APPENDIX 3.6-A

Water Consumption Technical Memorandum

Technical Memorandum

Date: February 20, 2012

To: Ann Koby, Bryan Porter

From: Erik Fanselau, Jeff Nelson

Subject: Water Usage Analysis for HST
Merced to Fresno Section

This Technical Memorandum (TM) presents our analysis and evaluation of anticipated water use requirements for both the construction and operation of the California High-Speed Train (HST) for the Merced to Fresno 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 Merced to Fresno section runs through Merced, Madera, and Fresno counties and will be 75 to 95 miles long, depending on the alignment that is constructed. The major features that are to be part of the Merced to Fresno Section include HST passenger stations in the cities of Merced and Fresno, and the track alignment and associated right-of-way. One Heavy Maintenance Facility (HMF) may also be included as part of this section. PB reviewed all relevant sections of pertinent HST reports and plans to identify all project facilities that would have significant water demand requirements. Based on this review, we identified three facilities requiring significant operational water usage, those being the two passenger stations that will be located in Merced and Fresno, and the one HMF that may be located in this section.

PB identified water use factors for the different facilities and estimated usage rates as summarized in Table 1. We used these factors to estimate the future water demand for each facility and track alignment alternatives for both construction activities and operation and maintenance at final build-out. PB then evaluated existing water usage for all five proposed HMF locations, the three alternative track alignments, and at each station location and compared this result with our future estimated demand. This comparison indicates that the construction of the Merced to Fresno section of the HST will result in a net decrease in annual water consumption to only 9% of the existing water usage for the project footprint and 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. This information is summarized in Table 4.

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 Merced to Fresno Section, shown in Figure 1 (and highlighted on the cover), will connect to the San Jose to Merced Section to the northwest via Pacheco Pass, the Merced to Sacramento Section to the north, and the Fresno and Bakersfield section (and from there to the Southern California sections) to the south. The Merced to Fresno section runs through Merced, Madera, and Fresno counties and will be 75 to 95 miles long, depending on the final alignment.

The major features that are to be part of the Merced to Fresno Section include HST passenger stations in the cities of Merced and Fresno, the track alignment and associated right-of-way, and possibly one Heavy Maintenance Facility (HMF). Other lesser facilities will include a maintenance-of-way facility, a traction power supply station (TPSS), and switching and paralleling stations.

Methodology

Our analysis consisted of the following steps.

1) We 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) We 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) We then developed water demand estimates for both construction and long term operation of the planned facilities and the track alignments. Our water demand estimate for construction is based on the estimated one-time, five year construction period concluding in 2020. Our annual water use estimate is based on full build-out in 2035.

4) We then determined water usage of the existing uses at the sites/stations where the HSR system would be constructed and operated. To determine existing water usage we used the actual parcel land use information and applied region specific water usage rates developed from recent data. In addition, we contacted the owners of the HMF sites and asked for specific historical water usage data for each of the HMF sites.

5) Finally, we 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 our approach for each step is described below.

Identification of Project Features with Significant Water Usage

PB reviewed all relevant project documents to identify all project related facilities that would have significant water demand requirements. Based on this review, we identified three facilities requiring significant operational water usage, those being the Merced and Fresno passenger stations and the potential Heavy Maintenance Facility.

There are two potential locations being evaluated for the Fresno station; both locations are within a few blocks of each other. The station configurations and footprints will be the same for either location. There is only one location currently being evaluated for the Merced 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 Merced to Fresno 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 Merced to Fresno section: Castle Commerce Center, Harris-DeJager, Fagundes, Gordon-Shaw, and Kojima.

The HMF will include a heavy rail vehicle maintenance area and a layover area. The HMF will require approximately 154 acres to accommodate all activities associated with the train fleet assembly, disassembly and complete rehabilitation; all on-board components of the train-sets; and overnight layover accommodations and servicing facilities. The facility will also include a maintenance shop, yard operations control center building, one traction power supply station (TPSS), a train interior cleaning platform and other support facilities. The HMF footprint is expected to cover the same area (154 acres) regardless of which of the five potential locations is chosen. However, the total site limit area associated with the five possible sites (site limit) varies in size from 231 acres for the Fagundes site to 401 acres for the Harris-DeJager site. If there is a HMF located within the Merced to Fresno section, a maintenance-of-way facility will likely be incorporated into the HMF. If an HMF is not located within the Merced to Fresno 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. We do not anticipate significant water usage associated with the maintenance-of-way facility.

The TPSS, 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 three track alignment alternatives. These alignments are referred to as the UPRR/SR 99, BNSF, and the Hybrid alignment, which incorporates portions of both the UPRR/SR 99 and BNSF alignments. We performed an analysis for all three alignments.

Estimating Future Water Demand Requirements for Merced to Fresno Section

This section describes the relevant information and assumptions we 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. We reviewed the 15% design plans for both the Merced and Fresno stations. Both stations have a similar footprint. As a result, the water demand for both office space and landscaping would be similar with the only variable being a difference in passenger usage.

The process we followed for estimating the water demand for the 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

PB identified operational water use factors 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 the August 2008 Fresno Urban Water Management Plan (FUWMP). We then compared the different water use factors and used our professional engineering judgment to select the most appropriate annual water usage rate.

HMF - After careful consideration, PB decided to use the recent operational data from the Hayward BART facility (water rate usage of 31 gallons/employee/day) 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 size, 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). PB compared the number of train sets and employees for both the BART (actual numbers) and HST (planned numbers) facilities and took into account other climatic conditions (average temperature, humidity) and landscaping, 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/employee/day. PB also spoke with the BART Shop Superintendent at the Hayward facility and confirmed that the work performed there is similar to the work that would be performed at the proposed HMF. With the ongoing improvement in water recycling and reuse technologies likely to be employed at the HMF, we feel that this water use factor may be conservatively high, but appropriate for use in this analysis.

Passenger Stations - PB looked at several different approaches for estimating the future water demand for the Fresno and Merced stations including estimating water demand on a per capita basis as well as on a facility square foot basis. After comparing these methods, we chose the method that yielded the most conservative results, that being applying gallons/capita/day use factors to the estimated number of passengers and employees at each station. The factors we used were 30 gallons per capita per day (gpcpd) of water use for each employee, and 5 gpcpd for passengers.

Track alignments – no water will be utilized 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 we 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 that use water:
    - manufacturing of concrete
    - earthwork and soil conditioning
    - dust suppression
    - irrigation for reseeded areas

Based on anticipated project construction schedule and on PB's past actual water usage experience on other construction projects in the Central Valley with similar elements, we developed water usage estimates for construction of the stations, HMF, and track. This is discussed in more detail below in the "Water Supply to Serve Construction" section. Our 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

We identified land areas that will be impacted by the HST for each of the three 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 154 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 only focused on the 154 acres that will be developed for the HMF. Four of the five potential HMF locations are served by untreated agricultural water and groundwater; one proposed HMF location, the Castle Commerce Center, is supplied by treated groundwater (See Table 3A). As the HMF facility is expected to have the same layout and number of employees regardless of the site selected, and as all five potential sites are near one another with similar climatic conditions, all HMF alternatives will use the same amount of water.

Alignments

PB evaluated existing land use information for each of the three track alternatives. The predominant land use (60%-70%) for each of the alignments is agricultural. Other identified land uses include single family residential, multi-family residential, commercial, industrial, and landscape irrigation. PB utilized the FUWMP land use factors for determining the water usage for the land areas identified as being used for single family residential, multi-family residential, commercial, industrial, and landscape irrigation purposes.

As part of our evaluation to determine an appropriate agricultural usage factor for this section, PB reviewed two California Department of Water Resources (DWR) documents that contained detailed water usage information for specific crops. The first document entitled "Crop Water Use in California", Bulletin 113-4, April 1986, contained specific water use for individual crops. This Bulletin provided County-specific data to allow us to utilize specific rates for Madera,

Merced, and Fresno counties. Water use varies from 1.1 ac-ft/ac/year for grain to 6.7 ac-ft/ac/year for rice. The average for all crops was 3.8 ac-ft/ac/year for Merced County, 3.6 ac-ft/ac/year for Madera County, and 3.7 ac-ft/ac/year for Fresno County.

A second document we referenced is DWR's 2001 crop usage water rates table (included in Appendix A to this TM). This document also provides specific crop water usage rates by County. The data in the 2001 table shows a slight overall reduction in average water use from 1986. In this 2001 table, water use varies from 1.4 ac-ft/ac/year for grain to 5.6 ac-ft/ac/year for rice. Average crop water usage rates by County are:

- Madera County - 3.5 ac-ft/ac/year;
- Merced County - 3.3 ac-ft/ac/year;
- Fresno County - 3.4 ac-ft/ac/year.

As we were not able to determine the breakdown of specific crop type for each alignment alternative, we applied the County specific average crop water usage rates from the DWR's 2001 Table information to the total agriculture land area each alignment alternative footprint would cover in each County to calculate the water usage for the alignment footprint through each County. Much of the farm land has gone out of production over the past several years. To account for the agricultural land being taken out of service, we applied a 10% reduction factor to the total areas of agricultural land for each alignment.

