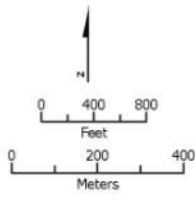


- | | | |
|-----------------------------|---------------------------|--------------------|
| Alternative alignments | Land use | Industrial |
| Footprint of station | Mobile home | Community facility |
| Half-mile buffer of station | Residential single-family | Agriculture |
| | Residential multi-family | Transportation |
| | Commercial | Uncategorized |

Figure 9
 Existing land use: Kings/Tulare Regional Station–East Alternative

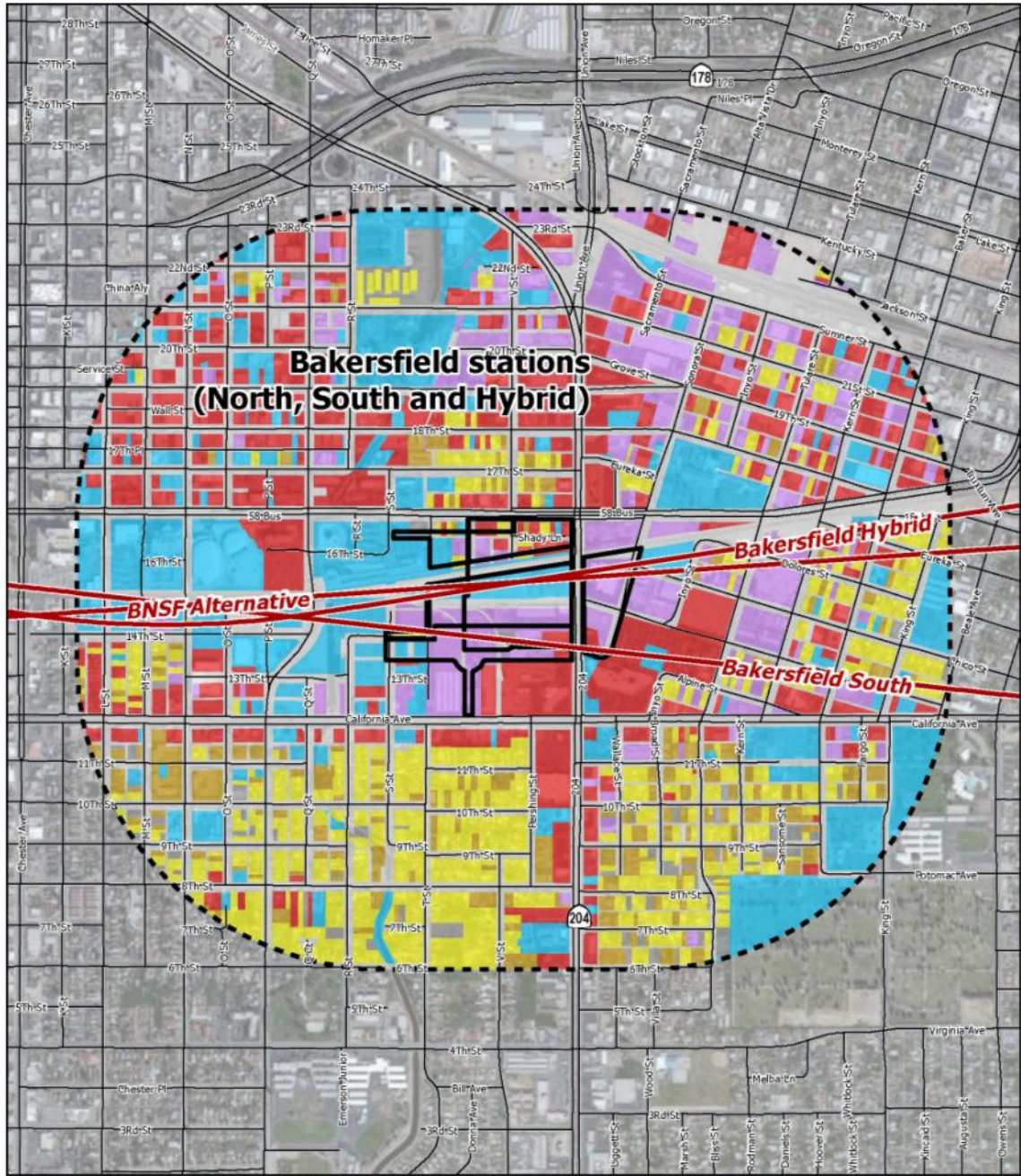


Source: URS/HMM/Arup JV, 2013; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009; City of Fresno, 2009
 Imagery source: ESRI
 October 25, 2013.



