California High-Speed Train System

Map based on 2005 Statewide Programmatic EIR/S preferred route, and staff recommendation to Authority Board December 19, 2007
Mapping Sources: US Census 2000; CA Dept. of Conservation, Farmland Mapping and Monitoring Program 2000;
California Resources Agency Legacy Project 2002; CA Dept. of Fish and Game 1999

- **Provide a new mode of high-speed intercity travel to link major metropolitan areas**
- **Forecasted to carry as many as 100 million passengers annually by the year 2035**
- **800-mile system with stations built to allow for express service**
- **Service linking the San Francisco Bay Area, Central Valley and Southern California**
- **100% clean electric power**
- **Estimated travel time from San Francisco to Los Angeles: less than 2 hours 40 minutes**

California High-Speed Train Project Sections

High Speed Train Project Sections

San José to Merced

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Purpose and Objectives of the Statewide HST System

Purpose

The purpose of California High-Speed Train (HST) projects is to implement the statewide HST system in sections consistent with program-level (Tier 1) decisions that will:

- Link Southern California cities, the Central Valley, Sacramento and the Bay Area
- Provide new transportation option that increases mobility throughout California
- Provide reliable HST service that delivers predictable and consistent travel times using electric powered steel wheel trains
- Provide a transportation system that is commercially viable

San Jose to Merced Section

In implementing the HST system and the program-level (Tier 1) decisions in the San Jose to Merced section, the Authority's objective is to provide reliable high-speed electric powered train service from San Jose to Merced through the Pacheco Pass that delivers predictable and consistent travel times. The San Jose to Merced section will connect to the San Francisco to San Jose section to the north and the Central Valley section in the east. The system will:

- Provide access to a new transportation mode
- Connect to and be part of the statewide system
- Contribute to increased mobility throughout California

Design Objectives and Evaluation Criteria

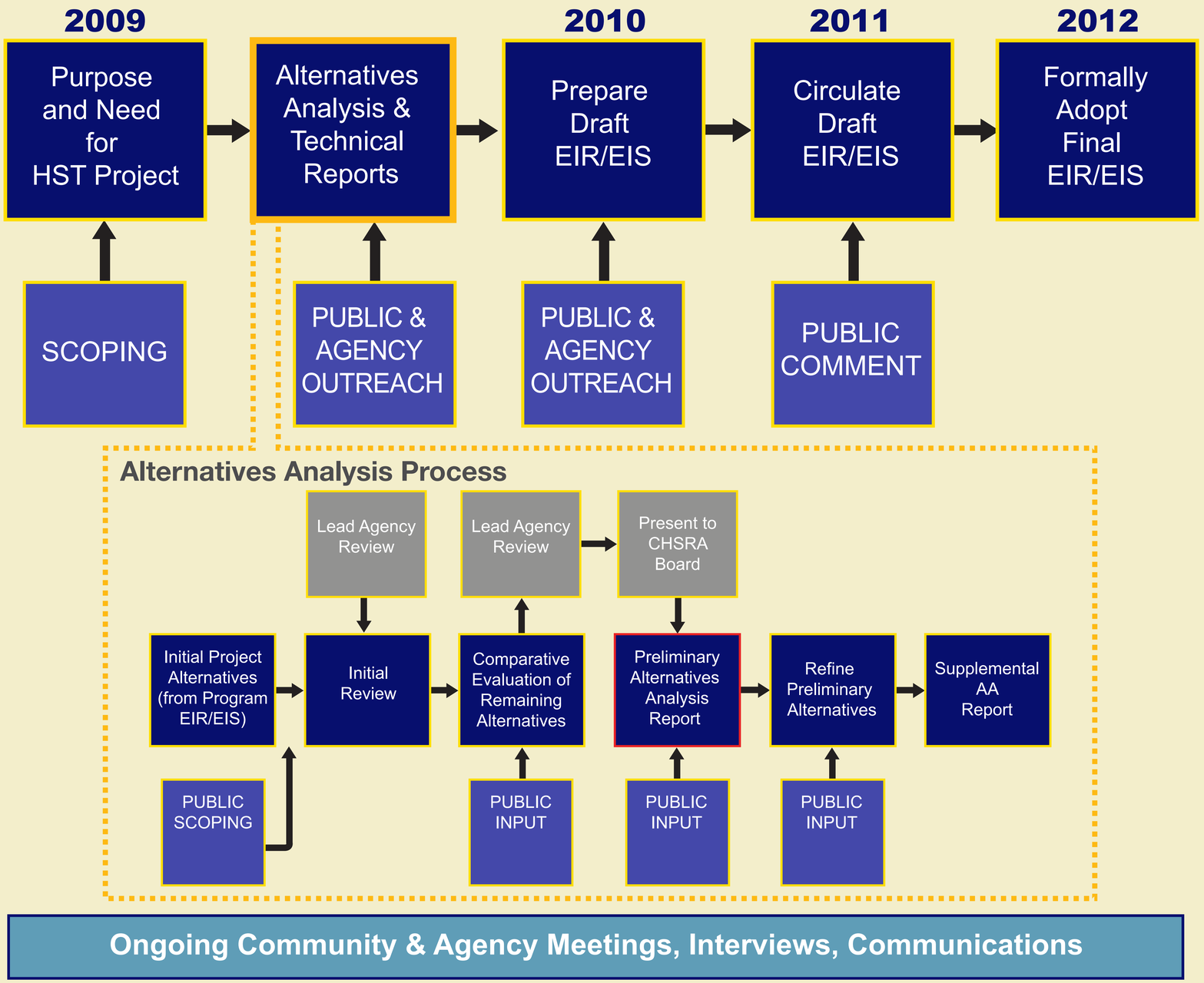
Objective	Criteria
Maximize ridership & revenue potential	Minimize travel time
Maximize accessibility	Intermodal connections
Minimize operating and capital costs	Minimize route length