HMF sites – PB attempted to obtain specific water use information from representatives for each of the potential HMF sites. Mr. Jim Pichner with Merced County was able to provide specific water usage data for the Castle Commerce Center, which we used to estimate current water usage at the potential HMF site. Bobby Kahn from the Madera County Economic Development Commission (Fagundes, Kojima, and Gordon-Shaw sites), and Russell Harris, the landowner for the Harris-DeJager site, provided information regarding the specific crops grown at each site (plus dairy usage in the case of one site), and water supply source information for each of these sites. For these sites, we utilized DWR crop water usage data, by County, (included in the Appendix) to identify the specific agricultural water use factor for each specific crop grown at each site. PB then applied these specific water use factors to the different HMF site locations and generated estimated existing annual water usage for each of these sites. The information for each potential HMF site is summarized below.

Fagundes - the Fagundes site is currently occupied by an active dairy operation (20%) and corn (80%) grown for feed silage. PB estimated the water use associated with growing the corn based on the DWR crop use data. PB estimated the water use associated with the dairy by estimating the number of cows (61 cows for 154 acres) and assuming an average water demand of 45 gallons/day for milking cows. The dairy operation is currently supplied by on-site groundwater wells. The corn is irrigated with water from the Chowchilla Irrigation District. Based on the DWR crop water use data, the water use factor we used for growing corn is 2.9 ac-ft/ac/yr.

Kojima - the Kojima site is currently used for almond orchards. The water supply for this site is split equally between private groundwater wells and the Chowchilla Irrigation District. Based on the DWR data, the water usage for growing almonds is 3.7 ac-ft/ac/yr.

Gordon-Shaw - The Gordon-Shaw site in being used solely for agricultural purposes and is currently being used as both an almond orchard and to grow grapes, with each crop covering about half of the site. The water supply for this site is a combination of groundwater supplied by local wells and surface water supplied by the Madera Irrigation District. Groundwater is used more during dry years and surface water is used more during wet years, with the usage being about the same from each source over several years (resulting in, on average, the site uses about 50% groundwater and 50% surface irrigation water). Utilizing the DWR crop data, the overall average water usage for this site would be 3.2 ac-ft/ac/yr (averaging 3.7 ac-ft/ac/yr for almonds and 2.7 ac-ft/ac/yr for grapes).

Harris-DeJager - The Harris-DeJager site is also used for almonds and grapes of roughly equal proportions. The water supply is also 50% groundwater from private wells and 50% from the Merced Irrigation District. Like the Gordon Shaw site, the overall average water usage for this site would be 3.2 ac-ft/ac/yr (averaging 3.7 ac-ft/ac/yr for almonds and 2.7 ac-ft/ac/yr for grapes).

Castle Commerce Center - Mr. Pichner reported that the entire Castle Commerce Center site is supplied water by two approximately 900-foot-deep onsite wells. The groundwater is treated for potable use at the well head. Mr. Pichner told us that the water production for 2010 was 73,839,000 gallons which is equivalent to 227 acre-feet/year. This equates to 0.45 ac-ft/ac/yr. This water supplies an approximately 500 acre service area that contains 60 buildings that are mainly used for commercial purposes and some landscape irrigation.

Assuming each HMF location would use on-site groundwater only to serve HMF uses, that demand would be less than existing groundwater use at each site except for Fagundes. At Fagundes, existing groundwater use is estimated at 3.1 ac-ft/yr. whereas the HMF would use 50 ac-ft/yr (total water use at Fagundes would decrease from 360 ac-ft/yr to 50 ac-ft/yr, including current surface water use, see Table 4). The other four HMF sites currently have their own on-site groundwater supply well(s) with adequate capacity to meet the HMF water demand needs (without the need for surface water), we anticipate that local 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 - Both the Fresno and Merced station locations are currently supplied with treated municipal water by the local municipal water supplier, those being the City of Fresno Water Division and the City of Merced Water Supply Division, respectively (Table 3B). In order to calculate the existing water use at the proposed station locations, we identified the actual land use for each parcel at each station location. We then overlaid the proposed station footprint on these parcels and added the parcel areas according to land use classification. We then applied water use factors for each of the different land use classifications for each of the station footprints and totaled the estimated current water usage for each station location. This information is summarized in Table 3B.

PB used water use factors taken from the August 2008 adopted Fresno Urban Water Management Plan (FUWMP). 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. UWMPs 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 UWMP for Merced has not been updated since 2005, and does reflect new guidance developed by the DWR and the water use factors it reports are higher than those in the FUWMP. Therefore, we are using the water demand factors from the Fresno UWMP for Merced, and otherwise as appropriate, to calculate existing water use as the Fresno numbers are more conservative and more recent. The FUWMP includes water use rates for 2005, 2010, and 2025. PB used the 2010 water use rates to estimate current water usage. Mike Carbajal, from the City of Fresno, confirmed to PB on May 3, 2011, that Fresno would supply water to the station. It will be necessary to file a formal application for service with the City of Fresno. Kim Nutt, from the City of Merced, confirmed to PB on April 20, 2011, that Merced would supply water to the station. As with Fresno, it will be necessary to file a formal application for service with the City of Merced.

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/year.

- Merced Station – current estimated water usage is 52 ac-ft/yr and estimated future demand is 15 ac-ft/yr.

- Tracks alignments – Estimated existing water usage for the uses being displaced by the alignments ranged from 4892 ac-ft/yr to 6703 ac-ft/yr. We do not anticipate any water usage associated with any of the three alignments (the alignments will consist solely of track, switches and other unmanned equipment). 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 69 ac-ft/year (CCC) to 568 ac-ft/yr (Kojima). Estimated future water demand, regardless of the HMF location, is 50 ac-ft/yr.

Water supply to serve construction

Table 2 provides estimated construction water use for concrete work, earthwork, dust control, and irrigation for reseeded areas for the HMF and UPRR/SR99 and BNSF track alignments. CH2M Hill provided the water use for the Hybrid alignment separately and will incorporate this information into future revisions of the Draft EIR/EIS.

Since this table did not include values for the Merced and Fresno stations the water use volume for earthwork, dust control, and irrigation was estimated using the rate for the 154 acre HMF site and scaling it down for the 24 acre Merced station and 20.5 acre Fresno station sites. This methodology was not used for estimating the concrete work for the stations as it is not comparable to the percentage of concrete work on the HMF site. In order to estimate the water used during construction for concrete work for the Merced and Fresno stations we consulted with our Senior Structural Engineer, Ali Seyedmadani, PE, PhD. Dr. Seyedmadani used the 15% Station Plans as a reference and estimated the water required based on his estimation of the concrete volume from the elevation drawings and area of structure footprint.

Construction of the Merced to Fresno 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. Specifically, we estimate that the water usage during the construction of the Merced to Fresno HST section will be only 9% (685 acre-feet/yr needed for construction compared to 7362 acre-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 by the uses the project will displace is far greater than the water project 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. Often use is sporadic and a function of the particular construction activities going on at the time. This lessens the burden on the water supply as the 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 Merced to Fresno section facilities

This section describes water supply sources for each facility location and track alignment. As stated above, both the Fresno and Merced Station areas are currently served by their respective municipal water supply agencies. We anticipate that both stations will connect to the existing municipal systems. The heavy maintenance facility sites are located in or near the service areas of the following water supply districts: Merced Irrigation District (Castle Commerce Center), Chowchilla Water District (Harris-DeJager, Fagundes, Kojima), and Madera Irrigation District (Gordon-Shaw). 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. However, it is known that the Merced Irrigation District gets water from the Merced River and approximately 170 groundwater wells. Madera Irrigation District gets water from the Fresno River. Chowchilla Water District also gets water from surface supplies. The 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 and the project will use less water than existing groundwater use at each site, the most probable alternative for the project is to continue 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 Merced to Fresno section of the HST will result in net decrease in annual water consumption to only 9% of the current water usage along 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 within the project footprint to only 1.5% of the current water usage. Water usage will decrease at all facility locations with the exception of the Fresno station, where water usage is expected to increase. The increase in water usage at the Fresno site is due to the large amount of undeveloped land at the Fresno site as well as the high passenger boardings expected at the station. The City of Fresno is developing an ongoing plan to meet the water demand for this and other users within the FUWMP study area. The small increase in estimated water usage at the Fresno station location is greatly out-weighed by the substantially larger decrease in water usage expected for the rest of the section.

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Appendix

Table 1
California High Speed Rail
Merced - Fresno Segment
Water Demand Summary
February 2012

Facility	Daily Employee and Passenger Use	Method	Facility Area (sf)	Use Factor (gal/day/1000 ft^2)	Use Factor (gal/cap/day)	Estimated Daily Volume (gal/day)	Annual Water Use (ac-ft/yr)
Heavy Maintenance Facility	1500 employees	1. EIR/EIS		0	24	35,618	40
		2. BART data		0	30	45,000	50
		3. AWWA		0	137	206,209	231
		Selected Value				45,000	50
Merced Station	2600 passengers 24 employees	1. EIR/EIS					
		Station				3700	4
		Landscaping				2300	3
		Total Consumption					7
		2. Office	44,070	150	0	6611	7
		Concourse	117,417	20	0	2348	3
		Landscaping		0	0	2300	3
		Total Consumption by Area					13
		3. Common Use Factors			5 gal/passenger	13,720	15
		Total Consumption by Person			30 gal/employee		
		Selected Value				13,720	15
Fresno Station	8400 passengers 8 employees	1. EIR/EIS					
		Station				5500	6
		Landscaping				2300	3
		Total Consumption					9
		2. Office	44,070	150	0	6611	7
		Concourse	117,417	20	0	2348	3
		Landscaping		0	0	2300	3
		Total Consumption by Area					13
		3. Common Use Factors			5 gal/passenger	42,240	47
		Total Consumption by Person			30 gal/employee		
		Selected Value				42,240	47
Total							113

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. Footprint areas used in this table were taken from the "Merced HSR Station - Space Program" document. Fresno station will have similar areas.
6. Maintenance of Way facility and Traction Power Supply Station were not included due to negligible water use.
7. EIR/EIS values for the Merced and Fresno Station were taken from Table 3.6-20 in the Draft EIR/EIS.

