

Appendix 3.6-B
Technical Memorandum: Water Usage
Analysis for CHST Fresno to Bakersfield
Section

Draft Technical Memorandum

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Subject: Water Usage Analysis for CAHST
Fresno to Bakersfield Section

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 usage 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 114 to 115 miles long, depending on the alignment that is constructed. The major features that are to be part of the Fresno to Bakersfield Section include HST passenger stations in the cities of Fresno and Bakersfield and in the vicinity of Hanford (Kings/Tulare Regional Station), 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 usage were identified, those being the Fresno, Kings/Tulare Regional, and Bakersfield passenger stations and the one HMF that may be located in this section.

Water use factors were identified for the different facilities and estimated usage rates 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 usage was then evaluated for all five proposed HMF locations, the BNSF alternative alignment and four alternative track alignments, and at each station location. The existing water usage 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 five year construction period. 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 only 3% of the current water usage. Water usage will decrease at the track alignment, the HMF and the Kings/Tulare facility locations, but increase in the Fresno 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 within the FUWMP study area. Similarly, the Bakersfield Urban Water Management Plan (BUWMP) is an ongoing plan developed to meet water demand within the City of Bakersfield study area.

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 12 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 114 to 115 miles long, depending on the final alignment.

Major features of the Fresno to Bakersfield Section include the Fresno, Kings/Tulare Regional and Bakersfield passenger 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, five year construction period concluding in 2020. The annual water use estimate is based on full build-out in 2035.
- 4) Determined water usage of the existing uses at the sites/stations where the HST system would be constructed and operated. Parcel land use information was identified then county specific water usage rates developed from recent data were applied. In addition, the irrigation districts who supply water to the HMF sites were contacted for specific historical water usage 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 described 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, those being the Fresno, Kings/Tulare Regional, and Bakersfield passenger stations and the potential HMF.

Two potential locations are being evaluated for the Fresno station; both locations are within a few blocks of each other. The station configurations and footprints are similar at these locations. There are also two locations being evaluated for the Bakersfield station located within a few blocks of each other. Footprint and station building size are similar, but the overall layouts of the stations are dissimilar. There is only one location currently being evaluated for the Kings/Tulare Regional station.

One HMF will be located either as part of the Merced to Fresno section or as part of the Fresno to Bakersfield section. While it is not certain if an HMF will be included as part of the Fresno to Bakersfield section, this TM includes an analysis of the water usage associated with a HMF for completeness. Five potential locations for the HMF have been identified along the Fresno to Bakersfield section: Fresno Works – Fresno, Kings County – Hanford, Kern Council of Governments – Wasco, Kern Council of Governments – Shafter East, and Kern Council of Governments – Shafter West sites.

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 limit area associated with the five possible sites varies in size from 420 acres at the Kern Council of Governments – Wasco site to 590 acres at the Fresno Works – Fresno site. If there is a HMF located within the Fresno to Bakersfield section, a maintenance-of-way facility will likely be incorporated into the HMF. If an HMF is not located within 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 and 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 usage 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 usage. Therefore, no water usage analysis was performed for these facilities.

There are five alternative alignments. These alignments are referred to as the BNSF Alternative Alignment, Corcoran Bypass, Allensworth Bypass, Wasco-Shafter Bypass, and Bakersfield South. The bypass alignments and Bakersfield South correspond to only a segment of the overall BNSF alignment. 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, and
 - 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, 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 HMF site (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 adjusted the water usage factor for the HMF 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 appropriate for use in this analysis.

Passenger Stations - Several different 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 being applying gallons per capita per day (gpcpd) use factors to the estimated number of passengers. The factor used was 5 gpcpd for passengers.

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

The different water use factors and our 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

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 five 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 2-4), and for each of the station locations (Figure 5). 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 a HMF (Figure 6). 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 Alignment and each of the four bypass options track alternatives and the Corcoran elevated option. The predominant land use (almost 50%) for the BNSF alignment is agricultural, with roadways/right-of-way (ROW)/no data categories comprising nearly 25%, unknown land uses comprising nearly 13%, and industrial land use comprising just over 8%. The majority land use for all bypass alternatives along the HST Fresno-Bakersfield section is agricultural (68-82%), except for the urbanized Bakersfield South alternative. The Corcoran elevated option predominantly passes through areas of industrial and roadways/ROW/no data land use.

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 is 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 Appendix Table A1). 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/ROW/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 3C shows the water use factors applied to the BNSF Alternative and each of the five alternative alignments. Total annual water use for the BNSF Alternative alignment was calculated to be approximately 4,044 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:

- Corcoran Bypass: 901 ac-ft/yr (161 ac-ft/yr more than the corresponding segment on the BNSF alternative)
- Corcoran Elevated: 52 ac-ft/yr (27 ac-ft/yr less than the corresponding segment on the BNSF alternative)
- Allensworth Bypass: 832 ac-ft/yr (113 ac-ft/yr more than the corresponding segment on the BNSF alternative)
- Wasco-Shafter Bypass: 709 ac-ft/yr (172 ac-ft/yr more than the corresponding segment on the BNSF alternative)
- Bakersfield South: 248 ac-ft/yr (24 ac-ft/yr more than the corresponding segment on 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 – This prospective HMF site is located within Fresno County. The site is mainly agricultural (51%), with substantial areas of industrial (21%) and institutional (12%) land uses. Single-family residential, commercial, roadways/ROW/no data and unknown 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 A1) calculated from 2001 DWR data, as site-specific information regarding existing water use is related to surface water only, and does not account for supplemental water supply from groundwater (for which data is not available). It is understood from information provided by the Fresno Irrigation District (Bill Stretch, pers. comm. April 20, 2011) that water for non-agricultural 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 rated 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 approximately 1,500 ac-ft/yr (refer Table 3A). Hence, the water use factor within this area is 2.56 ac-ft/ac/yr, or 384 ac-ft/yr for a standard 150-ac site.

Kings County – Hanford – This prospective HMF site is located within Kings County, and is more than 98% agricultural. Industrial and roadways/ROW/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 A1) calculated from 2001 DWR data, as site-specific information regarding existing water use was related to surface water only and did not account for supplemental water supply by groundwater (for which data was not readily available). It is understood from initial discussions with Lakeside Irrigation Water District (Andrew Hemans, pers. comm., April 26, 2011) 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 (Andrew Hemans, pers. comm., April 26, 2011). Kings County Water District provides water to numerous private ditch companies who 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 511-acre site is approximately 1630 ac-ft/yr (refer Table 3A). Hence, the water use factor within this area is 3.19 ac-ft/ac/yr, or 477 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Wasco – 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/ROW/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 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 (Dana Munn, pers. comm., April 6, 2011), indicate that this area has historically been used to grow roses, but under the current economy, hay, grain and cotton are more commonly grown. Information provided by WSID (Jerry Ezell, pers. comm. April 14, 2011), 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-ac site is about 1700 ac-ft/yr (refer Table 3A). Hence, the water use factor within this area is 4.08 ac-ft/ac/yr, or 614 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Shafter East – This prospective HMF site is located within Kern County, immediately east of the proposed HST alignment and existing BNSF railroad. Over 97% of the HMF site is in agricultural use as permanent almond tree orchards, with small areas of industrial or “roadway/ROW/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 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 (Munn, pers. comm., April 6, 2011). 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-ac site is approximately 1955 ac-ft/yr (refer Table 3A). Hence, the water use factor within this area is 3.95 ac-ft/ac/yr, or 593 ac-ft/yr for a standard 150-acre site.

Kern Council of Governments – Shafter West - 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/ROW/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 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 within a NKWSD “improvement area” with an average of 1 ac-ft/ac delivery (Munn, pers. comm., April 6, 2011). 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 480-ac site is approximately 1895 ac-ft/yr (refer Table 3A). Hence, the water use factor within this area is 3.95 ac-ft/ac/yr, or 592 ac-ft/yr for a standard 150-ac site.

Since each site relies on-site groundwater supply well(s), it is reasonable to assume that groundwater would be the water supply source for each HMF facility. Well-head treatment systems would likely be employed to ensure 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 (Table 3B). For the proposed Kings/Tulare Regional (Hanford) station location, the majority of the affected area (99.9%) is within 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 7-9 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 3B.

Water use factors from the FUWMP, adopted in August 2008, were used. Urban Water Master 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* dated January 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.

Approximately 99% of the proposed Kings-Tulare Regional station site is 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 station site location, based on 2001 DWR data (see Table A1).