Evaluation Measures

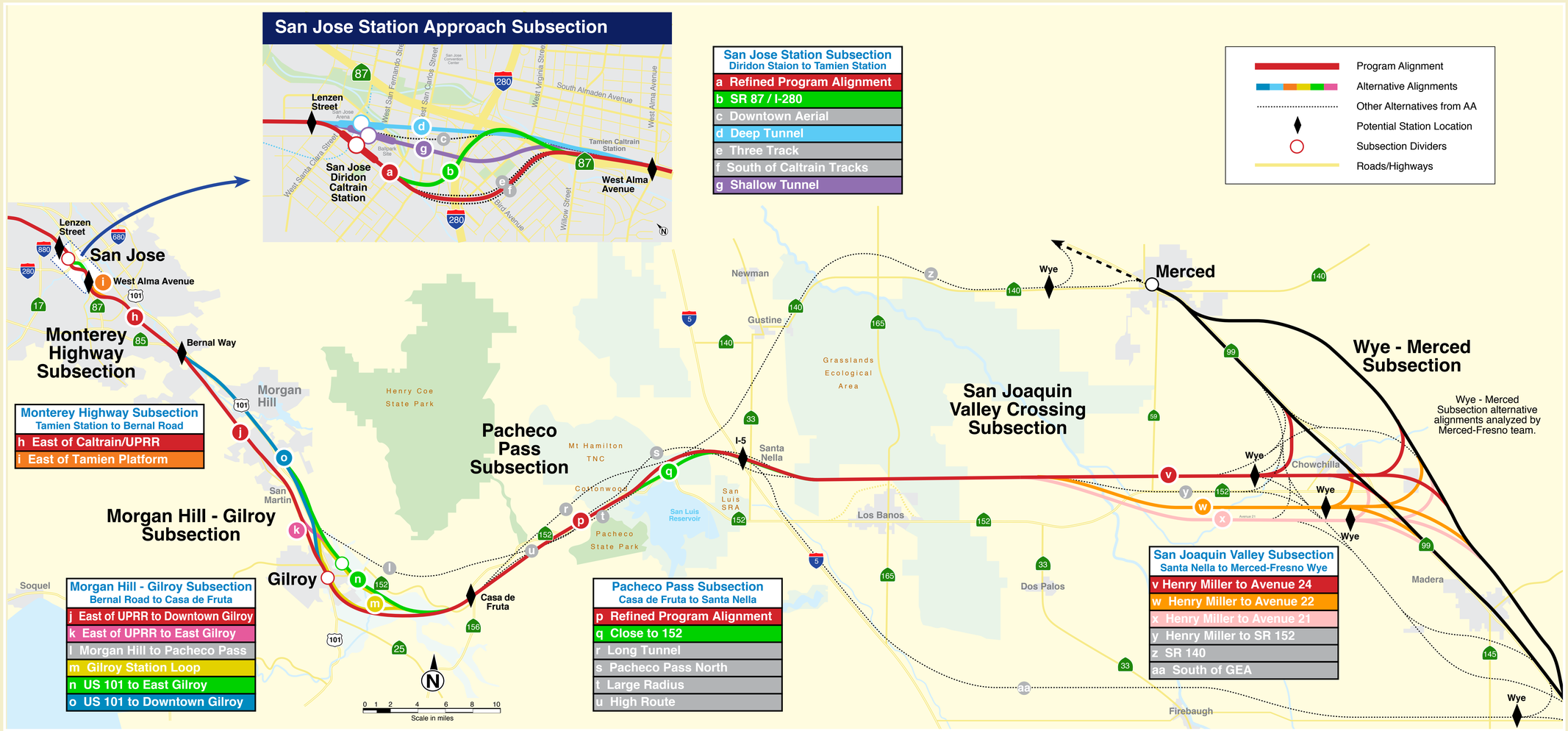
- Minimize disruption to neighborhoods and communities
- Minimize impacts to environmental resources
- Minimize impacts to natural resources
- Land use
- Construction feasibility