- | | | |
|-----------------------------|---------------------------|--------------------|
| Alternative alignments | Land use | Industrial |
| Footprint of station | Mobile home | Community facility |
| Half-mile buffer of station | Residential single-family | Agriculture |
| | Residential multi-family | Transportation |
| | Commercial | Uncategorized |

Figure 10
 Existing land use: Kings/Tulare Regional Station–West Alternative



Source: URS/HMM/Arup JV, 2013; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009; City of Fresno, 2009
 Imagery source: ESRI

October 25, 2013

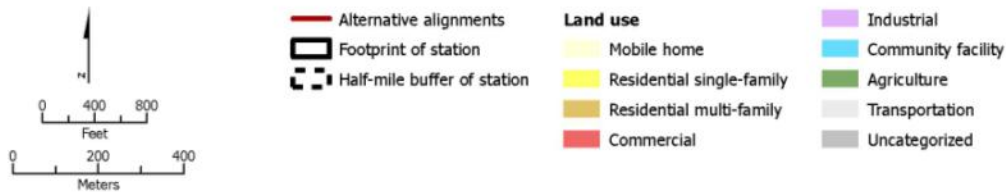


Figure 11
 Existing land use: Bakersfield stations

Table 1
 Water Demand Summary

Facility	Daily Employee and Passenger Use	Method	Facility Area	Use Factor (gal/day/1000 ft ²)	Use Factor (gal/capita/day)	Estimated Daily Volume (gal/day)	Annual Water Use (ac-ft/yr)	
Heavy Maintenance Facility	1,500 employees	1. BART data			31	46,500	52	
		2. Adjusted value			30	45,000	50	
		3. AWWA			137	205,500	230	
		Selected Value				45,000	50	
Fresno Station	8,400 passengers (2035 estimate)	1. Mariposa Alternative						
		Station (Office)	5,000 sf	150		750	0.8	
		Station (Concourse)	70,000 sf	20		1,400	1.6	
		Parking Structure	5.5 acres	5		1,200	1.3	
		Landscaping	1.0 acres			1,300	1.5	
		Total Consumption by Area						5.2
		2. Consumption by Person			5 gal/passenger	42,000	47	
Selected Value				42,000	47			
Kings/Tulare Regional Station	3,300 passengers (2035 estimate)	1. East Alternative						
		Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	35,000 sf	20		700	1	
		Parking Structure	0.0 acres	5		0	0	
		Landscaping	3.3 acres			4,500	5	
		Total Consumption by Area						7
		2. West Alternative, at-grade option						
		Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	101,000 sf	20		2,020	2	
		Parking Structure	3.5 acres	5		800	1	
		Landscaping	34.1 acres			45,600	51	
		Total Consumption by Area						55
		3. West Alternative, below-grade option						
		Station (Office)	5,000 sf	150		750	1	
Station (Concourse)	96,000 sf	20		1,920	2			

Table 1
 Water Demand Summary

Facility	Daily Employee and Passenger Use	Method	Facility Area	Use Factor (gal/day/1000 ft ²)	Use Factor (gal/capita/day)	Estimated Daily Volume (gal/day)	Annual Water Use (ac-ft/yr)	
Kings/Tulare Regional Station (cont.)		Parking Structure	3.7 acres	5		800	1	
		Landscaping	34.4 acres			46,000	52	
		Total Consumption by Area						55
		4. Consumption by Person			5 gal/passenger	16,500	18	
		Selected Value						55
Bakersfield Station	9,200 passengers (2035 estimate)	1. North Alternative						
		Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	47,000 sf	20		940	1	
		Parking Structure	7.5 acres	5		1,600	2	
		Landscaping	2.1 acres			2,800	3	
		Total Consumption by Area						7
		2. South Alternative						
		Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	46,000 sf	20		920	1	
		Parking Structure	5.0 acres	5		1,100	1	
		Landscaping	3.8 acres			5,000	6	
		Total Consumption by Area						9
		3. Hybrid Alternative						
		Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	57,500 sf	20		1,150	1	
		Parking Structure	4.5 acres	5		1,000	1	
		Landscaping	2.5 acres			3,300	4	
		Total Consumption by Area						7
		4. Consumption by Person				5 gal/passenger	46,000	52
		Selected Value					46,000	52
Total						204		

Table 1
 Water Demand Summary

Facility	Daily Employee and Passenger Use	Method	Facility Area	Use Factor (gal/day/1000 ft ²)	Use Factor (gal/capita/day)	Estimated Daily Volume (gal/day)	Annual Water Use (ac-ft/yr)
<p>Notes:</p> <ol style="list-style-type: none"> HMF water consumption would be the same regardless of which location is selected. HMF water consumption includes industrial, landscaping, and train washing uses. Selected value for HMF is based on actual data from a comparable facility. Selected value for stations is based on the methodology that resulted in the highest use. <p>Acronyms and Abbreviations:</p> <p>AWWA = American Water Works Association ac-ft/yr = acre-feet per year BART = Bay Area Rapid Transit gal = gallon HMF = heavy maintenance facility sf = square feet</p>							