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

- Fresno Kern 34 ac-ft/yr
- Fresno Mariposa 42 ac-ft/yr
- Kings Tulare Regional 70 ac-ft/yr
- Bakersfield North 42 ac-ft/yr
- Bakersfield South 46 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 34 to 42 ac-ft/yr and estimated future demand is 47 ac-ft/yr.
- **Kings/Tulare Station** – Current estimated water usage is 70 ac-ft/yr and estimated future demand is 18 ac-ft/yr.
- **Bakersfield Station** – Current estimated water usage is 42 to 46 ac-ft/yr and estimated future demand is 52 ac-ft/yr.
- **Tracks alignments** – Estimated existing water usage for the BNSF alignment is 4,044 ac-ft/yr. The proposed increase in water usage (compared to the equivalent segment of the BNSF alignment) for each of the four bypass options ranged from 24 ac-ft/yr (Bakersfield South) to 172 ac-ft/yr (Wasco-Shafter), while the Corcoran elevated option results in approximately 27 ac-ft/yr less water usage from the equivalent segment of the BNSF alignment. No water usage associated with of the track alignments is anticipated. There will be no demand for water for landscaping, operation, or maintenance along the track alignment.
- **HMFs** – Current estimated water usage for the five HMF locations ranges from 1,500 ac-ft/yr (Kings County – Hanford HMF) to 1,956 ac-ft/yr (Kern Council of Governments – Shafter East HMF). 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 factor used to estimate the amount of concrete required for the track alignments, as provided by ARUP engineers, is 12.5 cubic yards of concrete per foot of elevated track. The total length of each alternative alignment and the length of elevated track for each alignment is as follows:

- The BNSF Alternative is 114 miles long with 22.1 miles of elevated track.
- Corcoran Elevated is 3.7 miles long, all elevated track.
- Corcoran Bypass is 19.5 miles long with 2.9 miles of elevated track.
- Allensworth Bypass is 21.7 miles long with 1.3 miles of elevated track.
- Wasco-Shafter Bypass is 20.3 miles long with 3.1 miles of elevated track.
- Bakersfield South is 9.4 miles long with 6.9 miles of elevated track.

This factor was used to estimate the amount of concrete required and then determine the amount of water to be used at concrete batch plants during track construction. Water demand was estimated at 31 gallons per cubic yard of concrete. The volume of earthwork required for the rail embankments was calculated based on length of at-grade track. Water demand for earthwork compaction was calculated for an optimum moisture content of 10 percent 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 a portion 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 from structure footprints and building characteristics described in the Fresno to Bakersfield Section Draft Environmental Impact Statement/Environmental Impact Report (EIR/EIS). The amount of water needed for concrete was estimated from the concrete demand. Water for dust control at the Fresno and Bakersfield stations was calculated for the duration of the construction schedule indicated in the Draft EIR/EIS. (The construction schedule for the Kings/Tulare station is similar.) 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 from the structure footprint and building characteristics described in the Draft EIR/EIS. Parking at the HMF consists of surface parking and not within concrete parking structures. Water for dust control was accounted for during all three phases of construction at the HMF: the test track assembly, the test track light maintenance facility, and construction of the HMF. Irrigation for seed germination was also calculated for a portion of the 150 acre HMF site. It was estimated that 25 percent of the HMF would be reseeded.

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 five year construction period. Specifically, we estimate that the water usage during the construction of the Fresno to Bakersfield HST section will be only 17% (900 ac-ft/yr needed for construction compared to 5,300 ac-ft/yr current existing water use) 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 use 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 utilize 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 Kings/Tulare Station is outside of the city of Hanford service area, and therefore the station would likely pump and treat groundwater for use as municipal 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). As the stations and HMF are expected to require less than 250 ac-ft/yr, water supply assessments will not be needed for these facilities, nor any other special action to secure water from the local agencies.

The heavy maintenance facility 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 municipal 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 alternative for the project is to utilize the groundwater supply. Although well improvements and treatment may be required this alternative would eliminate any costly connections such as pipelines to the adjacent water districts.

Conclusions

Construction of the Fresno to Bakersfield section of the HST will result in net decrease in annual water consumption to only 17% of the existing water usage for the project footprint; this information is summarized in Table 4.

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 only 3% of the current water usage. Water usage will decrease at the track alignment, the HMF and the Kings/Tulare facility locations, but increase in the Fresno 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 within the FUWMP study area. Similarly, the BUWMP is an ongoing plan developed to meet water demand within the City of Bakersfield study area.

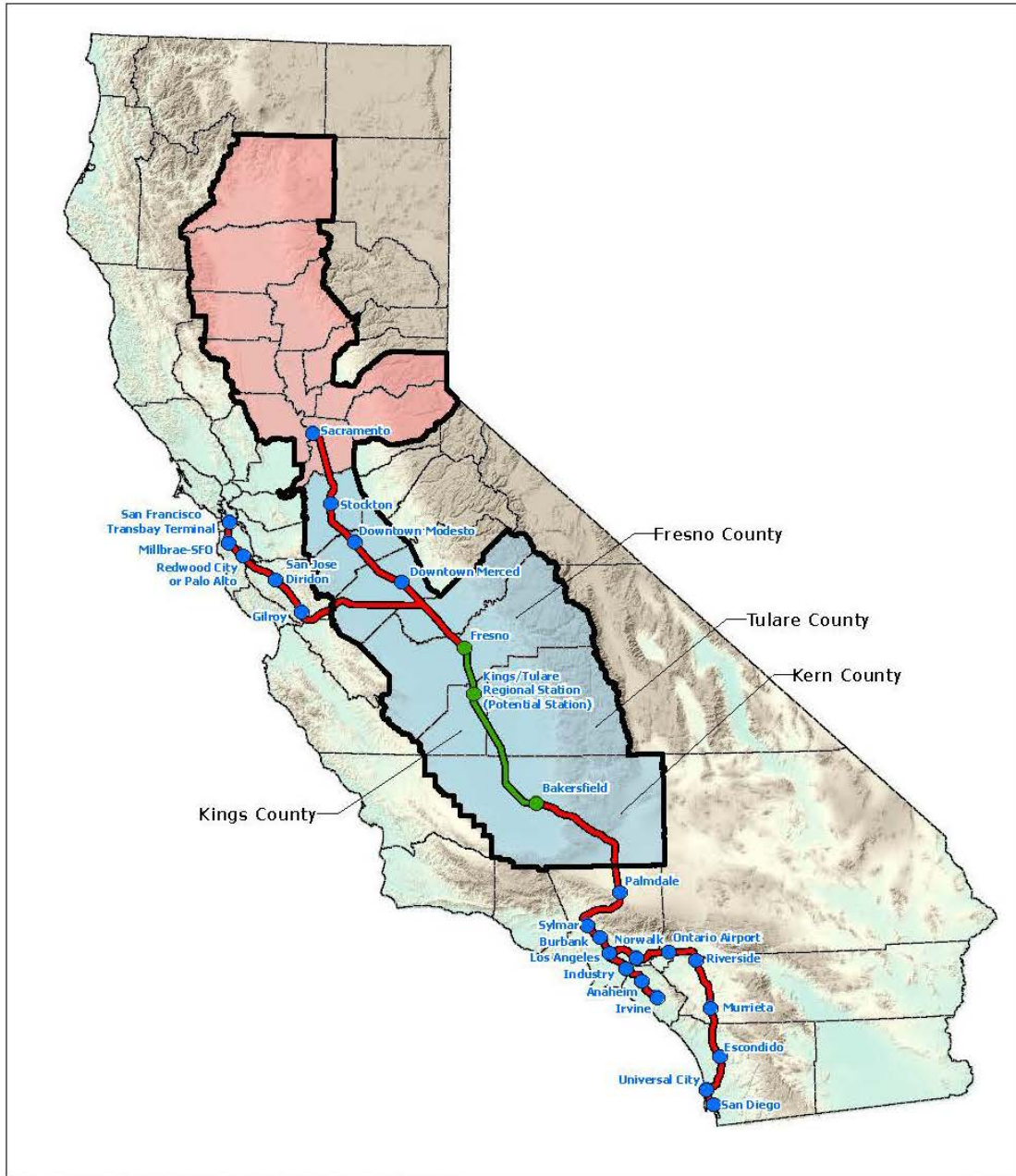
References

- American Water Works Association (AWWA), *Manual of Water Supply Practices M50*, 2001
- Bay Area Rapid Transit (BART), Hayward Maintenance Facility – Water Use Per Employee.
- City of Fresno, *Urban Water Management Plan*, West Yost Associates, August 2008.
- California Department of Water Resources (DWR), *Crop Water Use in California*, Bulletin 113-4, April 1986.
- California Department of Water Resources (DWR), Crop Water Use (DWR website), 2001.
- California High Speed Train Project - Fresno to Bakersfield Section EIR/EIS (draft)*, California High Speed Rail Authority, 2011.
- Los Angeles World Airports - Plumbing Criteria*, Syska Hennessy.
- Los Angeles International Airport Terminals Water Demand Master Plan*, 2005.
- Power Demand, Water, and Sewage Demand for Central Valley High Speed Train Stations*, Kate King – ARUP, August 6, 2010.
- Personal communication from Lauren Scammel – ARUP with attached file, *15% CCE Draft Quantities – Concrete Demand.xlsx*, April 12th 2011
- Water Supply and Pollution Control*, 4th ed., Viessman Jr, Warren and Hammer, Mark J, 1985.
- Western Farm Press, *California's Water Supply and Demand*, UC Davis, February 26, 2010.