Project Environmental Review Schedule and Alternatives Analysis Process

Environmental Review Schedule



San Jose to Merced Section Alignment Alternatives



Planned Stations

San Jose

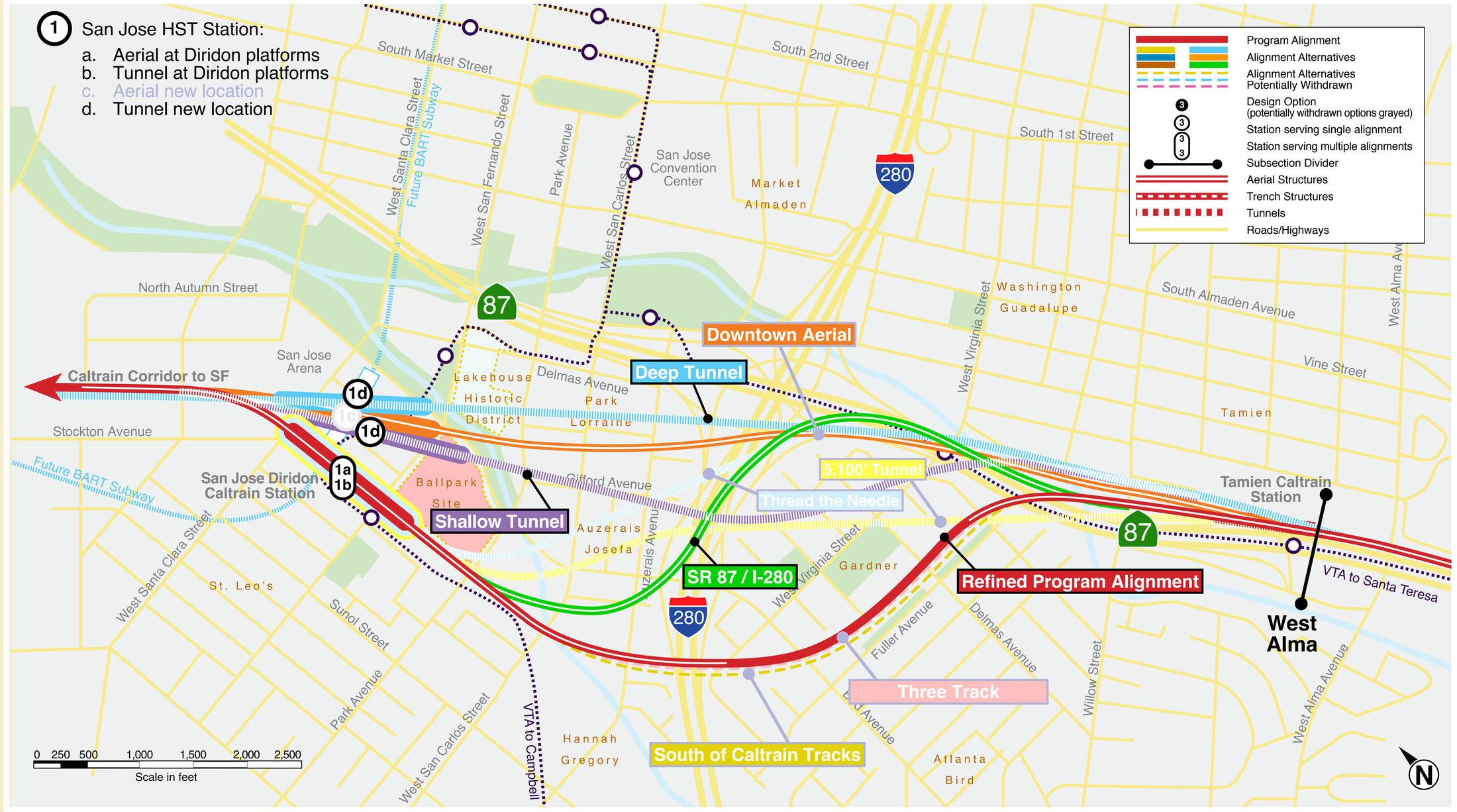
Gilroy

Merced

Estimated Travel Times

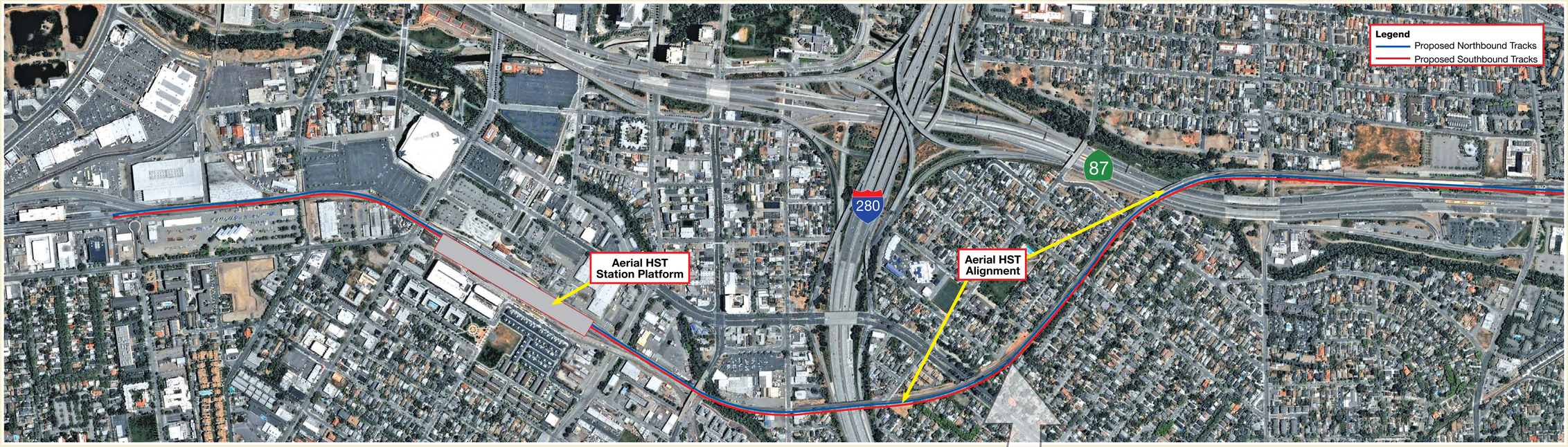
- San Francisco to San Jose: **30 mins**
- San Jose to Gilroy: **15 mins**
- Gilroy to Merced: **33 mins**
- San Francisco to Merced: **1 hr 14 mins**

South of San Jose Diridon Station to Tamien Subsection



Refined Program Alignment

Utilizes much of existing Caltrain Corridor to greatest extent possible
Curvature not conducive to high speeds



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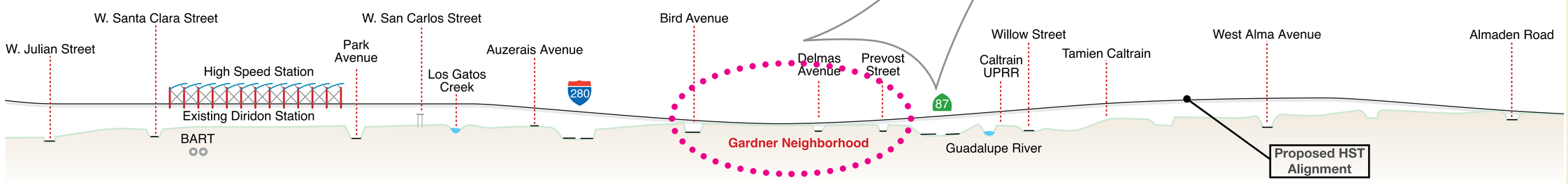
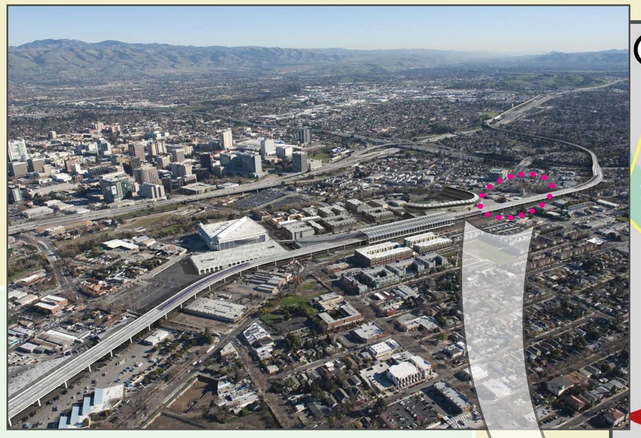
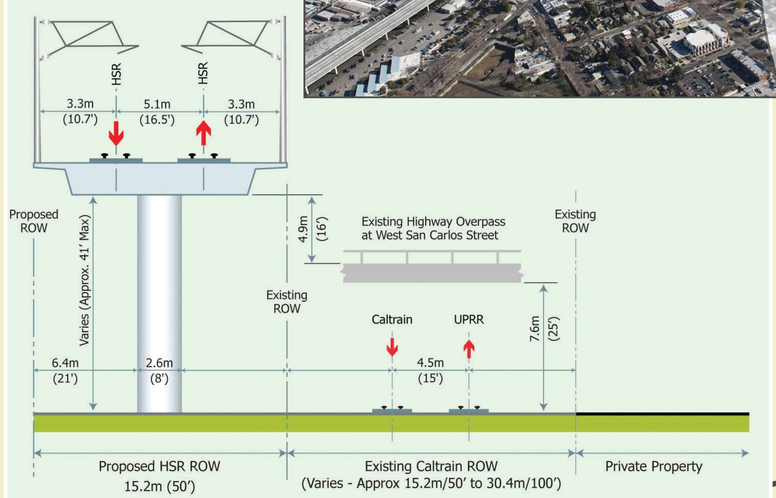
Surface disruption Disruption to existing railroad, traffic, utilities	Community, residential and business impacts Right-of-way impacts Local traffic and detour routing Aerial structures potentially divisive	Limited soil, groundwater constraints Noise, vibration and visual impacts