Table 2
 Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Use ^{1,2} (ac-ft/yr)
BNSF Alternative				
117 miles	Concrete Work	184	564	113
	Earthwork	30	92	18
	Dust Control (tracks)	713	2,190	438
	Irrigation (tracks)	161	495	99
	Total	1,088	3,340	668
Hanford West Bypass 1				
28 miles	Concrete Work	26	80	16
	Earthwork	9	28	6
	Dust Control (tracks)	170	521	104
	Irrigation (tracks)	38	118	24
	Total	243	747	149 (169)
Hanford West Bypass 1 Modified				
28 miles	Concrete Work	34	105	21
	Earthwork	8	26	5
	Dust Control (tracks)	170	520	104
	Irrigation (tracks)	38	118	24
	Total	250	769	154 (169)
Hanford West Bypass 2				
28 miles	Concrete Work	29	90	18
	Earthwork	9	27	5
	Dust Control (tracks)	169	520	104
	Irrigation (tracks)	38	118	24
	Total	246	755	151 (169)

Table 2
 Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Use ^{1,2} (ac-ft/yr)
Hanford West Bypass 2 Modified				
28 miles	Concrete Work	37	114	23
	Earthwork	8	25	5
	Dust Control (tracks)	169	520	104
	Irrigation (tracks)	38	118	24
	Total	253	777	155 (169)
Corcoran Elevated				
10 miles	Concrete Work	32	98	20
	Earthwork	0.6	2	0.4
	Dust Control (tracks)	61	188	38
	Irrigation (tracks)	14	42	8
	Total	107	330	66 (59)
Corcoran Bypass				
10 miles	Concrete Work	13	40	8
	Earthwork	3	9	2
	Dust Control (tracks)	62	190	38
	Irrigation (tracks)	14	43	9
	Total	92	282	56 (59)
Allensworth Bypass				
21 miles	Concrete Work	19	57	11
	Earthwork	7	22	4
	Dust Control (tracks)	129	397	79
	Irrigation (tracks)	29	90	18
	Total	184	565	113 (112)

Table 2
 Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Use ^{1,2} (ac-ft/yr)
Wasco-Shafter Bypass				
21 miles	Concrete Work	22	68	14
	Earthwork	7	20	4
	Dust Control (tracks)	127	390	78
	Irrigation (tracks)	29	88	18
	Total	185	567	113 (130)
Bakersfield South				
12 miles	Concrete Work	39	118	24
	Earthwork	0.9	3	0.6
	Dust Control (tracks)	73	223	45
	Irrigation (tracks)	16	50	10
	Total	129	394	79 (79)
Bakersfield Hybrid				
12 miles	Concrete Work	39	119	24
	Earthwork	0.9	3	0.6
	Dust Control (tracks)	73	224	45
	Irrigation (tracks)	17	51	10
	Total	129	397	79 (79)
Heavy Maintenance Facility				
150 acres	Concrete Work	12	36	7
	Dust Control	168	516	103
	Irrigation	6	19	4
	Total	186	570	114
Fresno Station				
20.5 acres	Concrete Work ³	6	18	4
	Dust Control	23	70	14
	Irrigation	0.2	0.5	0.1
	Total	29	89	18

Table 2
 Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Use ^{1,2} (ac-ft/yr)
Kings/Tulare Station – East Alternative				
25 acres	Concrete Work ³	6	18	4
	Dust Control	28	87	17
	Irrigation	0.5	2	0.3
	Total	35	106	21
Kings/Tulare Station – West Alternative, at-grade				
48 acres	Concrete Work ³	6	18	4
	Dust Control	54	166	33
	Irrigation	6	17	3
	Total	65	201	40
Kings/Tulare Station – West Alternative, below-grade				
48 acres	Concrete Work ³	6	18	4
	Dust Control	54	166	33
	Irrigation	6	17	3
	Total	66	201	40
Bakersfield Station – North Alternative				
19 acres	Concrete Work ³	6	18	4
	Dust Control	21	65	13
	Irrigation	0.3	1	0.2
	Total	27	84	17
Bakersfield Station – South Alternative				
20 acres	Concrete Work ³	6	18	4
	Dust Control	22	69	14
	Irrigation	0.6	2	0.4
	Total	29	88	18

Table 2
 Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (acre-feet)	Annualized Water Use ^{1,2} (ac-ft/yr)
Bakersfield Station – Hybrid Alternative				
24 acres	Concrete Work ³	6	18	4
	Dust Control	27	82	16
	Irrigation	0.4	1	0.2
	Total	33	102	20
Maximum Use Total				868
Notes: 1. Annualized water use is for a 5-year construction period. 2. Equivalent numbers for the corresponding segments of the BNSF Alternative are presented in parentheses. 3. Concrete volume for stations was estimated by structure footprints and building characteristics. Acronyms and Abbreviations: ac-ft/yr = acre-feet per year MG = million gallons.				