APPENDICES

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PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2010

April 27, 2011

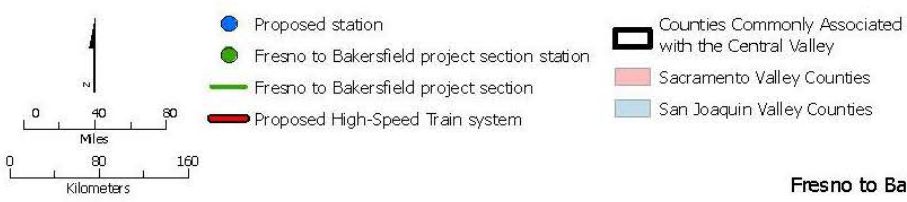
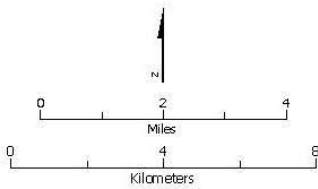
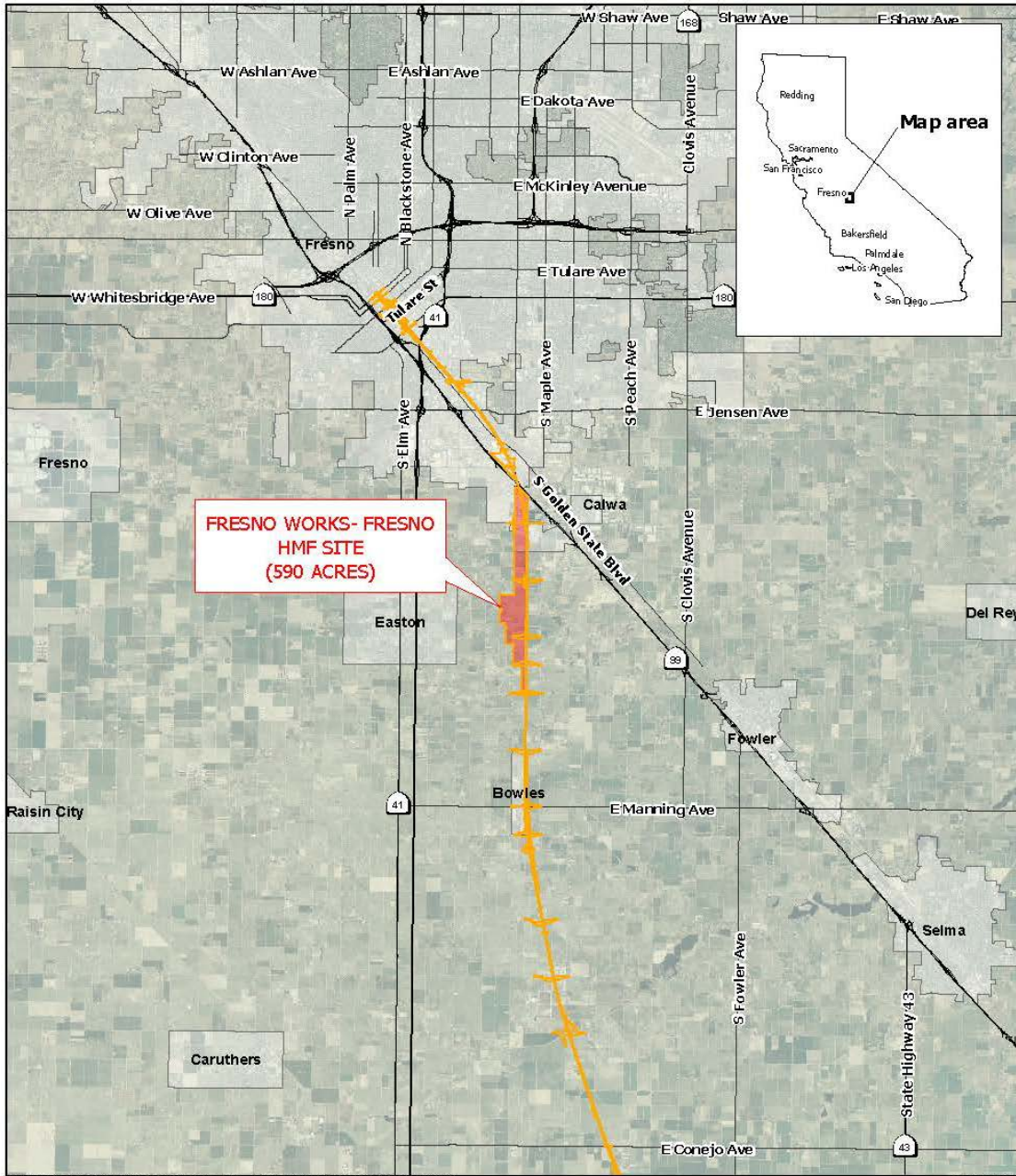
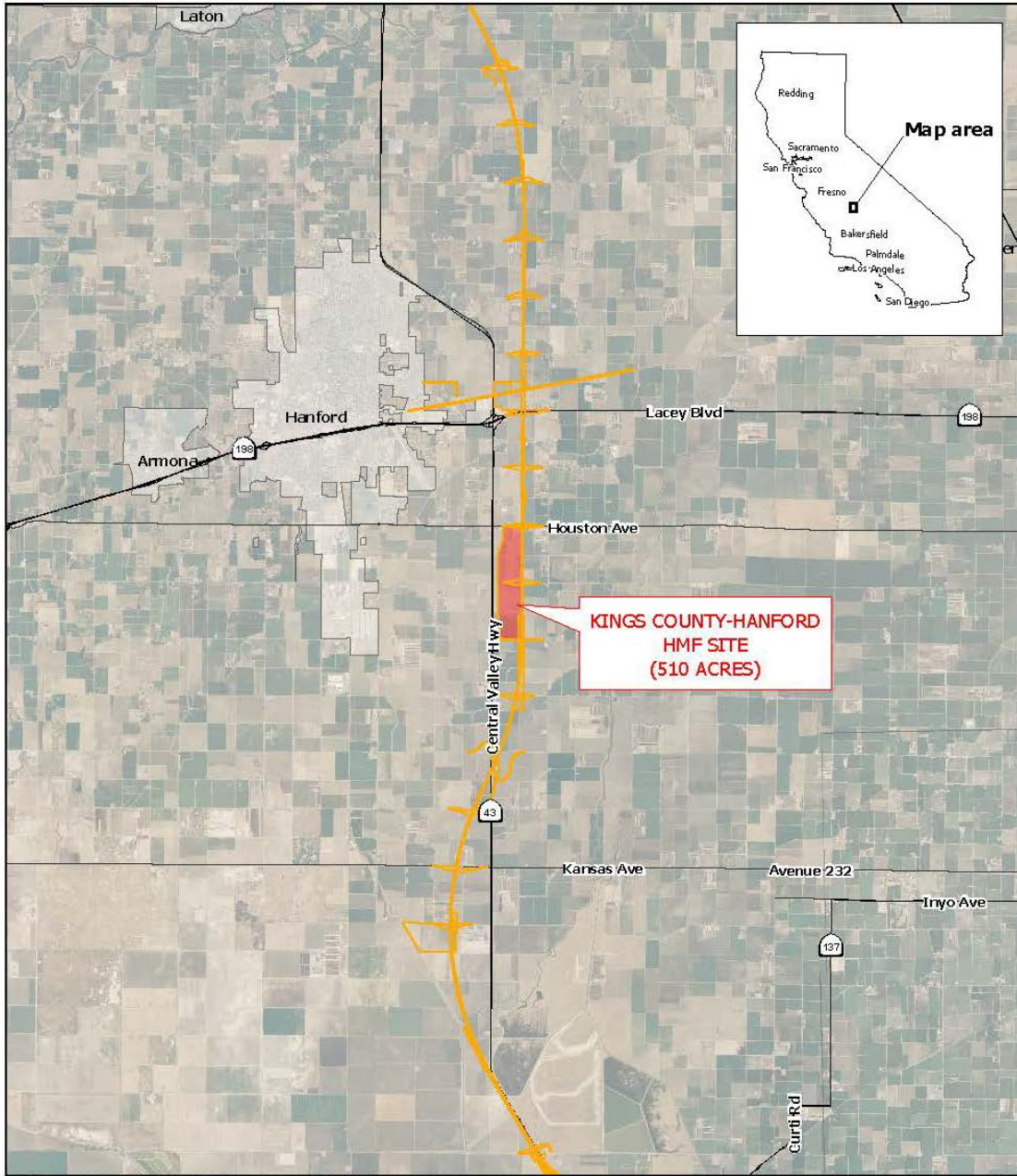