DRAFT PROFILE VIEW – subject to change

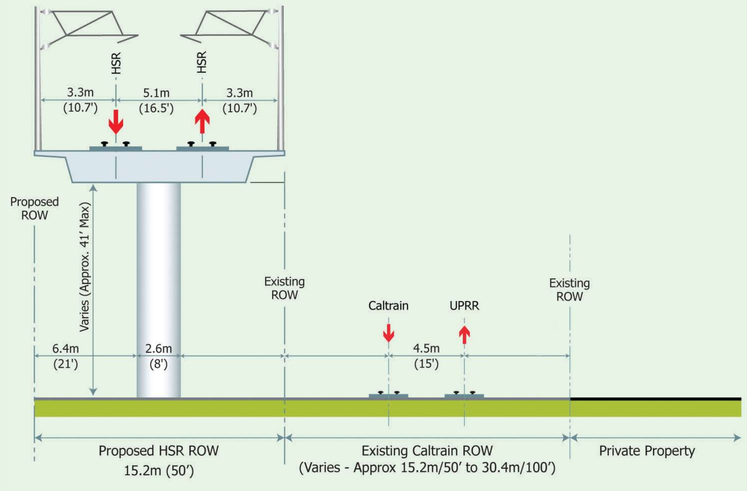
Refined Program Alignment Cross-Sections:
West San Carlos, Auzerais, West Virginia and Gardner