Table 2
California High Speed Rail
Merced - Fresno Segment
Construction Water Use Summary
February 2012

Heavy Maintenance Facility & UPRR Alignment				
90 miles	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
	Concrete Work	101	310.0	62
	Earthwork	17	52.2	10
	Dust Control (tracks)	545	1672.6	335
	Dust Control (HMF)	179	549.3	110
	Irrigation (tracks)	123	377.5	75
	Irrigation (HMF)	7	21.5	4
	Total	972	2983.0	597
Heavy Maintenance Facility & BNSF Alignment				
95 miles	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
	Concrete Work	83	254.7	51
	Earthwork	26	79.8	16
	Dust Control (tracks)	615	1887.4	377
	Dust Control (HMF)	179	549.3	110
	Irrigation (tracks)	139	426.6	85
	Irrigation (HMF)	7	21.5	4
	Total	1049	3219.3	644
Heavy Maintenance Facility & Hybrid Alignment				
75 miles	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
	Concrete Work	78	239.4	48
	Earthwork	21	64.4	13
	Dust Control (tracks)	533	1635.7	327
	Dust Control (HMF)	179	549.3	110
	Irrigation (tracks)	121	371.3	74
	Irrigation (HMF)	7	21.5	4
	Total	939	2881.7	576
Merced Station				
24 ac	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
	Concrete Work	7	21.5	4
	Earthwork	1.1	3.4	1
	Dust Control	28	85.9	17
	Irrigation	1	3.1	1
	Total	37.1	113.9	23
Fresno Station - Mariposa Alternative				
20.5 ac	Item	Total Volume (MG)	Total Volume (ac-ft)	Annualized Water Use (ac-ft/yr)
	Concrete Work	7	21.5	4
	Dust Control	23	70.6	14
	Irrigation	0.2	0.6	0
	Total	30.2	92.7	19
Total (max value)		1116.3	3425.8	685

Notes:

1. Annualized water use is for a five year construction period.
2. HMF & Track alignment water use numbers for concrete work, earthwork, dust control, and irrigation were taken from the Draft EIR/EIS section 3.6, Table 3.6-11 for the BNSF and Hybrid alignments. CH2M Hill provided the water use for the UPRR/SR99 alignment separately.
3. Earthwork, dust control, and irrigation water use rates for the stations were calculated by proportioning the water usage rates for the HMF.
4. Concrete volume for stations was estimated by total site area and review of the 15% design station plans. See the explaination in the Technical Memorandum, page 8, for more information.
5. For the purpose of this analysis, the alignment requiring the highest water use (BNSF alignment) was used in estimating the total water usage during construction.
6. MG is the abbreviation for million gallons.

Table 3A
California High Speed Rail
Merced - Fresno Segment
Existing Water Use - Potential Heavy Maintenance Facilities
February 2012

Site	Current Land Use	Area Impacted by HMF	Water Use Factors (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)	Water Service Provider
Castle Commerce Center 370 acres	Single-Family			0	Merced Irrigation District
	Commercial			0	
	Industrial	154	0.45	69	
	Institutional			0	
	Agricultural			0	
	Landscape Irrig.			0	
	Total			69	
Harris-DeJager 401 acres	Single-Family	0	3.5	0	Chowchilla Water District
	Commercial	0	1.9	0	
	Industrial	0	1.9	0	
	Institutional	0	1.9	0	
	Agricultural	154	3.2	493	
	Landscape Irrig.	0	2.9	0	
	Total			493	
Fagundes 231 acres	Single-Family	0	3.5	0	Chowchilla Water District
	Commercial	0	1.9	0	
	Industrial	0	1.9	0	
	Institutional	0	1.9	0	
	Dairy (20%)	154	See note below	3.1	
	Agricultural-Corn (80%)	123.2	2.9	357	
	Landscape Irrig.	0	2.9	0	
	Total			360	
Gordon-Shaw 364 acres	Single-Family	0	3.5	0	Madera Irrigation District
	Commercial	0	1.9	0	
	Industrial	15	1.9	29	
	Institutional	0	1.9	0	
	Agricultural	138	3.2	442	
	Landscape Irrig.	1	2.9	3	
	Total			473	
Kojima 392 acres	Single-Family	0	3.5	0	Chowchilla Water District
	Commercial	0	1.9	0	
	Industrial	0	1.9	0	
	Institutional	0	1.9	0	
	Agricultural	152	3.7	562	
	Landscape Irrig.	2	2.9	6	
	Total			568	

Notes:

1. Includes agricultural land impacted by the connecting track to the Merced Station.
2. Water use factors taken from the Fresno Urban Water Management Plan, Table 6.4, DWR 2001 Crop Usage Water Rates Table, and in the case of Castle Commerce from actual groundwater well production records.

The 2010 water use factors were used for the existing water use estimates.

3. Agricultural water use factors for each site were weighted based on specific crop usage at each site.
4. Dairy water usage calculated by assuming 2.5 acres per cow and 45 gallons of water per day per cow.

Table 3B
California High Speed Rail
Merced - Fresno Segment
Existing Water Use - Stations
February 2012

Site	[1]Current Land Use	Acres	[2]Water Use Factors (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)
Merced	Single-Family	4.3	3.5	15
24 ac	Multi-Family	0	6.2	0
	Commercial	9	1.9	17
	Industrial	1.8	1.9	3
	Institutional	0	1.9	0
	Landscape Irrig.	0	2.9	0
	Transportation	6.2	1.9	12
	Vacant/unknown	2.7	1.9	5
Subtotal Merced Station				52
[3]Fresno	Single-Family	0.0	3.5	0
20.5 ac	Multi-Family	0.0	6.2	0
	Commercial	3.0	1.9	6
	Industrial	11.5	1.9	22
	Institutional	0.0	1.9	0
	Landscape Irrig.	0.0	2.9	0
	Transportation	2.0	1.9	4
	Vacant/unknown	4.0	1.9	8
Subtotal Fresno Station				39
Total				91

Notes:

1. Existing station land use info from the Draft EIR/EIS section 3.13.

2. Water use factors taken from the Fresno Urban Water Management Plan, Table 6.4.
The 2010 water use factors were used for the existing water use estimates.

3. The largest footprint of the two alternatives for the Fresno Station locations were used to portray the worst case scenario of water use.

Table 3C
California High Speed Rail
Merced - Fresno Segment
Existing Water Use - Track Alignment Alternatives
February 2012

Alt.	Current Land Use	Acres	Water Use Factors (ac-ft/ac/yr)	Annual Water Use (ac-ft/yr)
UPRR 90 miles	Single-Family	36	3.2	115
	Multi-Family	12	6.2	74
	Commercial	122	1.9	232
	Industrial	247	1.9	469
	Institutional	59	1.9	112
	Agricultural	1079	3.5	3777
	Landscape Irrig.	39	2.9	113
	Total			4892
BNSF 95 miles	Single-Family	82	3.2	262
	Multi-Family	78	6.2	484
	Commercial	98	1.9	186
	Industrial	299	1.9	568
	Institutional	63	1.9	120
	Agricultural	1429	3.5	5002
	Landscape Irrig.	28	2.9	81
	Total			6703
Hybrid 75 miles	Single-Family	81	3.2	259
	Multi-Family	75	6.2	465
	Commercial	91	1.9	173
	Industrial	290	1.9	551
	Institutional	58	1.9	110
	Agricultural	1317	3.5	4610
	Landscape Irrig.	37	2.9	107
	Total			6275

Notes:

1. Includes agricultural land impacted by the connecting track to the Merced Station.
2. Only one of the three track alignment alternatives will be built.
3. Water use factors taken from the Fresno Urban Water Management Plan, Table 6.4.
The 2010 water use factors were used for the existing water use estimates.
4. Agricultural water use estimate taken from the Draft EIR/EIS section 3.6, page 3.6-38.
5. Track land use impacts averaged from values listed in the Draft EIR/EIS section 3.13, Table 3.13-1.

Table 4
California High Speed Rail
Merced - Fresno Segment
Water Use Summary
February 2012

Facility Type	Facility Name	Annual Water Use (ac-ft)
Existing Water Use		
HMF	Castle Commerce Center	69
	Harris-DeJager	493
	Fagundes	360
	Gordon-Shaw	473
	Kojima	568
Stations	Merced	52
	Fresno	39
Track Alignment	UPRR	4892
	BNSF	6703
	Hybrid	6275
Maximum Use Total		7362
Construction Water Use		
HMF + Track Alignment	UPRR	597
	BNSF	644
	Hybrid	576
Stations	Merced	23
	Fresno	19
Maximum Use Total		685
	Estimated Water Use - 2035 at 100% Build-out	
	HMF (one location)	50
Stations	Merced Station	15
	Fresno Station	47
	Total	113

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.