Figure 1
 Fresno to Bakersfield HST Section



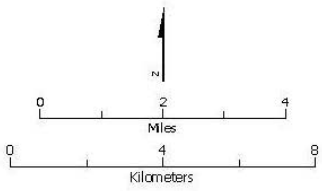
- Heavy maintenance facility
- Impact footprint
- Road

Figure 2
Proposed Fresno Works-Fresno HMF Site



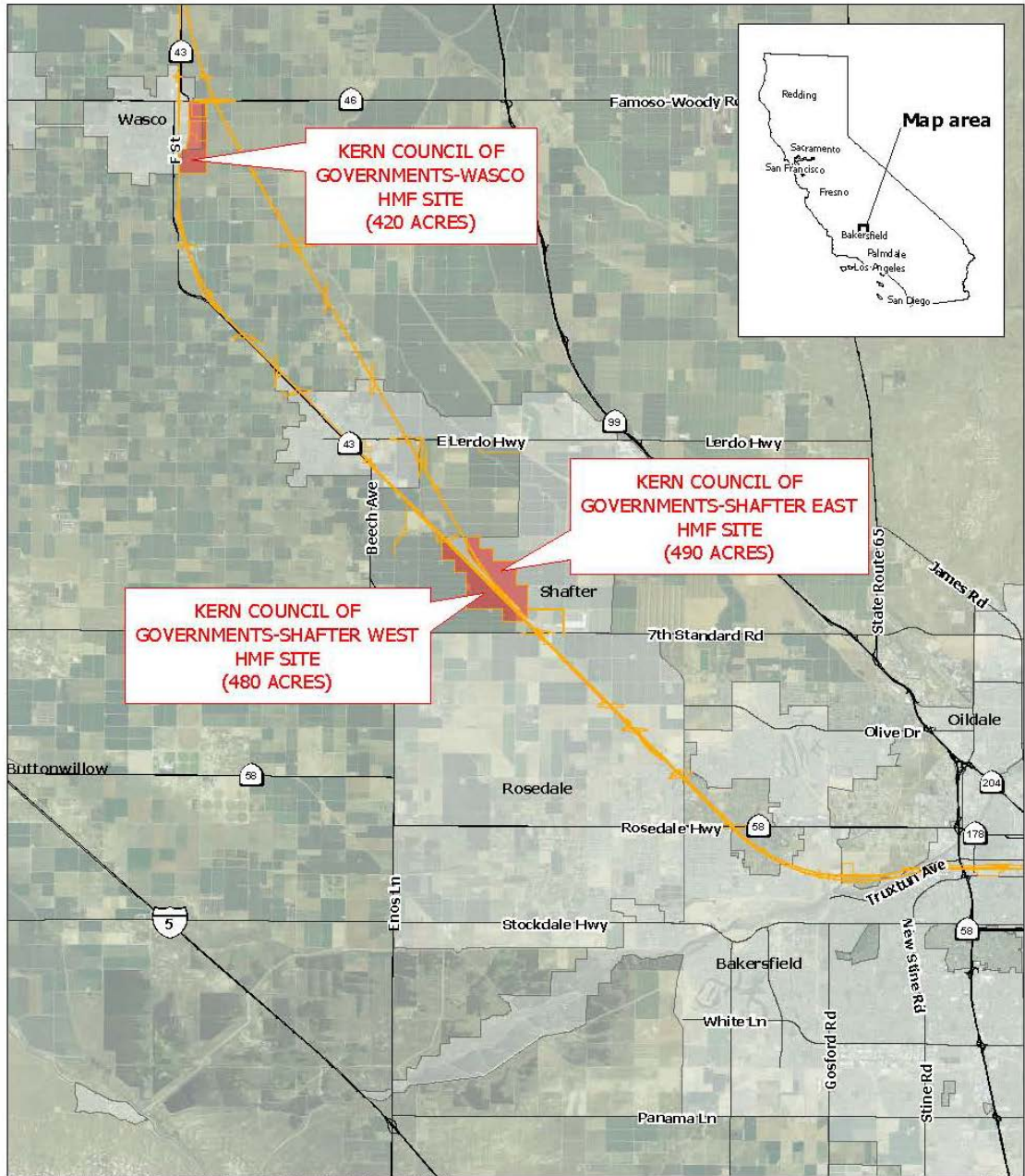
PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2010

April 27, 2011



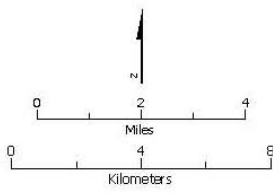
- Heavy maintenance facility
- Impact footprint
- Road

Figure 3
 Proposed Kings County-Hanford HMF Site



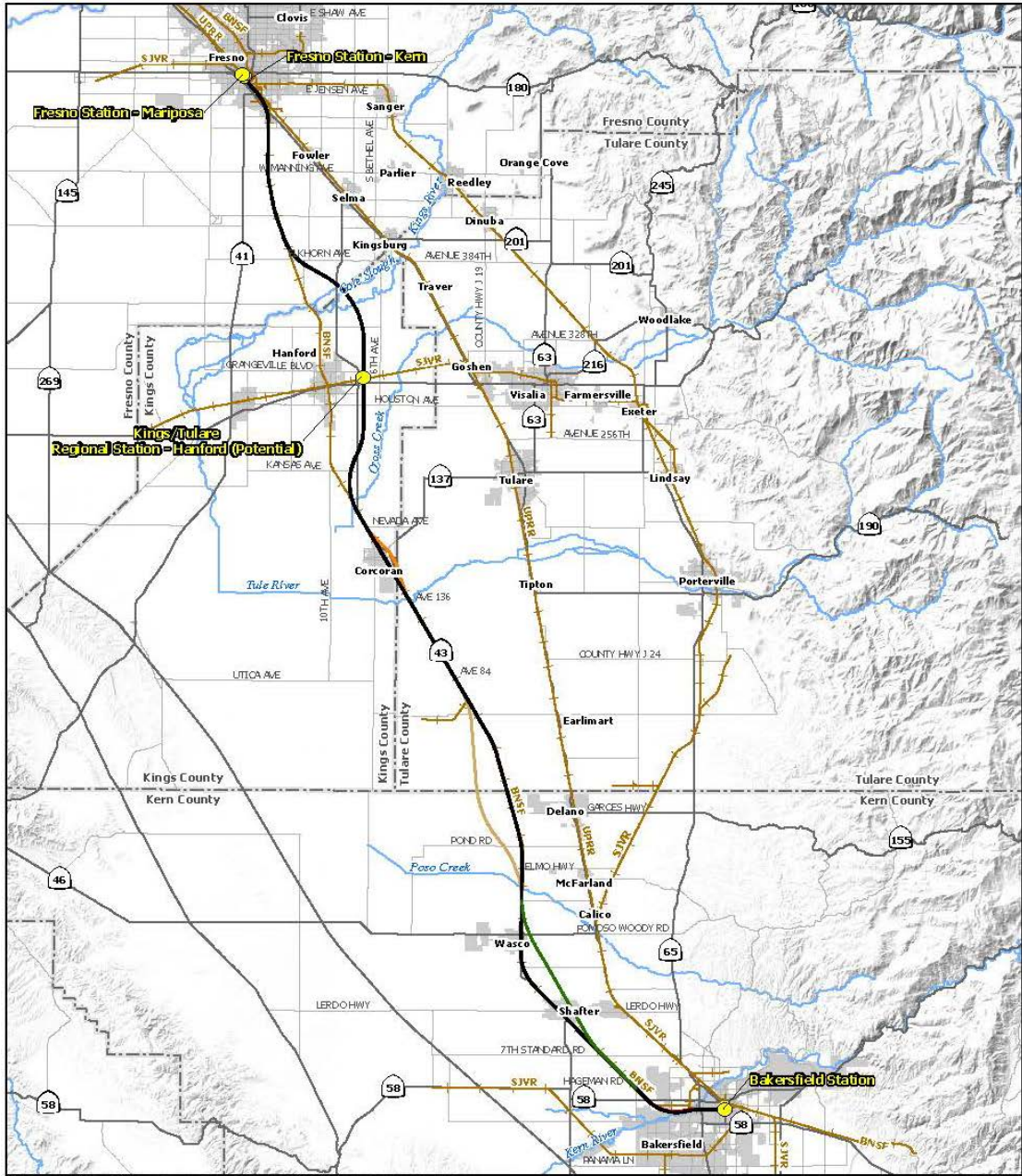
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 Source: URS, 2010