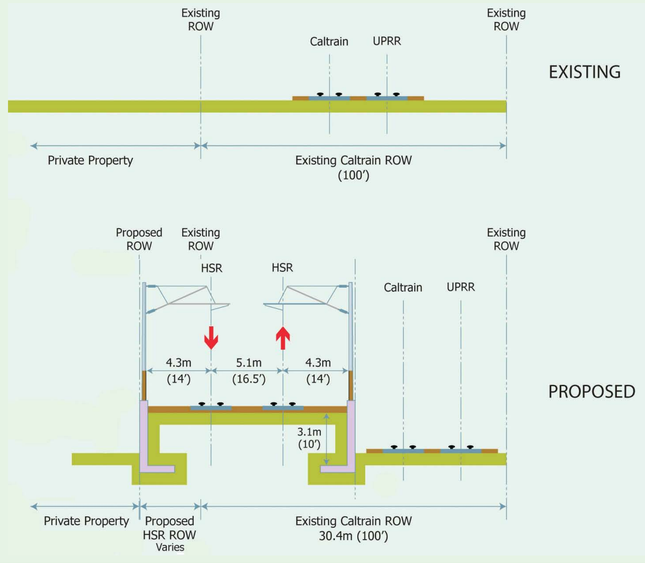


Program Alignment at West San Carlos

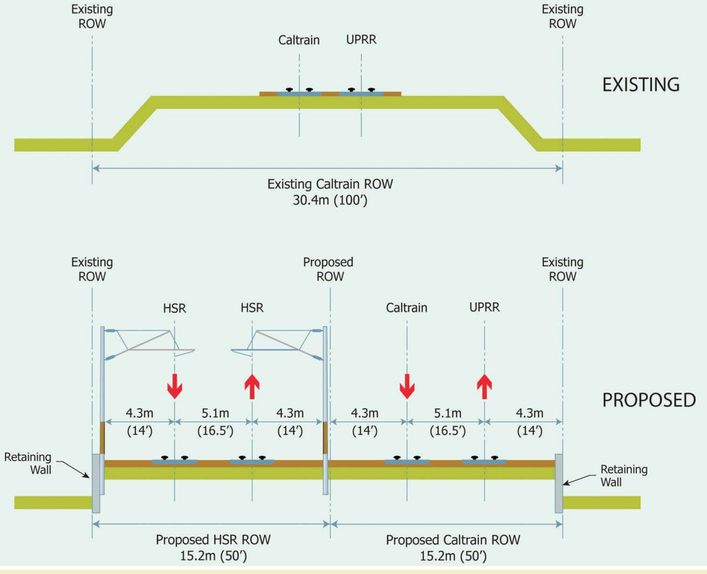
Program Alignment at Auzerais



Program Alignment at West Virginia

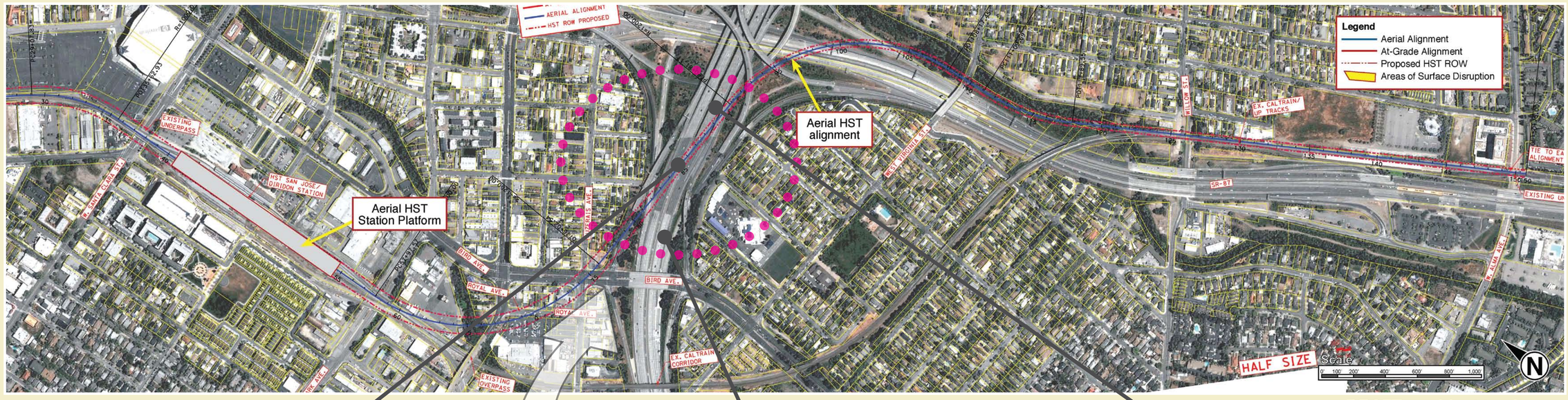


Program Alignment at Gardner



I-280/SR-87 Alignment Description

Follows existing transportation corridor to greatest extent possible
Curvature of alignment not conducive to high speeds



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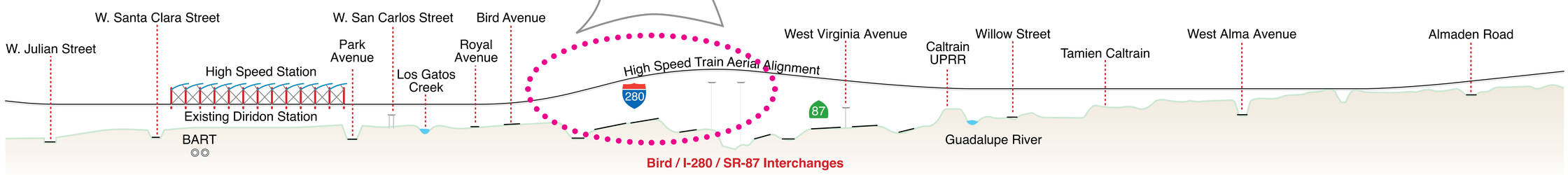
City of San Jose interested in an iconic bridge structure

Constructability potentially hindered by need to maintain existing freeway operations

Must avoid impacts to I-280 including the support structure underneath the roadway



Aerial Station Option (Refined Program and I-280/SR87 Alignments)