Table 3A
 Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (acres)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
Fresno Works – Fresno HMF Site	Single-Family	29	3.5	100	Fresno ID (ag) City of Fresno (non-ag)
	Commercial	0	1.9	0	
	Industrial	115	1.9	219	
	Institutional	0	1.9	0	
	Agricultural ²	345	3.0	1,035	
	Roadways/Right-of-way/No Data ³	28	1.9	53	
	Unknown ⁴	69	2.7	189	
Total		586	—	1,596	
Kings County – Hanford HMF Site	Single-Family	0	3.5	0	Kings County WD Lakeside Irrigation WD Note: Kaweah Delta Water Conservation District does not supply water to users, but looks for opportunities to maintain and recharge groundwater
	Commercial	0	1.9	0	
	Industrial	3	1.9	5	
	Institutional	0	1.9	0	
	Agricultural ²	506	3.2	1,618	
	Roadways/Right-of-way/No Data ³	3	1.9	6	
	Unknown ⁴	0	3.2	0	
Total		512	—	1,630	

Table 3A
 Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (acres)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
Kern Council of Governments – Wasco HMF Site	Single-Family	0	3.5	2	North Kern WSD Shafter-Wasco WSD City of Wasco WSA (non-ag only)
	Commercial ⁵	0	1.0	0	
	Industrial ⁶	1	1.0	1	
	Institutional	0	1.9	0	
	Agricultural ⁷	407	4.2	1,689	
	Roadways/Right-of-way/No Data ³	1	1.9	1	
	Unknown ⁴	6	4.1	26	
	Total		416	—	
Kern Council of Governments – Shafter East HMF Site	Single-Family	0	3.5	0	North Kern WSD Shafter-Wasco WSD
	Commercial	0	1.9	0	
	Industrial	56	1.9	107	
	Institutional	0	1.9	0	
	Agricultural ⁸	424	4.0	1,694	
	Roadways/Right-of-way/No Data ³	6	1.9	11	
	Unknown ⁴	9	3.7	33	
	Total		495	—	

Table 3A
 Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (acres)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
Kern Council of Governments – Shafter West HMF Site	Single-Family	2	3.5	8	North Kern WSD Shafter-Wasco WSD
	Commercial	0	1.9	0	
	Industrial	9	1.9	17	
	Institutional	0	1.9	0	
	Agricultural ⁸	439	4.0	1,754	
	Roadways/Right-of-way/No Data ³	0	1.9	0	
	Unknown ⁴	26	4.0	104	
	Total		476	—	

Table 3A
 Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (acres)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
<p>Notes:</p> <ol style="list-style-type: none"> 1. Water use factors taken from the City of Fresno Urban Water Management Plan (City of Fresno 2008), Table 6.4 (2010 projections), except as noted otherwise. 2. Water use factors for agricultural land uses derived from California DWR Irrigated Crop Acres and Water Use information by County (2001 data), due to lack of site specific water use data for these sites. See Table 4 for more details. A county-specific average for all crop types was used, as sites appear to be within crop rotation cycle, rather than permanent plantings. 3. No water use factors were available for Roadways/Right-of-way/No Data land uses, therefore an estimated water use factor of 1.9 was applied, as it seemed likely that water use on such land parcels would not be more than it would for commercial, industrial or institutional land uses. 4. No water use factors were available for Unknown land uses; therefore an average water use factor was calculated, based on a weighted average reflecting the area of known land uses within the specific station footprint being analyzed. 5. Water use factor for commercial land use at this site based on information provided by the City of Wasco (Allen, 2011, personal communication). 6. Water use factor for industrial land use at this site based on information provided by the Shafter-Wasco Irrigation District (Ezell, 2011, personal communication). 7. Water use factor for agricultural land use at this site based on information provided by the Shafter-Wasco Irrigation District, from his discussions with landowners (Ezell, 2011, personal communication). 8. Water use factor for agricultural land use at this site based on information provided by the Shafter-Wasco Irrigation District (Ezell, 2011, personal Communication) and the North Kern Water Storage District (Munn, 2011, personal communication) regarding the water needs of almonds. <p>Acronyms and Abbreviations: ac-ft/ac/yr = acre-feet per acre per year ac-ft/yr = acre-feet per year ag = agriculture ID = Irrigation District WD = water district WSA = water supply assessment WSD = water service district</p>					

Table 3B
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)
BNSF Alternative ⁵	Single-Family	132	3.5	463
	Multi-Family	10	6.2	60
	Commercial	70	1.9	133
	Industrial	179	1.9	340
	Institutional	334	1.9	635
	Agricultural ²			
	- Fresno County	617	3	1,852
	- Kings County	765	3.2	2,449
	- Tulare County	682	3.5	2,388
	- Kern County	832	3.3	2,747
	Roadways/Right-of-way/No Data ³	618	1.9	1,175
	Unknown ⁴	523	2.9	1,509
	Total	4,763	—	13,750