Table A1
California High Speed Rail
Merced - Fresno Segment
Crop Water Use
February 2012

Crop	Annual Ave Unit Applied Water (ac-ft/ac/yr)		
	County		
	Merced	Madera	Fresno
Grain	1.1	1.2	1.3
Rice	6.7		6.3
Cotton	3.7	3.8	3.7
Sugar Beets	3.7	3.7	3.8
Corn	3.5	3.5	3.6
Alfalfa	4.8	5.1	4.3
Pasture	6.1	6.3	6.0
Tomatoes	3.2	3.3	3.3
Almond/Pistachio	2.6	2.8	2.7
Other Deciduous	3.9	3.9	3.7
Citrus/Olive	3.0	2.8	2.6
Grapes	3.5	3.7	3.4
Ave	3.8	3.6	3.7

Note: Source of data: "Crop Water Use in California", Table 1, DWR, Bulletin 113-4, April 1986.

Crop	Annual Ave Unit Applied Water (ac-ft/ac/yr)		
	County		
	Merced	Madera	Fresno
Grain	1.4	1.6	1.6
Rice	5.5	5.6	5.5
Cotton	3.1	3.5	3.0
Sugar Beets	2.0	2.1	3.0
Corn	2.6	2.9	3.0
Alfalfa	5.0	4.9	4.9
Pasture	4.7	4.7	4.8
Tomatoes	3.1	3.2	2.5
Almond/Pistachio	3.3	3.7	3.6
Other Deciduous	3.6	3.8	3.9
Citrus/Olive	2.9	3.1	3.0
Grapes	2.2	2.7	2.5
Ave	3.3	3.5	3.4

Note: Source of data: DWR, 2001.

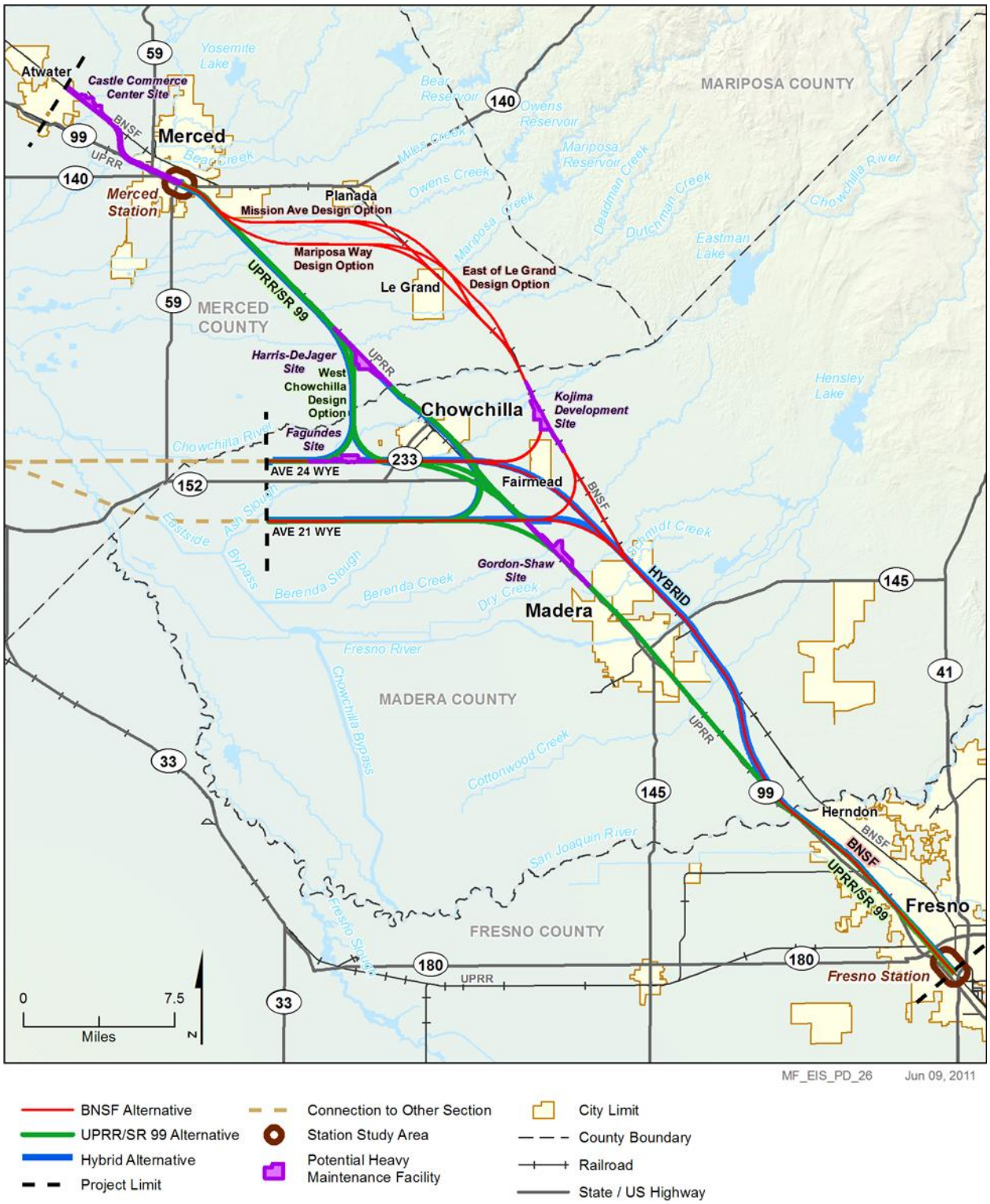


Figure 1
Merced to Fresno Segment

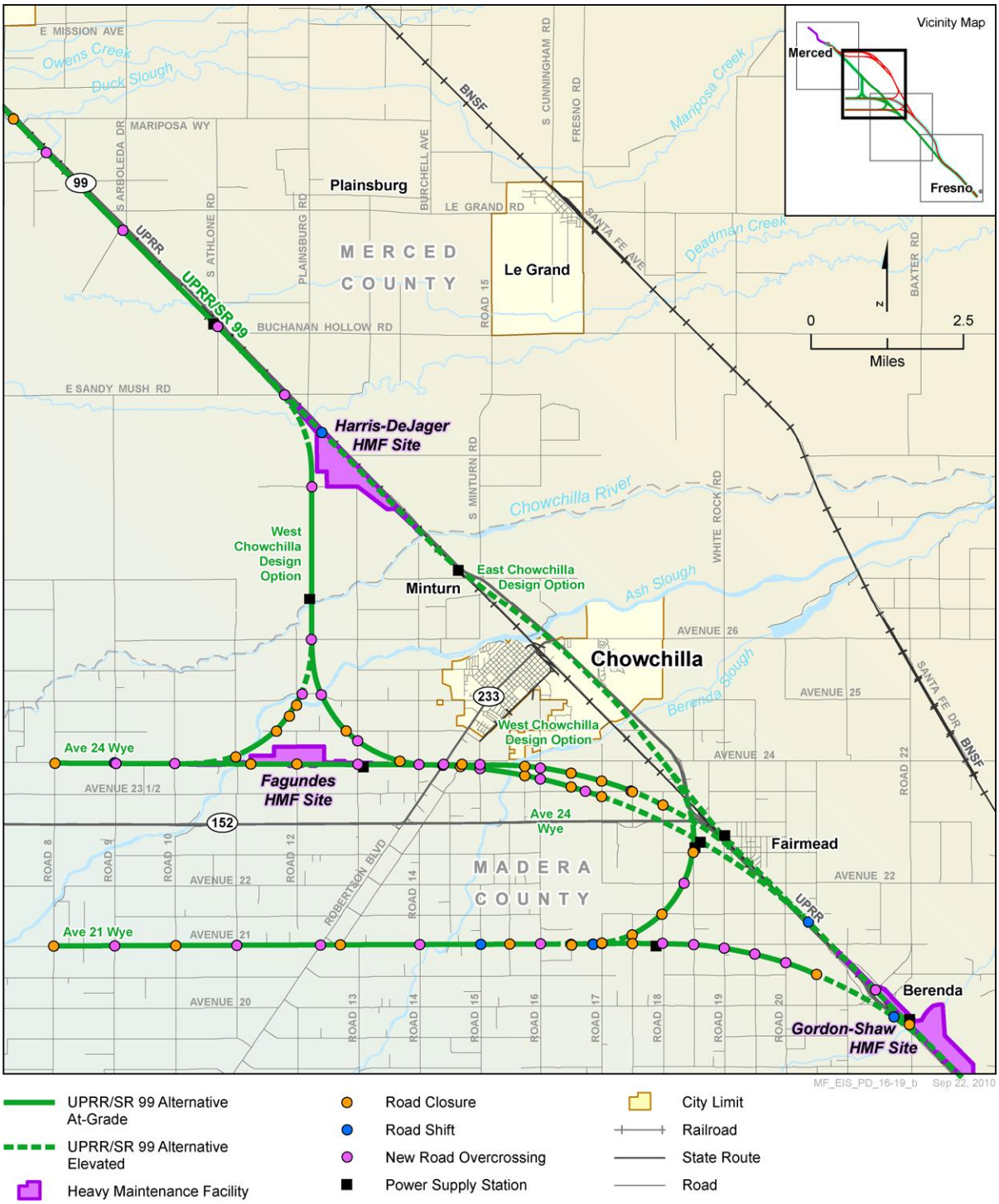


Figure 2
Harris-DeJager Heavy Maintenance Facility Site
Fagundes Heavy Maintenance Facility Site
Gordon-Shaw Heavy Maintenance Facility Site