Constructability

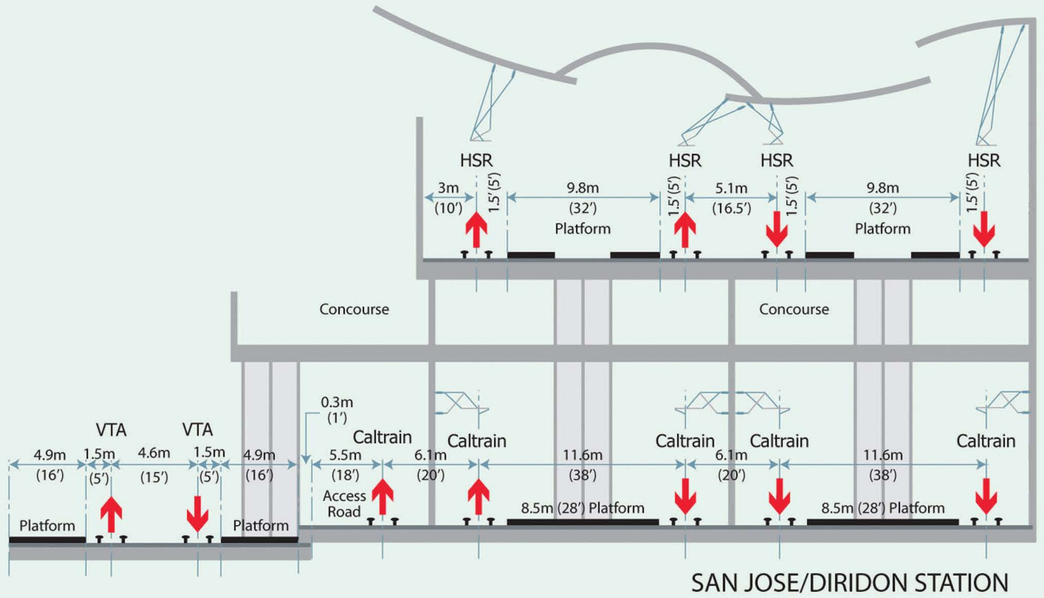
- Surface disruption

Disruption to Communities

- Residential/ business impact
- Local traffic and detour routing

Environmental and Natural Resource Impacts

- Noise, vibration, dust and visual impacts



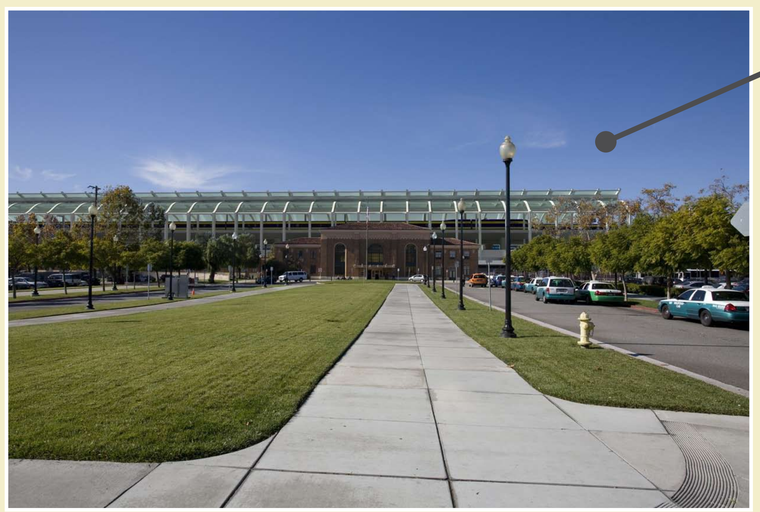


Photo simulation of Diridon Station with Aerial HST Station

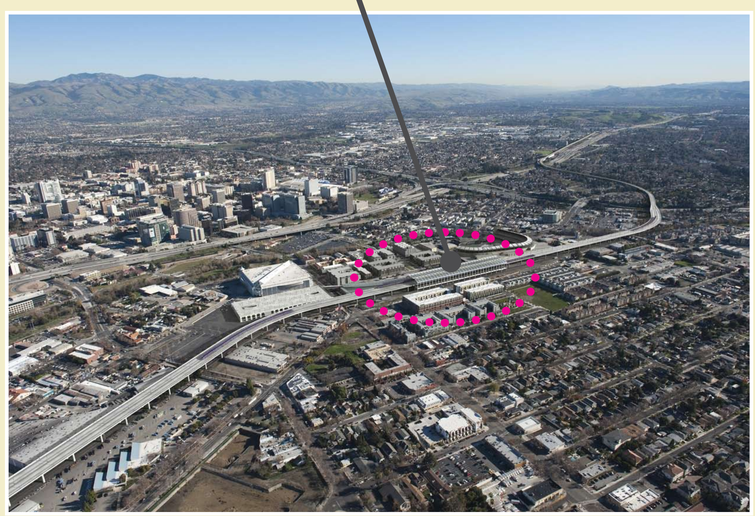
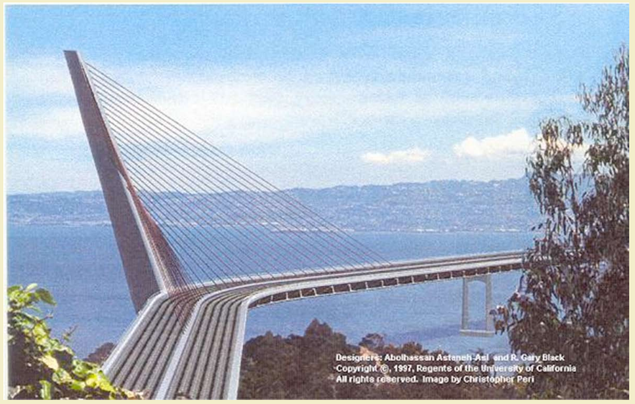