April 27, 2011



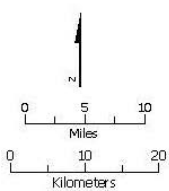
- Heavy maintenance facility
- Impact footprint
- Road

Figure 4
 Proposed Kern Council of Governments-
 Wasco, Shafter East, and Shafter West HMF Sites



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2011

April 28, 2011



- Allensworth Bypass
- BNSF Alternative
- Bakersfield South
- Corcoran Bypass
- Wasco-Shafter Bypass
- Station location
- ~ Stream
- Existing rail line
- Community/Urban area
- County boundary

Figure 5
 Fresno to Bakersfield HST
 section proposed station locations

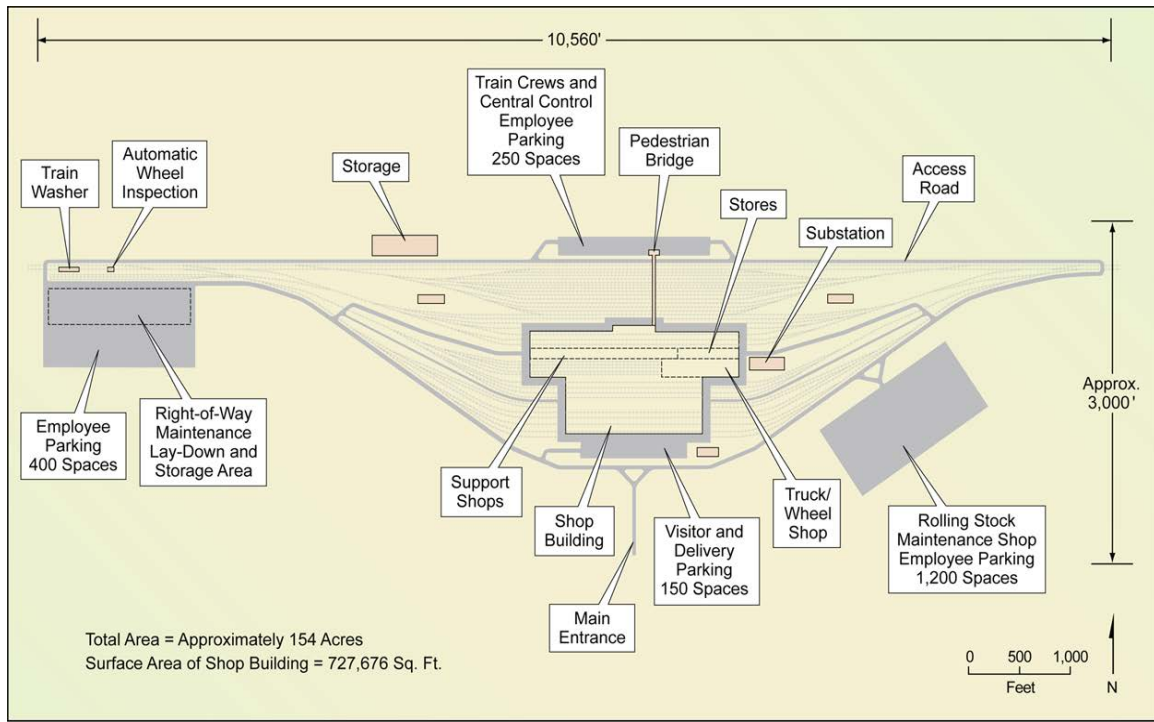
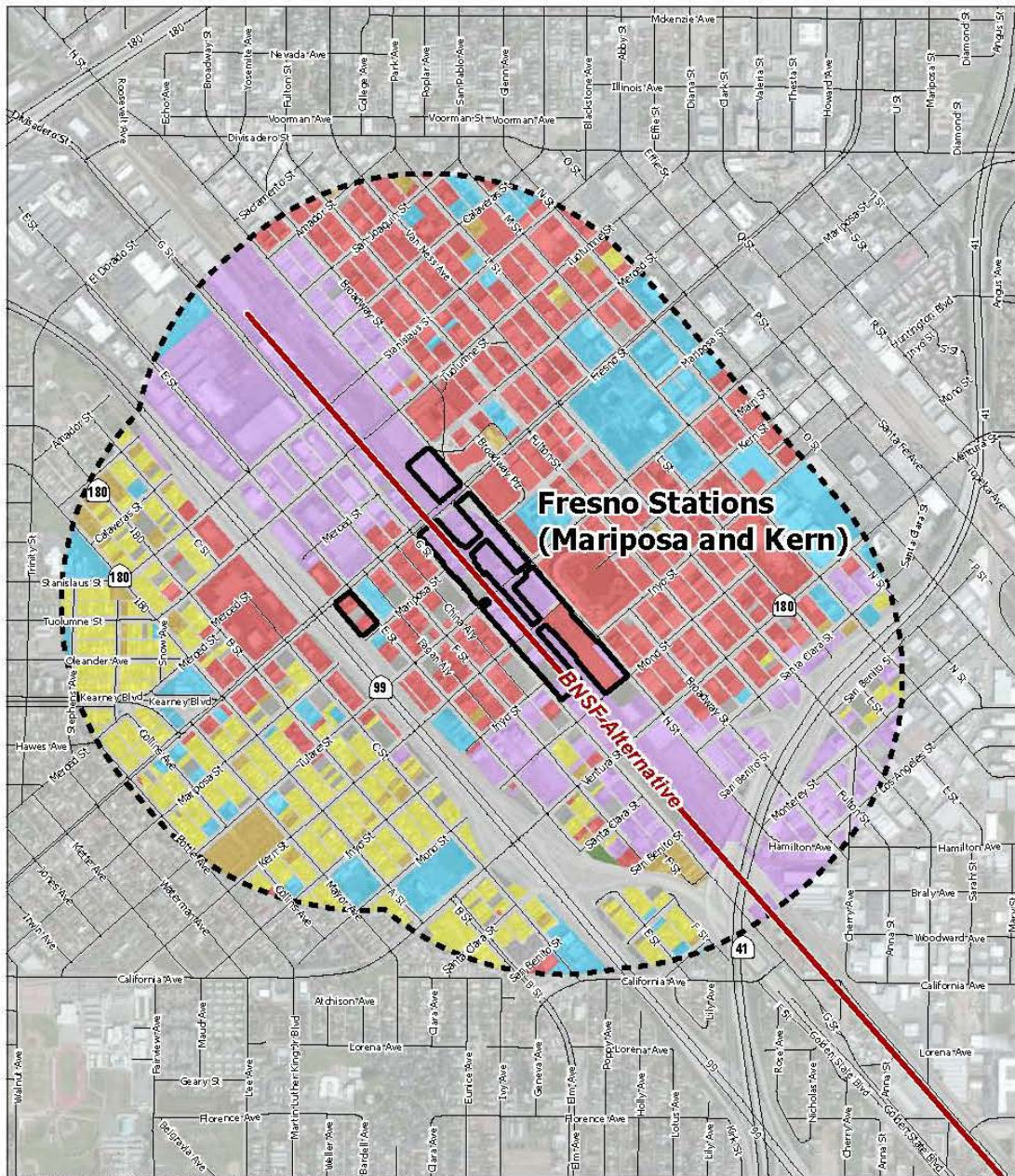


Figure 6
Typical HMF layout

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PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2011; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009;
 City of Fresno, 2009
 Imagery Source: Microsoft Corporation, 2009