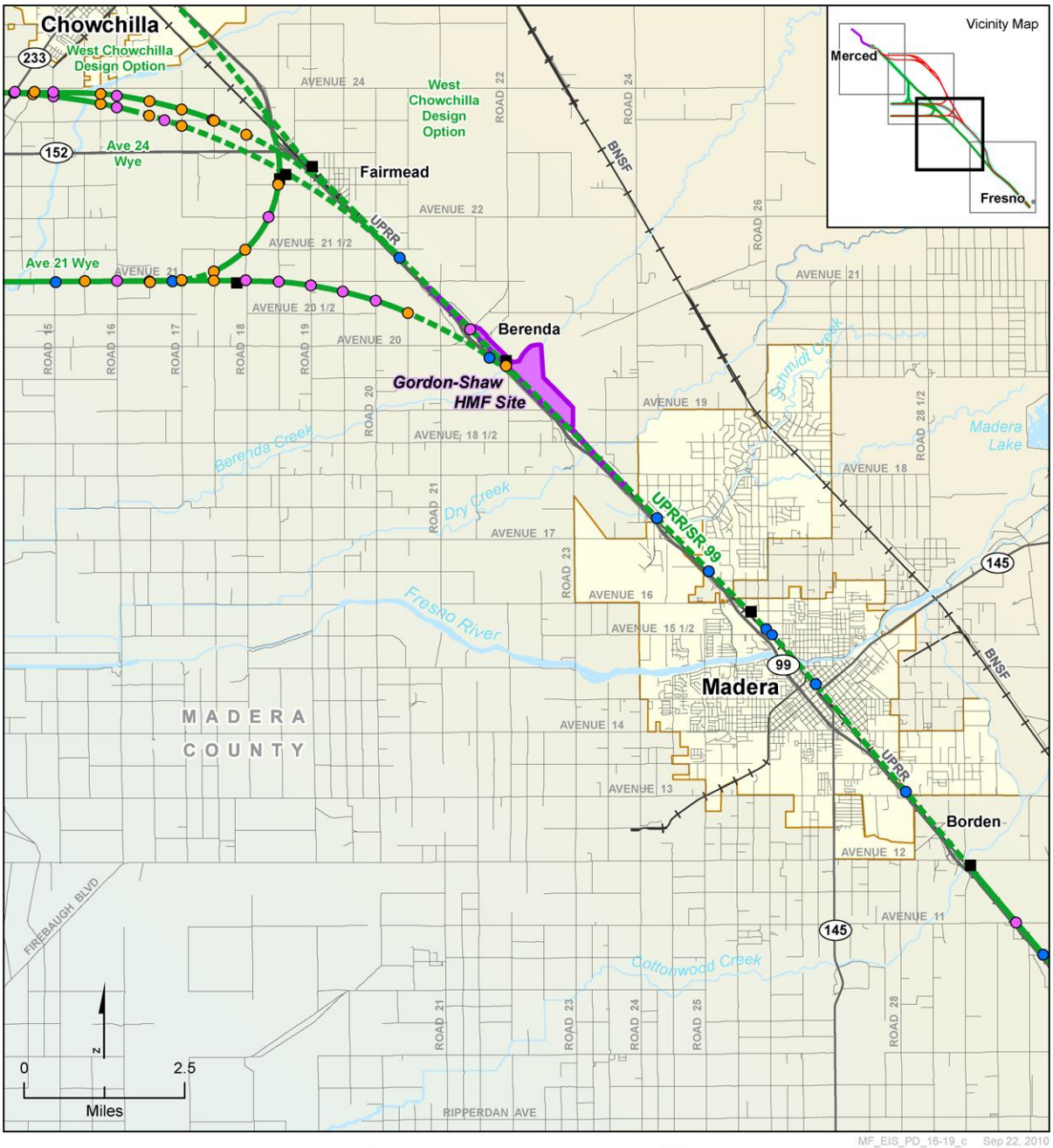


Figure 3
Gordon-Shaw Heavy Maintenance Facility Site

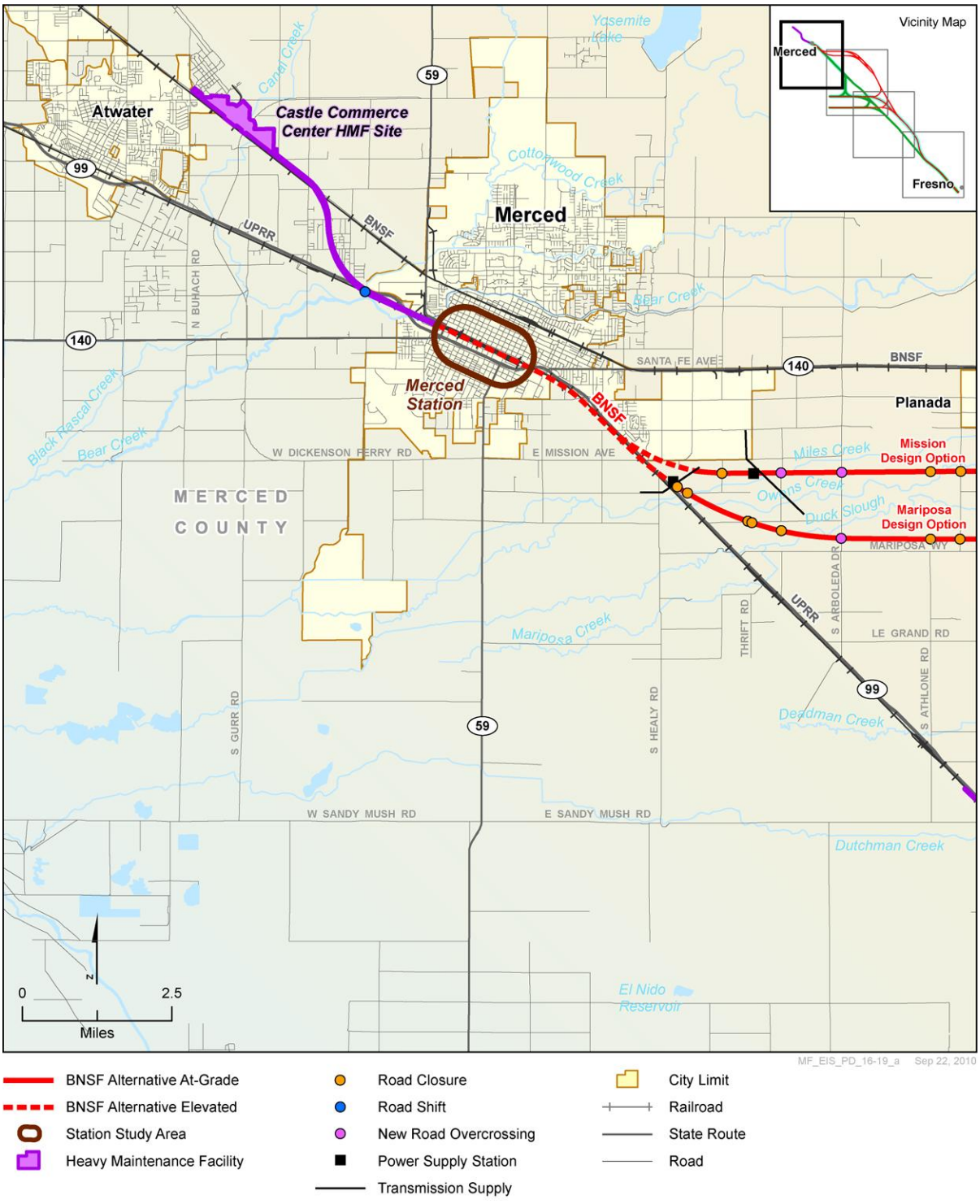


Figure 4
Castle Commerce Center Heavy Maintenance Facility Site

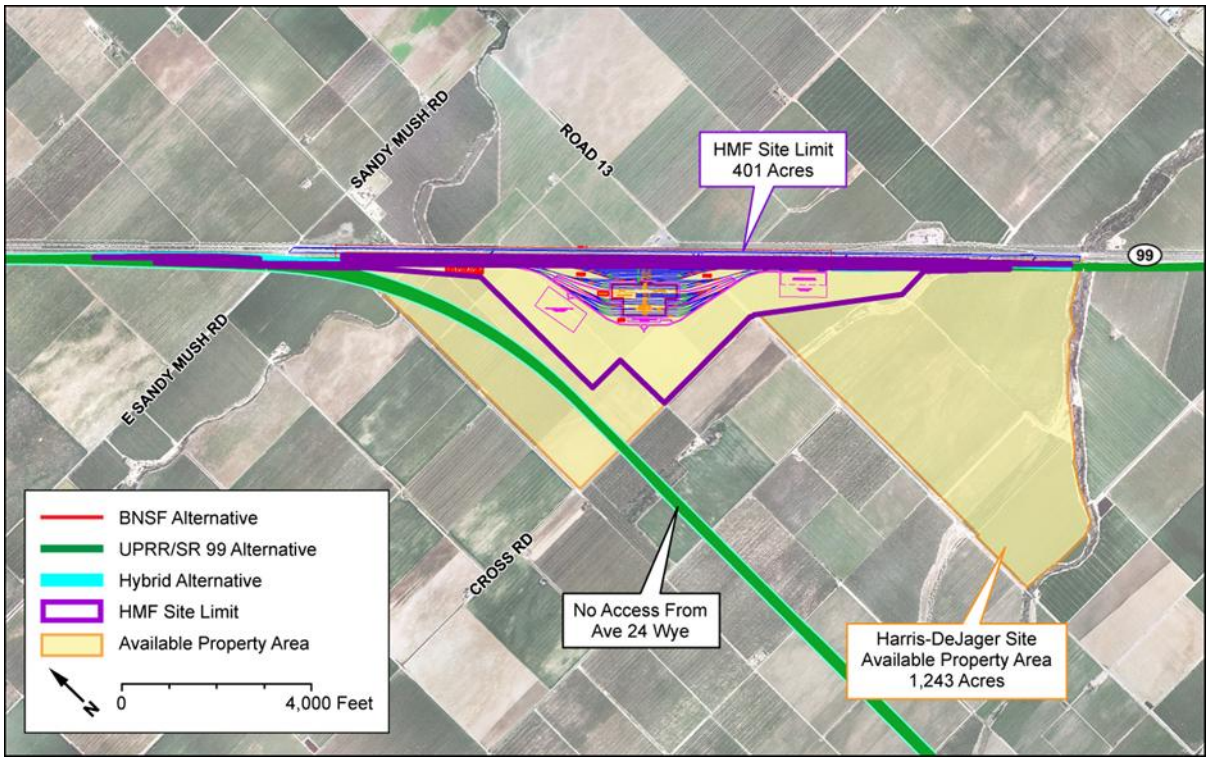


Figure 5
Proposed Harris-Dejager HMF Site Aerial View