Photo simulation of refined program alignment through downtown San Jose

Examples of Iconic Bridges and HST Stations

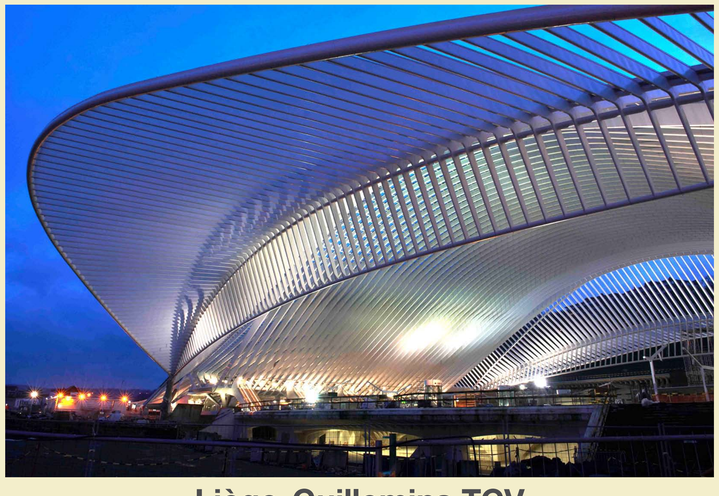


An Innovative Curved
Cable-Stayed Bridge

Seri Wawasan Bridge

Iconic Bridge Concept for
I-280/SR 87 Alignment

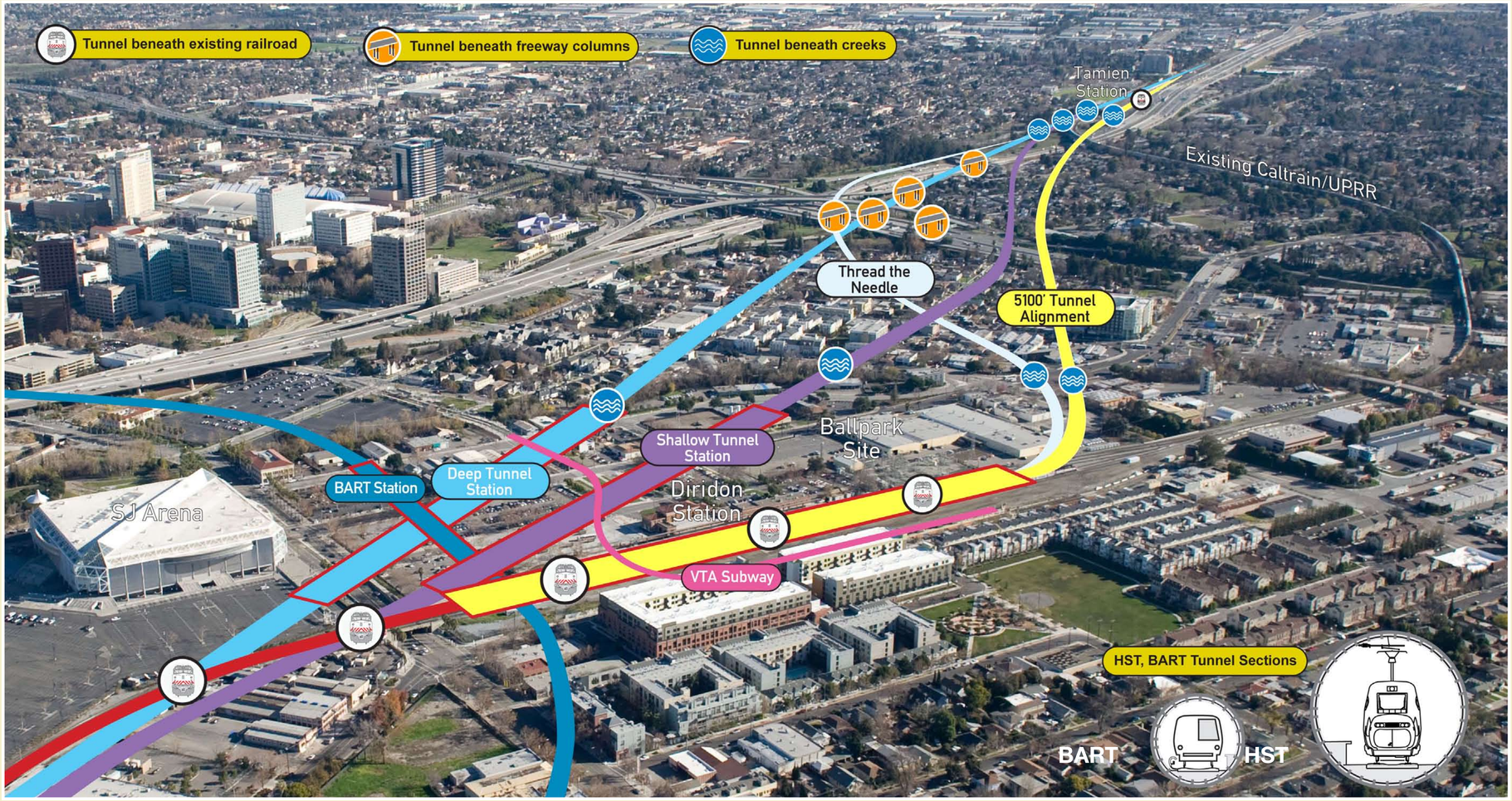
San Jose Station Concept



Liège-Guillemins TGV

Oriente Station in
Lisbon, Portugal

San Jose Tunnel Alternatives



Development of Tunnel Alternatives

- During the scoping process, several tunnel options were recommended
- City of San Jose and Voices of San Jose, a community-based public policy non-profit, identified three tunnel options: (1) Downtown Tunnel; (2) Thread the Needle; (3) 5100 Meter Tunnel
- City of San Jose requested the study of a shallow tunnel option, which may have significantly less constructability and fewer risk issues than a deep tunnel and station, but greater impacts at the surface and to future development

Tunnel Overview – Ground Conditions

Conditions on and under the Ground

SOIL

- Presence of clay, silt, sand and gravel, which go as deep as 1,000 feet below ground level
- These types of soil require ground support to eliminate their tendency to run into tunnel and station excavation, with the potential for causing settlement at the surface

HYDROLOGY

- Groundwater ranges from 4 to 18 feet below the ground surface (presence of a high groundwater table)
- Construction must be water tight to prevent excessive groundwater inflows

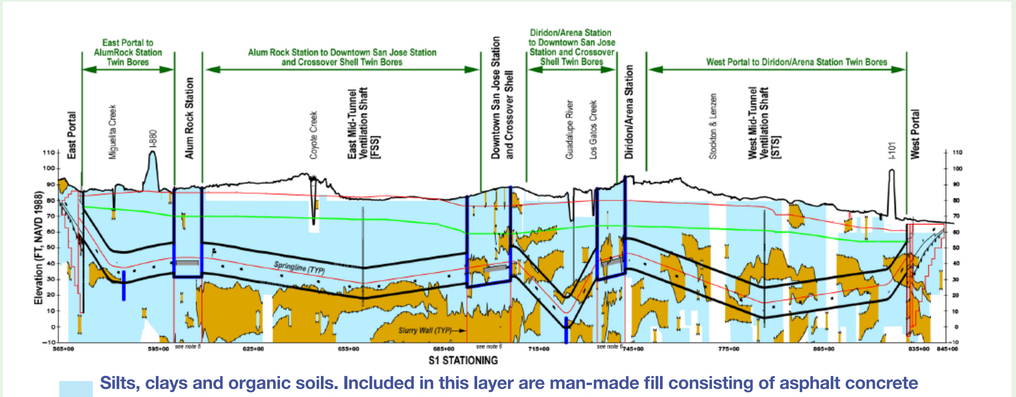
EXISTING BUILDINGS AND STRUCTURE FOUNDATIONS

- Tunnel would be located in an urban area, among a dense concentration of existing buildings and structure foundations (including I-280/SR 87)
- The primary access point for construction will be at the portals and at cut and cover locations
- Surface impacts will occur when performing ground stabilization and constructing access points, ventilation vents, and openings for emergency response
- In the case of a shallow tunnel, cut and cover construction techniques will require full access to ground/surface along planned non-tunnel track alignment and station location, as well as some areas surrounding construction for staging and equipment

Ground investigations performed for the proposed BART project show the presence of silty clay, sand and gravel. It is assumed that the proposed HST tunnel and station would be excavated in similar ground conditions.

Inherent Risks and Uncertainties

- Ground settlement requiring ground pre-treatment
- Earthquakes and subsequent liquefaction
- Major ground surface impacts, including vibration from construction and operations and fans providing construction ventilation, right-of-way acquisitions for shafts, portals, and station access
- Impacts on Guadalupe River and Los Gatos Creek
- Impacts on proposed BART station
- Impacts to surface conditions and buildings
- Limited future development above underground HST facilities



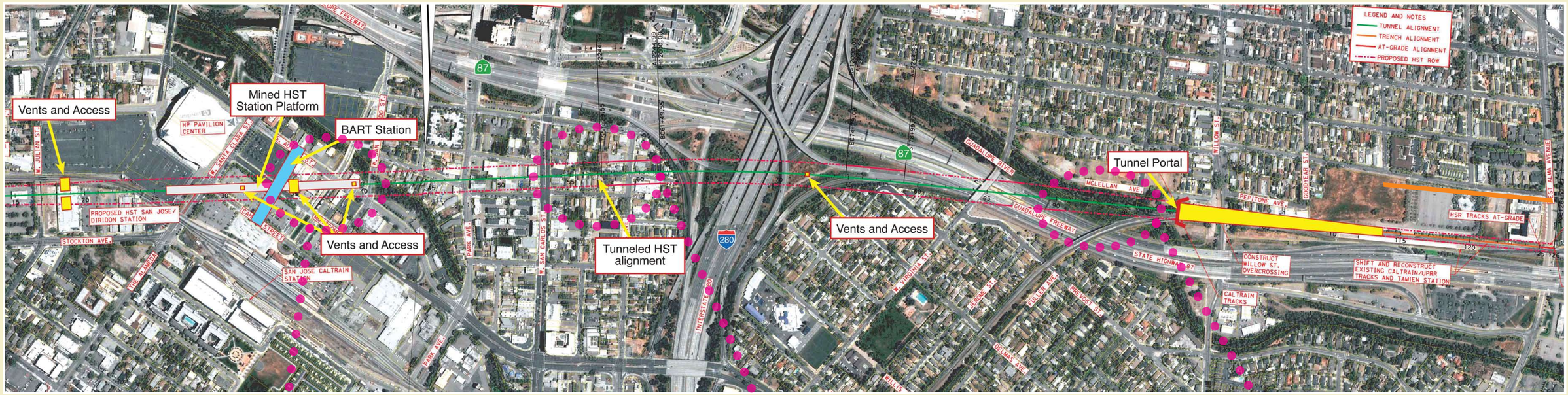
Silts, clays and organic soils. Included in this layer are man-made fill consisting of asphalt concrete and aggregate base encountered most often within five feet below ground surface; thin layers of coarse-grained soil.