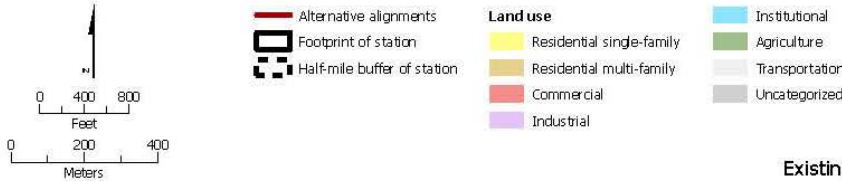
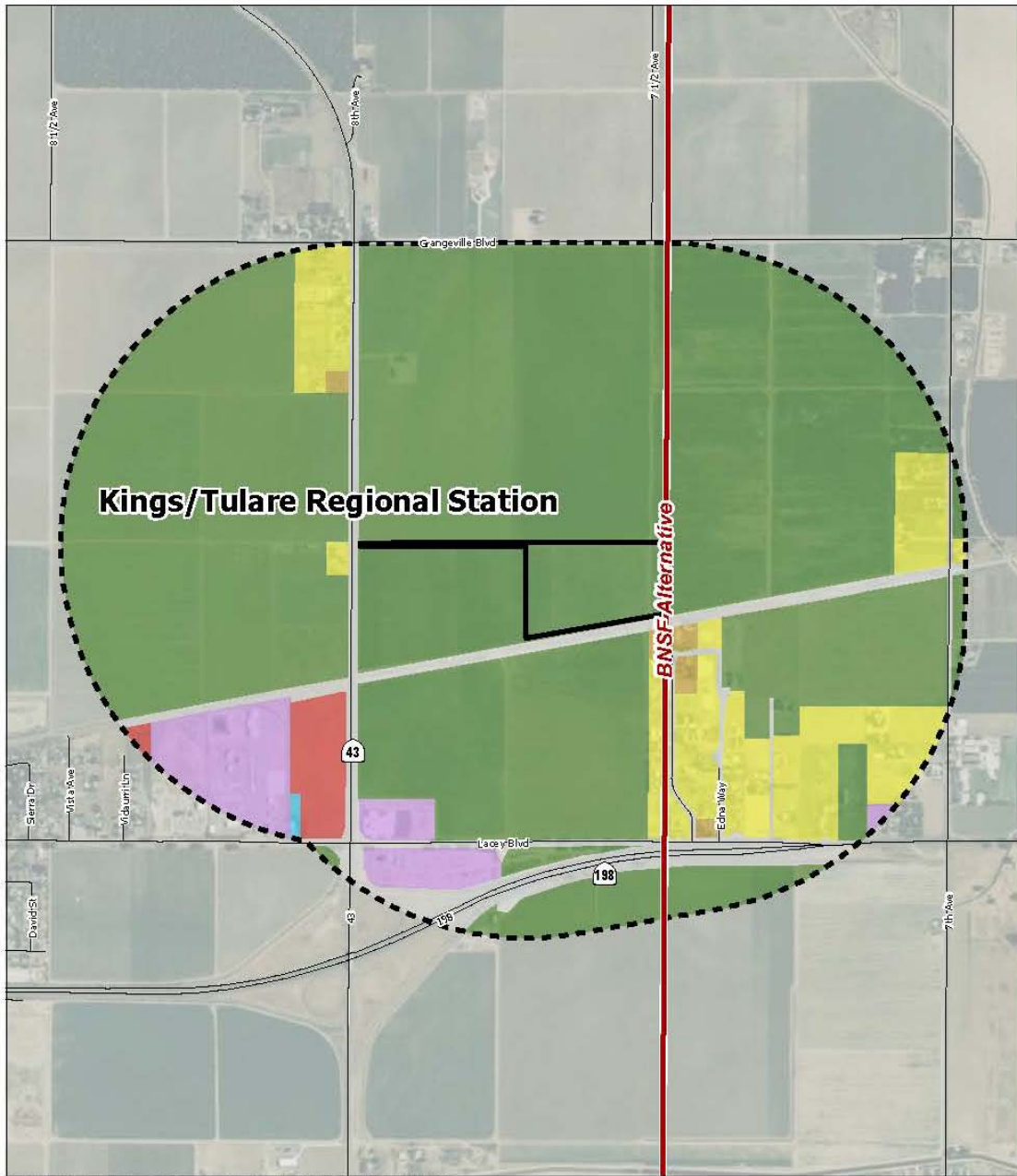
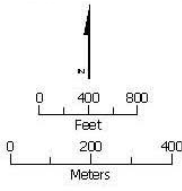


Figure 7
 Existing land use—Fresno stations



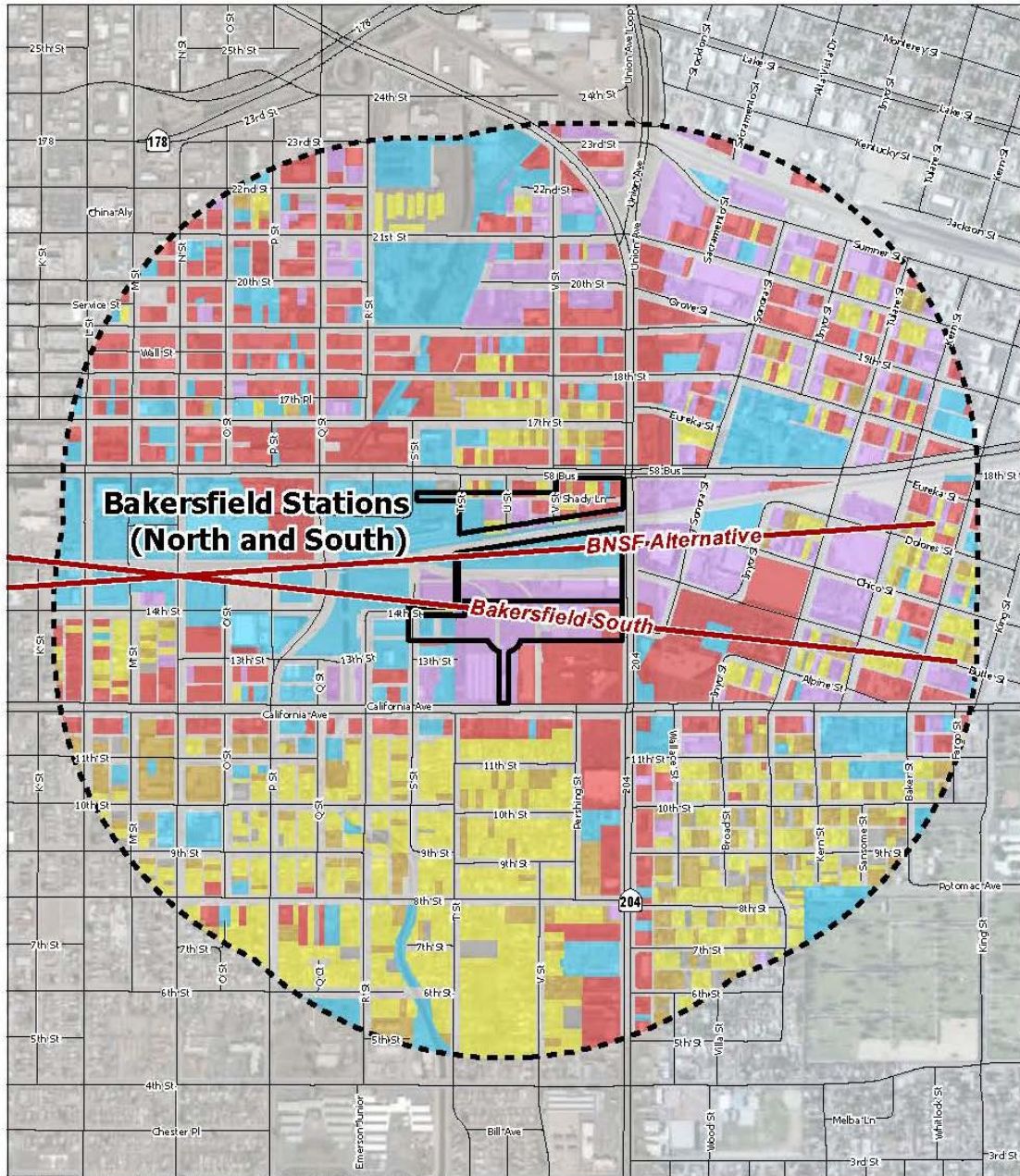
PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2011; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009;
 City of Fresno, 2009
 Imagery Source: Microsoft Corporation, 2009

March 23, 2011



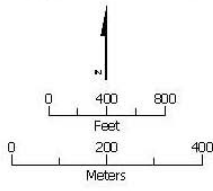
- | | | |
|-----------------------------|---------------------------|----------------|
| Alternative alignments | Land use | Institutional |
| Footprint of station | Residential single-family | Agriculture |
| Half-mile buffer of station | Residential multi-family | Transportation |
| | Commercial |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

Figure 8
 Existing land use—Kings/Tulare Regional Station



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
 Source: URS, 2011; Fresno County, 2009; Tulare County, 2009; Kings County, 2009; Kern County, 2009;
 City of Fresno, 2009
 Imagery Source: Microsoft Corporation, 2009

March 23, 2011



- Alternative alignments
- Footprint of station
- Half-mile buffer of station
- Land use**
- Residential single-family
- Residential multi-family
- Commercial
- Industrial
- Institutional
- Agriculture
- Transportation
- Uncategorized

Figure 9
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	1. Station (Office)	5,000 sf	150		750	1	
		Station (Concourse)	70,000 sf	20		1,400	2	
		Parking Structure	5.5 acres	5		1,200	1	
		Landscaping	1.2 acres			3,200	4	
		Total Consumption by Area						7
		2. Consumption by Person				5 gal/passenger	42,000	47
		Selected Value					42,000	47
Kings/Tulare Regional Station	3,300 passengers	1. 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			8,900	10	
		Total Consumption by Area						12
		2. Consumption by Person				5 gal/passenger	16,500	18
		Selected Value					16,500	18
Bakersfield Station	9,200 passengers	1. 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			5,700	6	
		Total Consumption by Area						10
		2. Consumption by Person				5 gal/passenger	46,000	52
		Selected Value					46,000	52
Total							168	

Notes:

1. HMF water consumption would be the same regardless of which location is selected.
2. HMF water consumption includes industrial, landscaping, and train washing uses.
3. Selected value for HMF is based on actual data from a comparable facility.
4. Selected value for stations is based on the methodology that resulted in the highest use.
5. Maintenance of Way facility and Traction Power Supply Station were not included due to negligible water use.