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
Hanford West Bypass 1 ⁶	Single-Family	35	28	8	3.5	124	27
	Multi-Family	1	2	-1	6.2	7	-4
	Commercial	0	2	-2	1.9	1	-3
	Industrial	12	14	-1	1.9	24	-2
	Institutional	31	58	-27	1.9	58	-52
	Agricultural ²						
	- Fresno County	128	239	-111	3	384	-333
	- Kings County	519	670	-152	3.2	1,660	-485
	Roadways/Right-of-way/No Data ³	102	127	-26	1.9	193	-49
	Unknown ⁴	126	107	20	3.0	373	58
	Total	955	1,246	-292	—	2,824	-843
Hanford West Bypass 1 Modified ⁶	Single-Family	44	28	17	3.5	155	59
	Multi-Family	2	2	0	6.2	14	3
	Commercial	0	2	-2	1.9	0	-4
	Industrial	13	14	0	1.9	25	-1
	Institutional	26	58	-32	1.9	50	-60
	Agricultural ²						
	- Fresno County	132	239	-106	3	397	-319
	- Kings County	578	670	-92	3.2	1,850	-295
	Roadways/Right-of-way/No Data ³	90	127	-37	1.9	171	-71
	Unknown ⁴	131	107	25	3.0	394	74
	Total	1,018	1,246	-228	—	3,057	-615

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
Hanford West Bypass 2 ⁶	Single-Family	33	28	6	3.5	116	20
	Multi-Family	1	2	-1	6.2	7	-4
	Commercial	4	2	2	1.9	8	5
	Industrial	11	14	-3	1.9	21	-5
	Institutional	72	58	14	1.9	137	27
	Agricultural ²						
	- Fresno County	128	239	-111	3	384	-333
	- Kings County	487	670	-183	3.2	1,560	-585
	Roadways/Right-of-way/No Data ³	96	127	-31	1.9	182	-60
	Unknown ⁴	125	107	19	2.9	363	54
	Total	958	1,246	-288	—	2,779	-882
Hanford West Bypass 2 Modified ⁶	Single-Family	44	28	17	3.5	155	59
	Multi-Family	2	2	0	6.2	14	3
	Commercial	5	2	3	1.9	10	6
	Industrial	11	14	-2	1.9	22	-4
	Institutional	92	58	34	1.9	175	65
	Agricultural ²						
	- Fresno County	132	239	-106	3	397	-319
	- Kings County	587	670	-84	3.2	1,877	-268
	Roadways/Right-of-way/No Data ³	99	127	-28	1.9	188	-54
	Unknown ⁴	130	107	24	2.9	380	69
	Total	1,104	1,246	-142	—	3,219	-444

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
Corcoran Elevated ⁶	Single-Family	3	3	0	3.5	9	0
	Multi-Family	0	1	-1	6.2	0	-7
	Commercial	26	18	8	1.9	49	16
	Industrial	21	28	-8	1.9	39	-15
	Institutional	69	30	40	1.9	132	75
	Agricultural ²						
	- Kings County	118	95	23	3.2	378	74
	- Tulare County	108	197	-89	3.5	379	-310
	Roadways/Right-of-way/No Data ³	84	50	34	1.9	159	64
	Unknown ⁴	11	17	-6	2.7	30	-15
	Total	440	438	2	—	1,175	-117
Corcoran Bypass ⁶	Single-Family	13	3	10	3.5	44	36
	Multi-Family	3	1	2	6.2	18	11
	Commercial	2	18	-16	1.9	4	-30
	Industrial	7	28	-22	1.9	13	-42
	Institutional	88	30	58	1.9	167	110
	Agricultural ²						
	- Kings County	196	95	101	3.2	626	322
	- Tulare County	101	197	-96	3.5	353	-336
	Roadways/Right-of-way/No Data ³	51	50	2	1.9	97	3
	Unknown ⁴	20	17	4	2.9	59	10
	Total	481	438	42	—	1,382	86