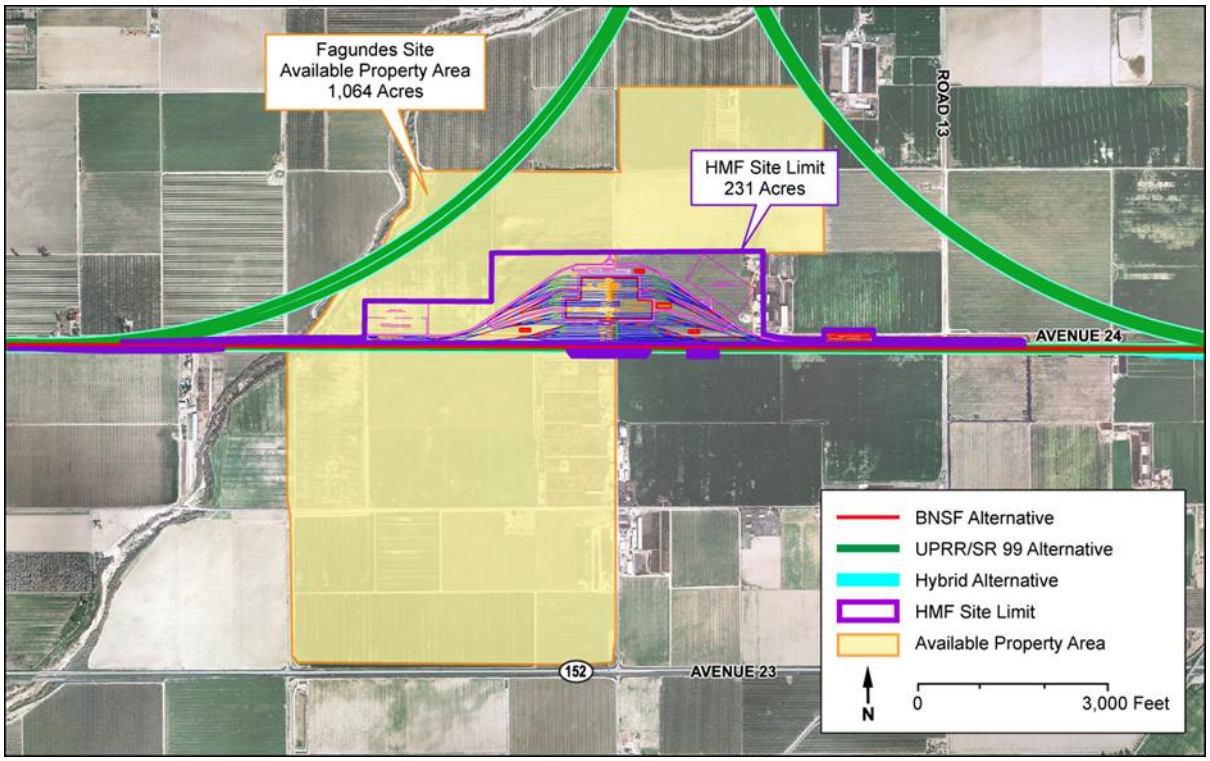


Figure 6
Proposed Fagundes HMF Site Aerial View

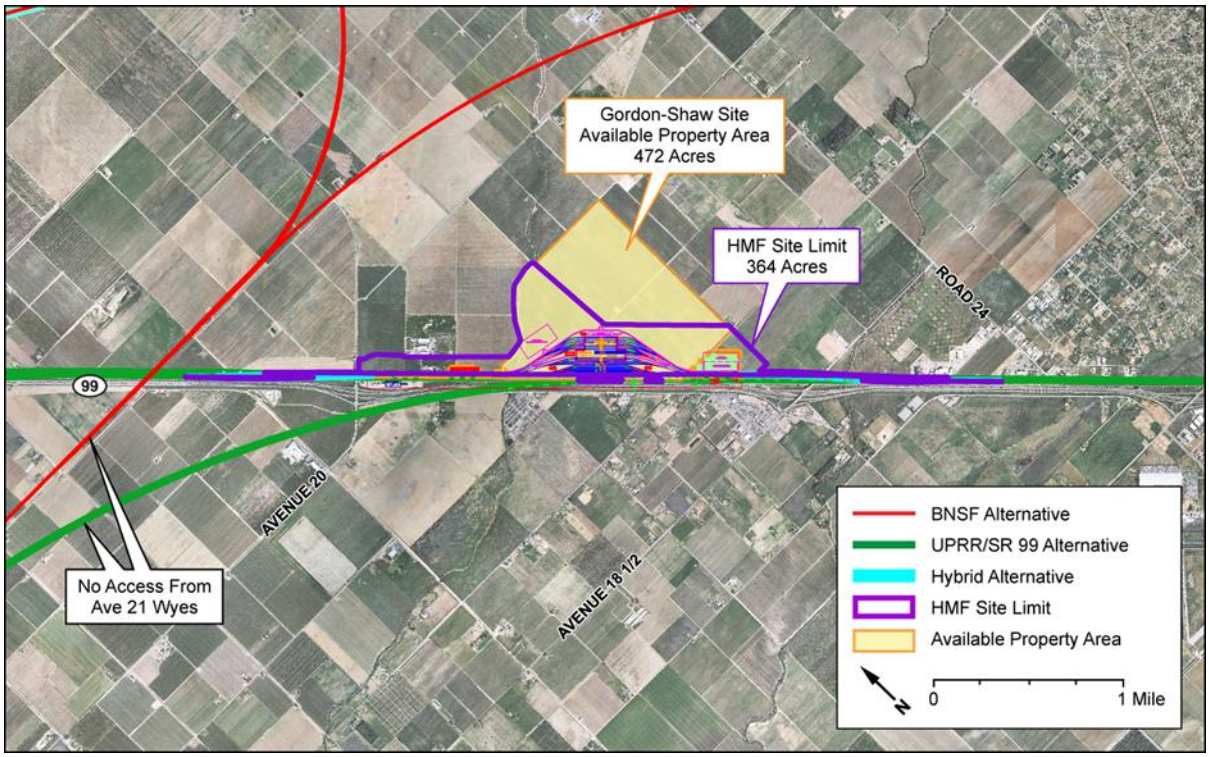


Figure 7
Proposed Gordon-Shaw HMF Site Aerial View

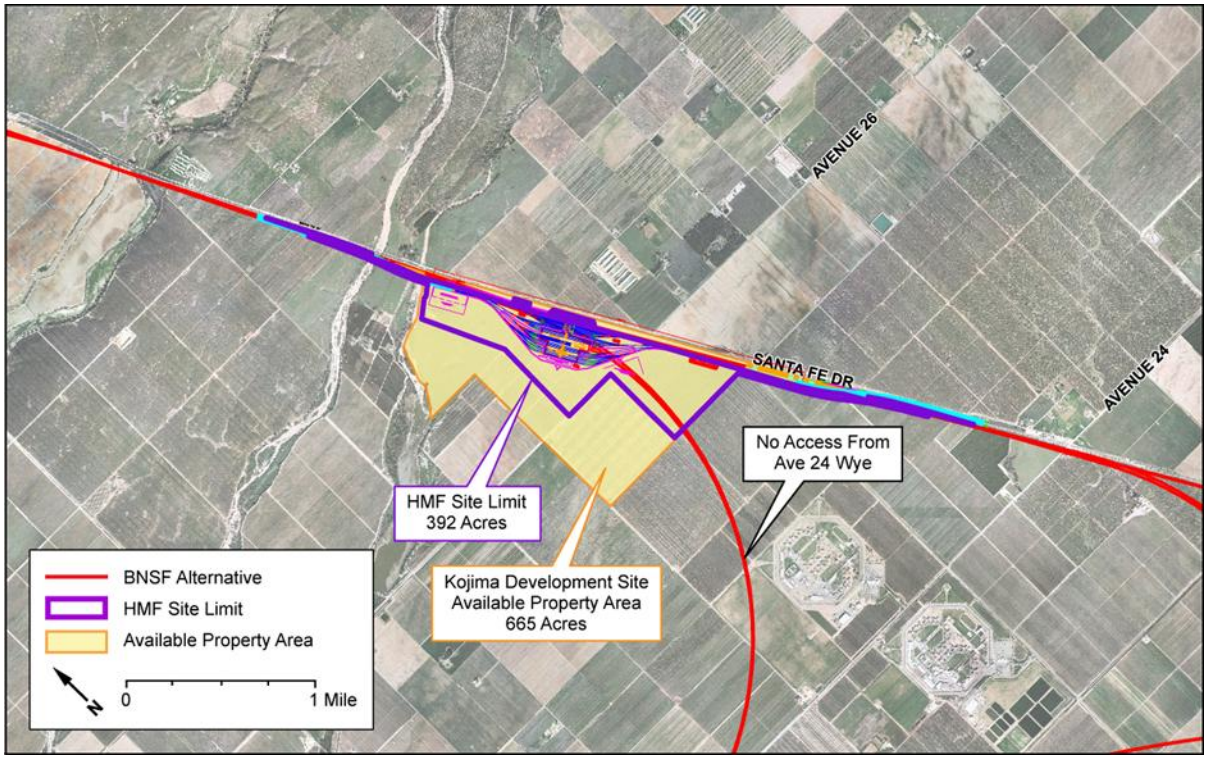


Figure 8
Proposed Kojima Development HMF Site Aerial View

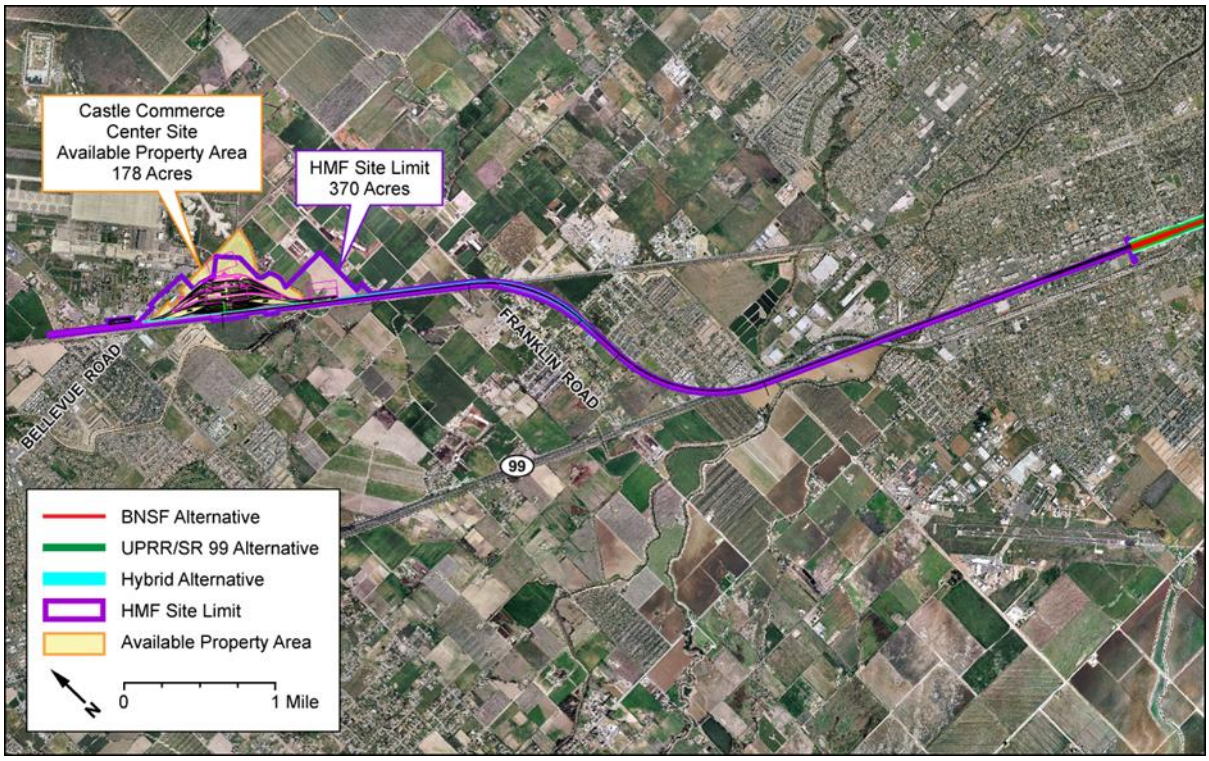


Figure 9