Table 2
Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
BNSF Alternative				
114 miles	Concrete Work	45	139	28
	Earthwork	36	112	22
	Dust Control (tracks)	698	2142	428
	Irrigation (tracks)	158	485	97
	Total	937	2876	575
Corcoran Bypass				
19 miles	Concrete Work	6	18	4
	Earthwork	7	20	4
	Dust Control (tracks)	119	365	73
	Irrigation (tracks)	27	83	17
	Total	158	486	97 (96)
Corcoran Elevated				
4 miles	Concrete Work	8	23	5
	Earthwork	0	0	0
	Dust Control (tracks)	23	69	14
	Irrigation (tracks)	5	16	3
	Total	35	108	22 (18)
Allensworth Bypass				
22 miles	Concrete Work	3	8	2
	Earthwork	8	25	5
	Dust Control (tracks)	133	407	81
	Irrigation (tracks)	30	92	18
	Total	173	532	106 (108)
Wasco-Shafter Bypass				
20 miles	Concrete Work	6	20	4
	Earthwork	7	21	4.2
	Dust Control (tracks)	124	380	76
	Irrigation (tracks)	28	86	17
	Total	165	506	101 (108)
Bakersfield South				
9 miles	Concrete Work	14	43	9
	Earthwork	1	3	0.6
	Dust Control (tracks)	57	175	35
	Irrigation (tracks)	13	40	8
	Total	85	261	52 (52)
Heavy Maintenance Facility				
150 ac	Concrete Work	14	44	9
	Dust Control	192	588	118
	Irrigation	6	19	4
	Total	212	650	130

Table 2 (cont.)
Construction Water Use Summary

Facility	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
Fresno Station				
13 ac	Concrete Work	7	23	5
	Dust Control	89	273	55
	Irrigation	0.2	1	0.1
	Total	97	296	59
Kings/Tulare Station				
28 ac	Concrete Work	1	2	0.5
	Dust Control	109	334	67
	Irrigation	1	2	0.3
	Total	110	338	68
Bakersfield Station				
20 ac	Concrete Work	9	29	6
	Dust Control	104	318	64
	Irrigation	1	2	0.4
	Total	114	349	70
Maximum Use Total				907

Notes:

1. Annualized water use is for a five year construction period.
2. Equivalent numbers for the corresponding segment of the BNSF Alternative are presented in parenthesis.
3. Concrete volume for stations was estimated by structure footprints and building characteristics.
4. Station option with the highest water use is presented.
5. MG is the abbreviation for million gallons.

Table 3A

Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (ac)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
Fresno Works – Fresno	Single-Family	23.02	3.2	73.67	Fresno ID (ag) City of Fresno (non-ag)
	Commercial	1.01	1.9	1.91	
	Industrial	125.12	1.9	237.74	
	Institutional	68.90	1.9	130.91	
	Agricultural ²	299.05	3	897.14	
	Roadways/ROW/No Data ³	26.67	1.9	50.67	
	Unknown ⁴	42.35	2.6	108.42	
	Total	586.11		1500.45	
Kings County - Hanford	Single-Family	0.00	3.2	0.00	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	0.00	1.9	0.00	
	Industrial	2.72	1.9	5.17	
	Institutional	0.00	1.9	0.00	
	Agricultural ²	504.63	3.2	1614.82	
	Roadways/ROW/No Data ³	4.42	1.9	8.40	
	Unknown ⁴	0.00	2.8	0.00	
	Total	511.78		1628.39	
Kern Council of Governments - Wasco	Single-Family	0.44	3.2	1.41	North Kern WSD Shafter-Wasco WSD City of Wasco WSA (non-ag only)
	Commercial ⁵	1.47	1	1.47	
	Industrial ⁶	5.20	1	5.20	
	Institutional	0.00	1.9	0.00	
	Agricultural ⁷	407.00	4.15	1689.06	
	Roadways/ROW/No Data ³	0.61	1.9	1.17	
	Unknown ⁴	1.51	3.6	5.41	
	Total	416.25		1703.74	

Table 3A (cont.)

Existing Water Use – Potential Heavy Maintenance Facilities

Site	Current Land Use	Permanent Impacted Areas (ac)	Water Use Factors (ac-ft/ac/yr) ¹	Annual Water Use (ac-ft/yr)	Water Service Provider
Kern Council of Governments - Shafter East	Single-Family	0.00	3.2	0.00	North Kern WSD Shafter-Wasco WSD
	Commercial	0.00	1.9	0.00	
	Industrial	4.88	1.9	9.27	
	Institutional	0.07	1.9	0.14	
	Agricultural ⁸	483.83	4	1935.31	
	Roadways/ROW/No Data ³	5.89	1.9	11.18	
	Unknown ⁴	0.00	4.0	0.00	
	Total	494.66		1955.89	
Kern Council of Governments - Shafter West	Single-Family	3.76	3.2	12.03	North Kern WSD Shafter-Wasco WSD
	Commercial	0.00	1.9	0.00	
	Industrial	10.14	1.9	19.26	
	Institutional	0.00	1.9	0.00	
	Agricultural ⁸	465.34	4	1861.35	
	Roadways/ROW/No Data ³	0.50	1.9	0.94	
	Unknown ⁴	0.00	4.0	0.00	
	Total	479.73		1893.59	

Notes:

1. Water use factors taken from the City of Fresno Urban Water Management Plan (August 2008), Table 6.4 (2010 projections), except as noted otherwise.
2. Water use factors for agricultural land uses derived from California DWR Agricultural Land and Water Use information by County (2001 data), due to lack of site specific water use data for these sites. See Appendix A 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/ROW/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 Mr. Dan Allen of the City of Wasco.
6. Water use factor for industrial land use at this site based on information provided by Mr. Jerry Ezell of Shafter-Wasco Irrigation District.
7. Water use factor for agricultural land use at this site based on information provided by Mr. Jerry Ezell of Shafter-Wasco Irrigation District, from his discussions with landowners.
8. Water use factor for agricultural land use at this site based on information provided by Mr. Jerry Ezell of Shafter-Wasco Irrigation District and Mr. Dana Munn of North Kern Water Storage District regarding the water needs of almonds, based on discussions with landowners.

Table 3B
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 – Mariposa Alternative	Single-Family	0.00	3.2	0.00
	Multi-Family	0.00	6.2	0.00
	Commercial	9.79	1.9	18.60
	Industrial	9.65	1.9	18.33
	Institutional	0.52	1.9	0.99
	Agricultural ²	0.00	3	0.00
	Roadways/ROW/No Data ³	1.11	1.9	2.11
	Unknown ⁴	0.97	1.9	1.84
	Subtotal		22.04	
Fresno Station-Kern Alternative	Single-Family	0.00	3.2	0.00
	Multi-Family	0.00	6.2	0.00
	Commercial	6.94	1.9	13.18
	Industrial	8.52	1.9	16.20
	Institutional	0.52	1.9	0.99
	Agricultural ²	0.00	3	0.00
	Roadways/ROW/No Data ³	0.30	1.9	0.57
	Unknown ⁴	1.70	1.9	3.23
	Subtotal		17.98	
Kings/Tulare Regional Station	Single-Family	0.00	3.2	0.00
	Multi-Family	0.00	6.2	0.00
	Commercial	0.00	1.9	0.00
	Industrial	0.00	1.9	0.00
	Institutional	0.00	1.9	0.00
	Agricultural ²	21.86	3.2	69.95
	Roadways/ROW/No Data ³	0.02	1.9	0.03
	Unknown ⁴	0.00	3.2	0.00
	Subtotal		21.87	
Bakersfield Station - North Alternative	Single-Family	1.05	3.2	3.35
	Multi-Family	0.16	6.2	1.02
	Commercial	1.90	1.9	3.61
	Industrial	5.55	1.9	10.54
	Institutional	7.15	1.9	13.58
	Agricultural ²	0.00	3.3	0.00
	Roadways/ROW/No Data ³	5.20	1.9	9.89
	Unknown ⁴	0.13	2.0	0.25
	Subtotal		21.14	

Table 3B (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 – South Alternative	Single-Family	0.26	3.2	0.84
	Multi-Family	0.00	6.2	0.00
	Commercial	0.89	1.9	1.69
	Industrial	10.76	1.9	20.44
	Institutional	6.30	1.9	11.96
	Agricultural ²	0.00	3.3	0.00
	Roadways/ROW/No Data ³	5.35	1.9	10.16
	Unknown ⁴	0.31	1.9	0.59
	Subtotal		23.86	

Notes:

1. Water use factors taken from the City of Fresno Urban Water Management Plan (August 2008), Table 6.4 (2010 projections), except for Agricultural, Roadways/ROW/No Data, and Unknown land uses.
2. Water use factors for agricultural land uses derived from California DWR Agricultural Land and Water Use information by County (2001 data). See Appendix A for more details. A county-specific average for all crop types was used.
3. No water use factors were available for Roadways/ROW/No Data land uses, therefore an estimated water use factor of 1.9 was applied, as it 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.