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
Allensworth Bypass ⁶	Single-Family	1	14	-13	3.5	5	-44
	Multi-Family	0	0	0	6.2	0	0
	Commercial	0	0	0	1.9	0	0
	Industrial	0	0	0	1.9	0	0
	Institutional	44	41	2	1.9	83	5
	Agricultural ²						
	– Tulare County	237	249	-12	3.5	829	-43
	– Kern County	250	215	35	3.3	824	115
	Roadways/Right-of-way/No Data ³	34	83	-48	1.9	65	-92
	Unknown ⁴	25	69	-45	3.2	79	-142
Total	591	672	-81	—	1,885	-202	
Wasco-Shafter Bypass ⁶	Single-Family	18	31	-13	3.5	64	-46
	Multi-Family	0	1	-1	6.2	0	-3
	Commercial	12	20	-8	1.9	22	-15
	Industrial	2	46	-44	1.9	3	-84
	Institutional	26	87	-61	1.9	50	-116
	Agricultural ²						
	- Kern County	555	611	-55	3.3	1,833	-182
	Roadways/Right-of-way/No Data ³	116	142	-26	1.9	221	-49
	Unknown ⁴	11	59	-48	3.0	34	-144
Total	741	997	-256	—	2,228	-639	

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
Bakersfield South ⁶	Single-Family	35	35	1	3.5	123	2
	Multi-Family	7	6	1	6.2	45	9
	Commercial	21	16	5	1.9	39	9
	Industrial	18	20	-2	1.9	35	-4
	Institutional	36	113	-77	1.9	69	-146
	Agricultural ²						
	- Kern County	12	7	5	3.3	39	17
	Roadways/Right-of-way/No Data ³	83	60	24	1.9	158	45
	Unknown ⁴	78	64	14	2.4	185	33
	Total	291	320	-29	—	695	-35
Bakersfield Hybrid ⁶	Single-Family	32	35	-2	3.5	113	-8
	Multi-Family	5	6	-1	6.2	28	-8
	Commercial	18	16	2	1.9	34	3
	Industrial	19	20	-1	1.9	36	-3
	Institutional	40	113	-73	1.9	76	-140
	Agricultural ²						
	- Kern County	12	7	5	3.3	39	17
	Roadways/Right-of-way/No Data ³	72	60	12	1.9	137	24
	Unknown ⁴	75	64	11	2.3	176	26
	Total	272	320	-48	—	638	-88

Table 3B (cont.)
 Existing Water Use – Track Alignment Alternatives

Track Alignment Alternative	Current Land Use	Acres (Bypass Route)	Acres (corresponding BNSF segment)	Acres (Difference between BNSF & Bypass)	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use - Bypass Route (ac-ft/yr)	Change in Annual Water Use (compared to BNSF segment) (ac-ft/yr)
<p>Notes:</p> <ol style="list-style-type: none"> Water use factors taken from the City of Fresno Urban Water Management Plan (City of Fresno 2008), Table 6.4 (2010 projections), except for Agricultural, Roadways of-way/No Data, and Unknown land uses. Water use factors for agricultural land uses derived from California DWR Irrigated Crop Acres and Water Use information by County (2001 data). See Table 4 for more details. A county-specific weighted average for all crop types was used. No water use factors were available for Roadways/Right-of-way/No Data land uses, therefore an estimated water use factor of 1.9 was applied, as it seemed likely that water use on such land parcels would not be more than it would for commercial, industrial or institutional land uses. No water use factors were available for Unknown land uses, therefore an average water use factor was calculated, based on a weighted average reflecting the area of known land uses within the specific station footprint being analyzed. Figures represent total acreage for entire track alignment between Fresno and Bakersfield. Figures represent difference in acreage between bypass and equivalent section of BNSF Alternative. <p>Acronyms and Abbreviations: ac-ft/ac/yr = acre-feet per acre per year ac-ft/yr = acre-feet per year</p>							

Table 3C
 Existing Water Use – Stations

Station Site	Current Land Use	Acres	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)
Fresno Station	Single-Family	0	3.5	0
	Multi-Family	0	6.2	0
	Commercial	2	1.9	4
	Industrial	2	1.9	4
	Institutional	0	1.9	0
	Agricultural ²	0	3	0
	Roadways/Right-of-way/No Data ³	1.4	1.9	3
	Unknown ⁴	15	1.9	28
	Subtotal	20	—	39
Kings/Tulare Regional Station – East Alternative	Single-Family	0	3.5	0
	Multi-Family	0	6.2	0
	Commercial	0	1.9	0
	Industrial	0	1.9	0
	Institutional	0	1.9	0
	Agricultural ²	25	3.2	79
	Roadways/Right-of-way/No Data ³	0	1.9	0
	Unknown ⁴	0	3.2	0
	Subtotal	25	—	80
Kings Tulare Regional Station – West Alternative, at-grade option	Single-Family	0	3.5	0
	Multi-Family	0	6.2	0
	Commercial	0	1.9	0
	Industrial	5	1.9	9
	Institutional	0.7	1.9	1.3
	Agricultural ²	43	3.2	137
	Roadways/Right-of-way/No Data ³	0	1.9	0
	Unknown ⁴	0	3.1	0
	Subtotal	48	—	147
Kings Tulare Regional Station – West Alternative, below-grade option	Single-Family	0	3.5	0
	Multi-Family	0	6.2	0
	Commercial	0	1.9	0
	Industrial	5	1.9	9
	Institutional	0.7	1.9	1.3
	Agricultural ²	43	3.2	137
	Roadways/Right-of-way/No Data ³	0	1.9	0
	Unknown ⁴	0	3.1	0
	Subtotal	48	—	147