Proposed Castle Commerce Center HMF Site Aerial View

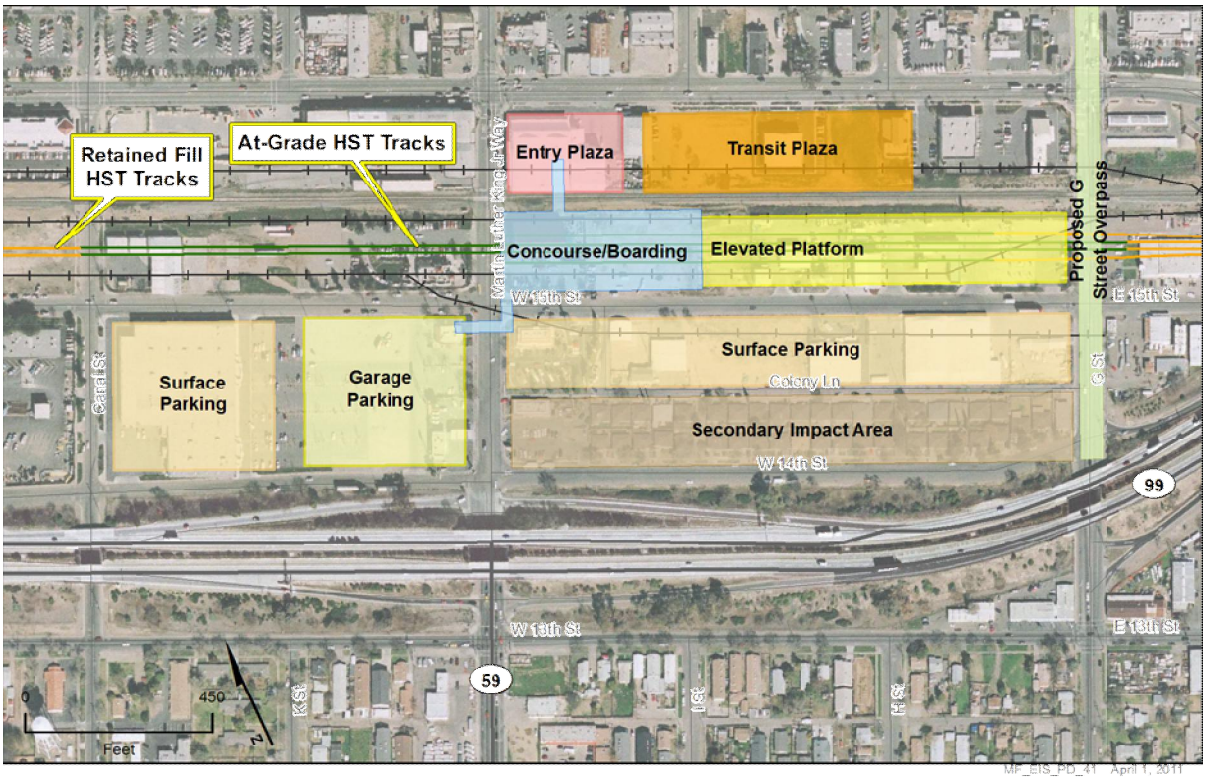


Figure 10
Merced Station Location

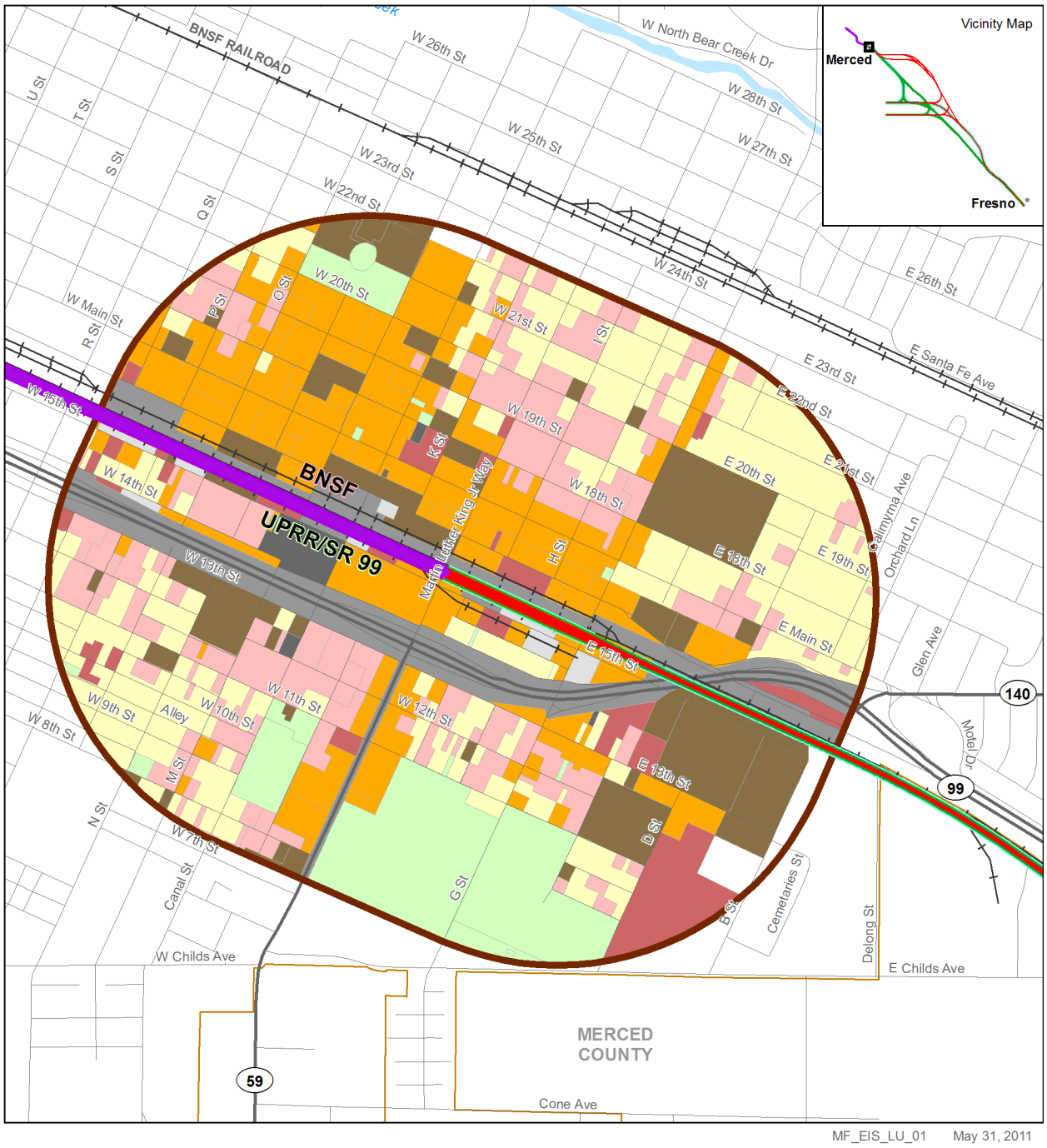
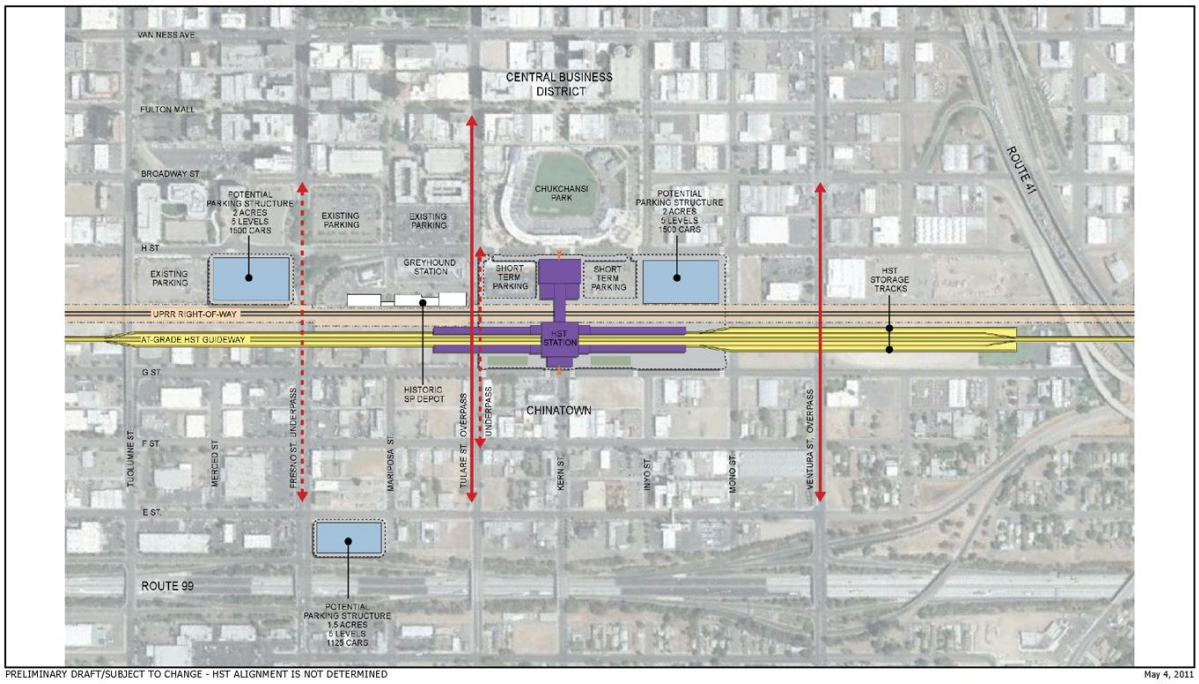


Figure 11
Existing Land Uses in the
Downtown Merced Station Area



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED

May 4, 2011

STATION ENTRANCE

KEY PEDESTRIAN LINKAGE

OPEN SPACE

STATION CAMPUS BOUNDARY

RIGHT-OF-WAY BOUNDARY

ROADWAY MODIFICATION

NOT TO SCALE

Figure 12
Fresno Station Location

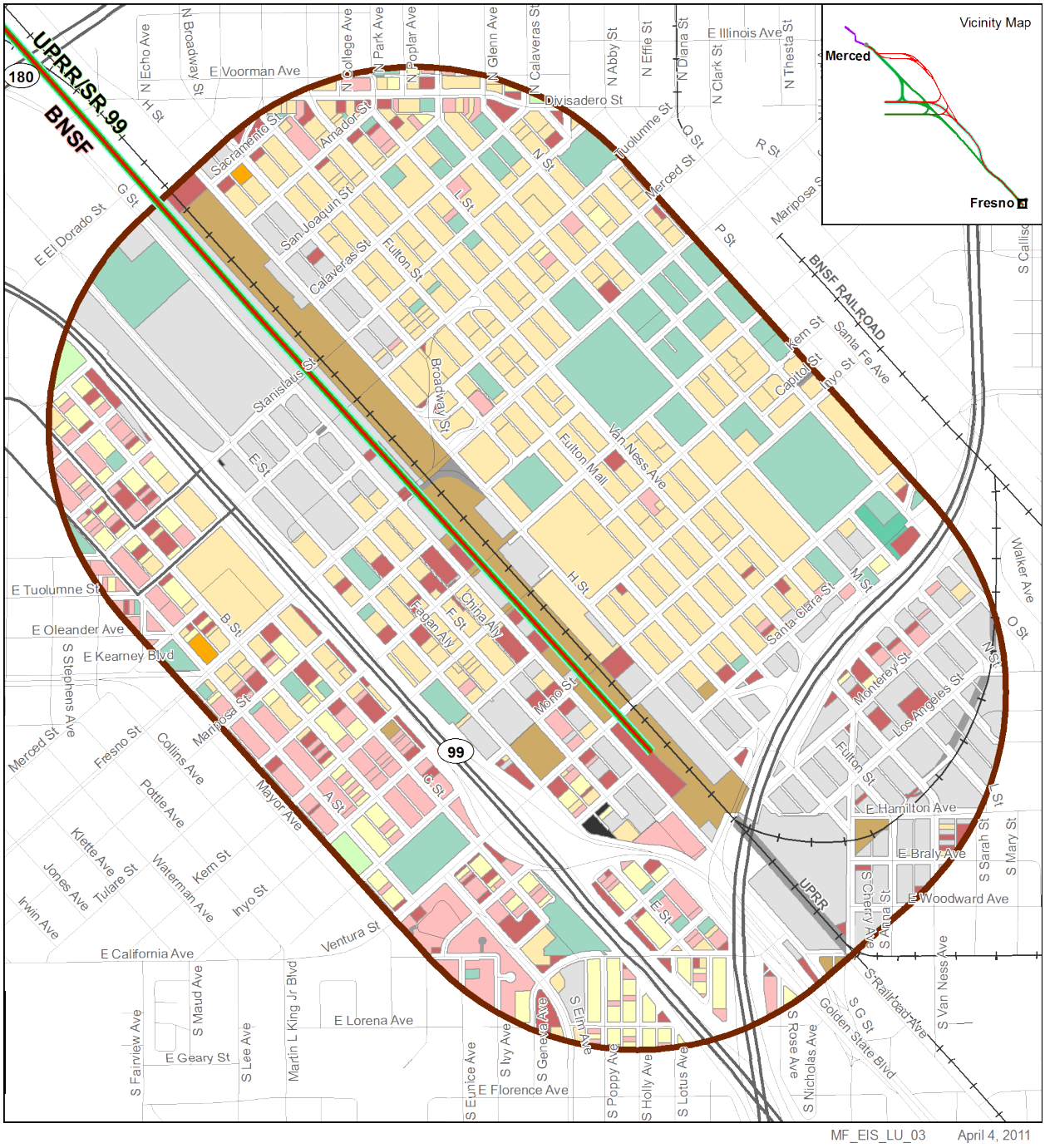


Figure 13
Existing Land Uses in the Downtown Fresno Station Study Area