Table 3C
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	36.76	3.2		117.62		
	Multi-Family	3.78	6.2		23.43		
	Commercial	12.39	1.9		23.54		
	Industrial	121.03	1.9		229.96		
	Institutional	40.47	1.9		76.90		
	Agricultural ²						
	- Fresno County	159.36	3		478.08		
	- Kings County	345.37	3.2		1105.18		
	- Tulare County	116.73	3.5		408.56		
	- Kern County	121.08	3.3		399.56		
	Roadways/ROW/No Data ³	352.99	1.9		670.68		
Unknown ⁴	189.31	2.7		510.65			
Total		1499.27			4044.17		
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 Bypass ⁶	Single-Family	6.47	0.75	5.72	3.2	20.69	18.30
	Multi-Family	1.23	0.00	1.23	6.2	7.64	7.64
	Commercial	0.00	6.50	-6.50	1.9	0.00	-12.35
	Industrial	0.00	15.13	-15.13	1.9	0.00	-28.74
	Institutional	0.00	0.04	-0.04	1.9	0.00	-0.08
	Agricultural ²						
	- Kings County	153.33	154.43	-1.10	3.2	490.65	-3.51
	- Tulare County	58.20	25.12	33.08	3.5	203.71	115.79
	Roadways/ROW/No Data ³	52.20	36.33	15.87	1.9	99.18	30.16
	Unknown ⁴	26.23	15.09	11.15	3.0	79.43	33.75
Total		297.66	253.38	44.29		901.31	160.95

Table 3C (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	0.00	0.24	-0.24	3.2	0.00	-0.76
	Multi-Family	0.00	0.00	0.00	6.2	0.00	0.00
	Commercial	0.00	4.53	-4.53	1.9	0.00	-8.60
	Industrial	8.43	15.13	-6.70	1.9	16.02	-12.72
	Institutional	0.00	0.04	-0.04	1.9	0.00	-0.08
	Agricultural ²						
	- Kings County	0.44	0.55	-0.11	3.2	1.42	-0.34
	- Tulare County	0.00	0.00	0.00	3.5	0.00	0.00
	Roadways/ROW/No Data ³	17.36	19.20	-1.84	1.9	32.99	-3.50
	Unknown ⁴	0.58	1.02	-0.44	1.9	1.11	-0.85
	Total	26.81	40.71	-13.90		51.53	-26.86
Allensworth Bypass ⁶	Single-Family	0.00	5.35	-5.35	3.2	0.00	-17.12
	Multi-Family	0.00	0.78	-0.78	6.2	0.00	-4.82
	Commercial	0.00	0.00	0.00	1.9	0.00	0.00
	Industrial	8.22	11.92	-3.70	1.9	15.62	-7.04
	Institutional	4.09	10.56	-6.47	1.9	7.77	-12.29
	Agricultural ²						
	- Tulare County	101.28	61.86	39.42	3.5	354.49	137.97
	- Kern County	116.77	60.07	56.71	3.3	385.36	187.14
	Roadways/ROW/No Data ³	29.12	92.98	-63.85	1.9	55.33	-121.32
	Unknown ⁴	4.38	19.99	-15.62	3.2	13.81	-49.26
	Total	263.87	263.51	0.36		832.38	113.26

Table 3C (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)
Wasco-Shafter Bypass ⁶	Single-Family	0.39	1.58	-1.19	3.2	1.24	-3.82
	Multi-Family	0.00	0.00	0.00	6.2	0.00	0.00
	Commercial	0.00	0.78	-0.78	1.9	0.00	-1.48
	Industrial	5.32	18.30	-12.98	1.9	10.11	-24.66
	Institutional	3.12	2.24	0.88	1.9	5.94	1.68
	Agricultural ²						
	- Kern County	170.01	57.65	112.36	3.3	561.05	370.80
	Roadways/ROW/No Data ³	68.01	143.66	-75.65	1.9	129.22	-143.74
	Unknown ⁴	0.49	9.81	-9.32	2.9	1.40	-26.71
Total	247.34	234.02	13.33		708.95	172.07	
Bakersfield South ⁶	Single-Family	14.75	14.66	0.10	3.2	47.20	0.30
	Multi-Family	0.74	1.22	-0.47	6.2	4.61	-2.93
	Commercial	15.19	5.11	10.08	1.9	28.86	19.15
	Industrial	18.29	12.88	5.41	1.9	34.76	10.28
	Institutional	22.02	21.57	0.44	1.9	41.83	0.84
	Agricultural ²						
	- Kern County	5.14	3.36	1.78	3.3	16.98	5.87
	Roadways/ROW/No Data ³	34.06	38.36	-4.30	1.9	64.72	-8.17
	Unknown ⁴	4.37	4.75	-0.39	2.2	9.47	-0.84
Total	114.57	101.92	12.65		248.43	24.51	

Table 3C (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)
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Notes:

1. Water use factors taken from the City of Fresno Urban Water Management Plan (August 2008), Table 6.4 (2010 projections), except for Agricultural, Roadways/ROW/No Data, and Unknown land uses.
2. Water use factors for agricultural land uses derived from California DWR Agricultural Land and Water Use information by County (2001 data). See Appendix A for more details. A county-specific weighted average for all crop types was used.
3. No water use factors were available for Roadways/ROW/No Data land uses, therefore an estimated water use factor of 1.9 was applied, as it 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. Figures represent total acreage for entire track alignment between Fresno and Bakersfield.
6. Figures represent difference in acreage between bypass and equivalent section of BNSF Alternative.

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Table 4
Water Use Summary

Facility Type	Facility Name	Annual Water Use (ac-ft)
Existing Water Use		
Track Alignment	BNSF Alternative	4044
	Corcoran Bypass	901 (740)
	Corcoran Elevated	52 (78)
	Allensworth Bypass	832 (719)
	Wasco-Shafter Bypass	709 (537)
	Bakersfield South	248 (224)
HMF (150 acres)	Fresno Works – Fresno	384
	Kings County – Hanford	477
	Kern Council of Governments – Wasco	614
	Kern Council of Governments – Shafter East	593
	Kern Council of Governments – Shafter West	592
Stations	Fresno Station-Mariposa Alternative	42
	Fresno Station-Kern Alternative	34
	Kings/Tulare Regional Station	70
	Bakersfield Station-North Alternative	42
	Bakersfield Station-South Alternative	46
Maximum Use Total		5303
Construction Water Use		
Track Alignment	BNSF Alternative	575
	Corcoran Bypass	97 (96)
	Corcoran Elevated	22 (18)
	Allensworth Bypass	106 (108)
	Wasco-Shafter Bypass	101 (108)
	Bakersfield South	52 (52)
HMF	HMF (one location)	130
Stations	Fresno Station	59
	Kings/Tulare Regional Station	68
	Bakersfield Station	70
Maximum Use Total		907
Estimated Water Use - 2035 at 100% Build-Out		
HMF	HMF (one location)	50
Stations	Fresno Station	47
	Kings/Tulare Regional Station	18
	Bakersfield Station	52
Total		168

Notes:

1. Maximum Use Total utilizes the facility alternative with the highest demand.
2. Construction water is annualized for a five year construction period.
3. Heavy Maintenance Facility water demand would be the same regardless of location.
4. Equivalent numbers for the corresponding segment of the BNSF Alternative are presented in parenthesis.

Table A1
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	

Source of data:

California Department of Water Resources (DWR), Agricultural Land and Water Use information by County (2001 data). Available at <http://www.water.ca.gov/landwateruse/anaglwu.cfm#> (accessed April 5, 2011).

Crop Acronym

Grain

Rice

Cotton

SgrBeet

Corn

DryBean

Safflwr

Definition

Wheat, barley, oats, miscellaneous grain and hay, and mixed grain and hay

Rice and wild rice

Cotton

Sugar beets

Corn (field and sweet)

Beans (dry)

Safflower

Table A1
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
Oth Flc	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 brussel 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							

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