Table 3C (cont.)
 Existing Water Use - Stations

Station Site	Current Land Use	Acres	Water Use Factors ¹ (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)
Bakersfield Station - North Alternative	Single-Family	1	3.5	2
	Multi-Family	0.1	6.2	0.8
	Commercial	2	1.9	4
	Industrial	5	1.9	10
	Institutional	6	1.9	11
	Agricultural ²	0	3.3	0
	Roadways/Right-of-way/No Data ³	4	1.9	7
	Unknown ⁴	2	2.0	3
	Subtotal	19	—	38
Bakersfield Station – South Alternative	Single-Family	0	3.5	0
	Multi-Family	0	6.2	0
	Commercial	1	1.9	2
	Industrial	10	1.9	18
	Institutional	5	1.9	10
	Agricultural ²	0	3.3	0
	Roadways/Right-of-way/No Data ³	3	1.9	5
	Unknown ⁴	1	1.9	3
	Subtotal	20	—	38
Bakersfield Station – Hybrid Alternative	Single-Family	1	3.5	2
	Multi-Family	0.1	6.2	0.8
	Commercial	3	1.9	6
	Industrial	8	1.9	15
	Institutional	4	1.9	8
	Agricultural ²	0	3.3	0
	Roadways/Right-of-way/No Data ³	4	1.9	7
	Unknown ⁴	5	2.0	9
	Subtotal	24	—	48

Notes:

1. Water use factors taken from the City of Fresno Urban Water Management Plan (City of Fresno 2008), Table 6.4 (2010 projections), except for Agricultural, Roadways/Right-of-way/No Data, and Unknown land uses.
2. Water use factors for agricultural land uses derived from California DWR Irrigated Crop Acres and Water Use information by county (2001 data). See Table 4 for more details. A county-specific average for all crop types was used.
3. No water use factors were available for Roadways/Right-of-way/No Data land uses, therefore an estimated water use factor of 1.9 was applied, as it seemed likely that water use on such land parcels would not be more than it would for commercial, industrial or institutional land uses.
4. No water use factors were available for Unknown land uses; therefore, an average water use factor was calculated, based on a weighted average reflecting the area of known land uses within the specific station footprint being analyzed.

Acronyms and Abbreviations:

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

Table 4
 Crop Water Use

Crop Type	Fresno County		Kern County		Kings County		Tulare County	
	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area
Grain	1.6	5.5	1.4	11.1	1.8	21.0	1.9	12.1
Rice	5.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Cotton	3.0	24.0	3.1	18.1	3.3	37.3	3.3	10.6
SgrBeet	3.0	1.0	2.5	0.4	2.4	0.4	2.5	0.2
Corn	3.0	2.4	3.7	7.1	3.3	10.3	3.6	15.5
DryBean	2.3	1.5	3.4	0.6	2.5	0.9	3.5	0.9
Safflwr	1.3	0.2	1.7	0.5	1.7	2.9	1.8	0.3
Oth Fld	2.9	0.2	3.1	1.5	2.8	1.6	3.3	1.1
Alfalfa	4.9	9.5	5.1	13.5	5.2	12.6	5.4	12.6
Pasture	4.8	1.4	4.9	0.5	4.9	0.8	5.3	0.7
Pr Tom	2.5	8.2	3.3	1.1	3.0	1.2	3.4	0.2
Fr Tom	2.4	0.6	2.8	0.1	2.8	0.0	2.9	0.2
Cucurb	2.4	2.8	2.8	0.7	2.6	0.2	2.7	0.2
On Gar	3.1	2.7	3.8	1.0	4.1	0.1	4.2	0.2
Potato	2.3	0.0	2.4	2.1	0.0	0.0	2.3	0.1
Oth Trk	1.6	4.1	1.7	5.1	1.4	1.1	1.8	1.3
Al Pist	3.6	7.4	3.8	18.5	4.2	3.9	4.1	3.8
Oth Dec	3.9	5.4	3.6	2.7	4.1	4.0	3.9	12.7
Subtrop A	3.0	2.8	3.6	5.2	3.5	0.2	3.3	17.8
Vine	2.5	19.6	2.7	10.2	2.6	1.3	2.8	9.4
Weighted Average	3.0	—	3.3	—	3.2	—	3.5	—

Table 4
 Crop Water Use

Crop Type	Fresno County		Kern County		Kings County		Tulare County	
	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area	Applied Water (ac-ft/ac)	Percentage of Total Irrigated Land Area
Source of data:	California Department of Water Resources (DWR), Irrigated Crop Acres and Water Use information by County (2001 data).							
Crop Acronym	Definition							
Grain	Wheat, barley, oats, miscellaneous grain and hay, and mixed grain and hay							
Rice	Rice and wild rice							
Cotton	Cotton							
SgrBeet	Sugar beets							
Corn	Corn (field and sweet)							
DryBean	Beans (dry)							
Safflwr	Safflower							
OthFld	Flax, hops, grain sorghum, sudan, castor beans, miscellaneous fields, sunflowers, hybrid sorghum / sudan, millet and sugar cane							
Alfalfa	Alfalfa and alfalfa mixtures							
Pasture	Clover, mixed pasture, native pastures, induced high water table native pasture, miscellaneous grasses, turf farms, bermuda grass, rye grass and klein grass							
Pro Tom	Tomatoes for processing							
Fr Tom	Tomatoes for market							
Cucurb	Melons, squash and cucumbers							
On Gar	Onions and garlic							
Potato	Potatoes							
Oth Trk	Artichokes, asparagus, beans (green), carrots, celery, lettuce, peas, spinach, flowers nursery and tree farms, bush berries, strawberries, peppers, broccoli, cabbage, cauliflower and Brussels sprouts							
Al Pist	Almonds and pistachios							
Oth Dec	Apples, apricots, cherries, peaches, nectarines, pears, plums, prunes, figs, walnuts and miscellaneous deciduous							
Subtrop	Grapefruit, lemons, oranges, dates, avocados, olives, kiwis, jojoba, eucalyptus and miscellaneous subtropical fruit							
Vine	Table grapes, wine grapes and raisin grapes							
Acronyms and Abbreviations: ac-ft/ac = acre-feet per acre								

Table 5
 Water Use Summary

Facility Type	Facility Name	Annual Water Use (acre-feet)
Existing Water Use		
Track Alignment ⁴	BNSF Alternative	13,750
	Hanford West Bypass 1	2824 (3667)
	Hanford West Bypass 1 Modified	3057 (3672)
	Hanford West Bypass 2	2779 (3660)
	Hanford West Bypass 2 Modified	3219 (3662)
	Corcoran Elevated	1175 (1293)
	Corcoran Bypass	1382 (1296)
	Allensworth Bypass	1885 (2087)
	Wasco-Shafter Bypass	2228 (2867)
	Bakersfield South	695 (730)
	Bakersfield Hybrid	638 (727)
HMF (150 acres)	Fresno Works – Fresno	408
	Kings County – Hanford	478
	Kern Council of Governments – Wasco	620
	Kern Council of Governments – Shafter East	560
	Kern Council of Governments – Shafter West	593
Stations	Fresno Station-Mariposa Alternative	39
	Kings/Tulare Regional Station – East Alternative	80
	Kings/Tulare Regional Station – West Alternative, at-grade option	147
	Kings/Tulare Regional Station – West Alternative, below-grade option	147
	Bakersfield Station–North Alternative	38
	Bakersfield Station–South Alternative	38
	Bakersfield Station–Hybrid Alternative	48
Maximum Use Total ¹		14,689
Construction Water Use²		
Track Alignment ⁴	BNSF Alternative	668
	Hanford West Bypass 1	149 (169)
	Hanford West Bypass 1 Modified	154 (169)
	Hanford West Bypass 2	151 (169)
	Hanford West Bypass 2 Modified	155 (169)
	Corcoran Elevated	66 (59)
	Corcoran Bypass	56 (59)
	Allensworth Bypass	113 (112)
	Wasco-Shafter Bypass	113 (130)
	Bakersfield South	79 (79)
	Bakersfield Hybrid	79 (79)

Table 5
 Water Use Summary

Facility Type	Facility Name	Annual Water Use (acre-feet)
HMF Stations	HMF (one location ³)	114
	Fresno Station	18
	Kings/Tulare Regional Station - East Alternative	21
	Kings/Tulare Regional Station - West Alternative, at-grade option	40
	Kings/Tulare Regional Station - West Alternative, below-grade option	40
	Bakersfield Station-North Alternative	17
	Bakersfield Station-South Alternative	18
	Bakersfield Station-Hybrid Alternative	20
Maximum Use Total ¹		868
Estimated Water Use – 2035 at 100% Build-Out		
HMF Stations	HMF (one location ³)	50
	Fresno Station	47
	Kings/Tulare Regional Station	55
	Bakersfield Station	52
Total		204
Notes: 1. Maximum Use Total utilizes the combination of facility alternatives with the highest demand. 2. Construction water is annualized for a 5-year construction period. 3. Heavy Maintenance Facility water demand would be the same regardless of location. 4. Equivalent numbers for the corresponding segments of the BNSF Alternative are presented in parenthesis.		