Sands and gravels. Included in this layer are cobbles; thin layers of fine-grained soil.

Preliminary Geologic Profile along the Proposed SVRT Project Site (Source: HMM/Bechtel, 2008d)

Conceptual Downtown Tunnel Alignment

Diridon Station to Tamien Station Track Configuration



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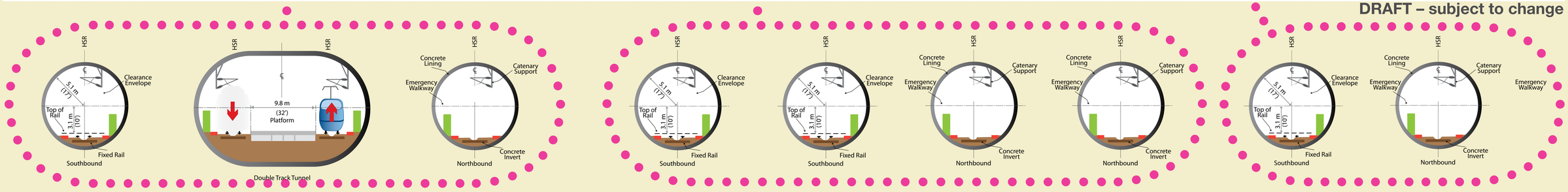

Diridon Station to Tamien Station Cross-Section

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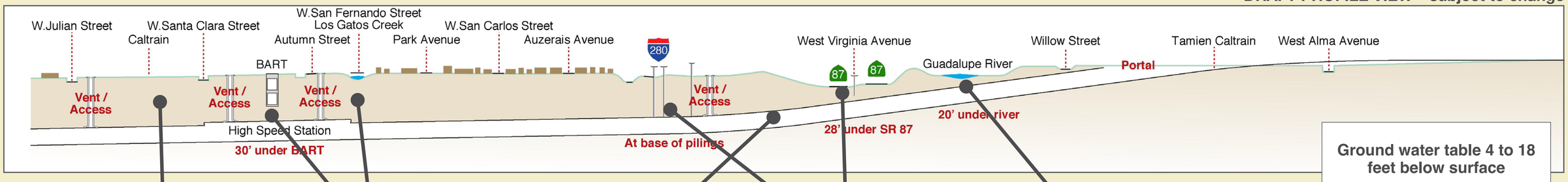


Deep Tunnel Configuration Options

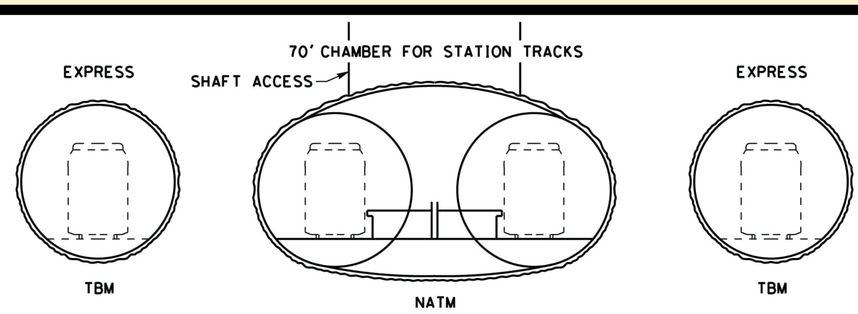
The first step in determining the optimal track and station configuration involved consideration of the various methods currently available. The information below shows the tunnel and station options considered in both cross-section and plan view with pros and cons noted on the left.

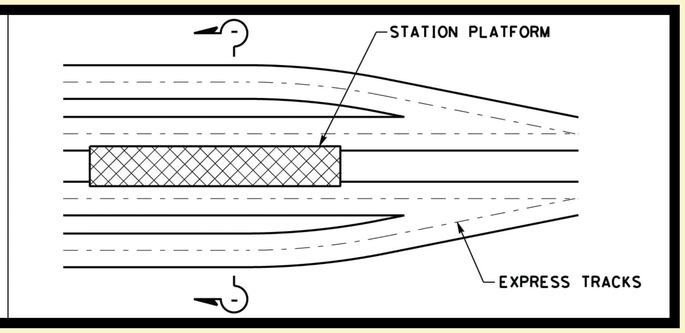
ALTERNATIVE 3

NOTES / COMMENTS:
- 70' WIDE NATM STATION CAVERN
- 2 - 30' DIA. OUTSIDE TBM TUNNELS

PROS:
- SINGLE CAVERN AND ACCESS SHAFT

CONS:
- SIZE IS LARGER THAN (1b) SO TUNNEL CONST. MORE DIFFICULT/RISKY
- COST: BASELINE ALTERNATIVE





Alternative 3 was selected as the best performing option for the conditions and used to develop tunnel layout as shown on next board

ALTERNATIVE 1a

NOTES / COMMENTS:
- 2 - 50' DIA. TBMS AT STATION
- 4 - LAUNCH/RETRIEVAL SHAFTS
- 2 - 30' DIA. OUTSIDE TBM TUNNELS

PROS:
- POSITIVE GROUND CONTROL

CONS:
- MULT. LARGE ACCESS SHAFTS
- TBM/TRAILING GEAR AS LONG OR LONGER THAN STATION
- COST: 1.28 X BASE
- SCHEDULE: VERY LONG (EQUIP)

ALTERNATIVE 1b

NOTES / COMMENTS:
- 2 - 50' WIDE NATM STATION CAVERNS
- 2 - 30' DIA. OUTSIDE TBM TUNNELS

PROS:
- CAN EXCAVATE TO ACTUAL OUTLINE
- SINGLE ACCESS SHAFT

CONS:
- 2 CAVERNS MORE EXPENSIVE THAN ONE
- COST: 1.38 X BASE

ALTERNATIVES 2a & 2b

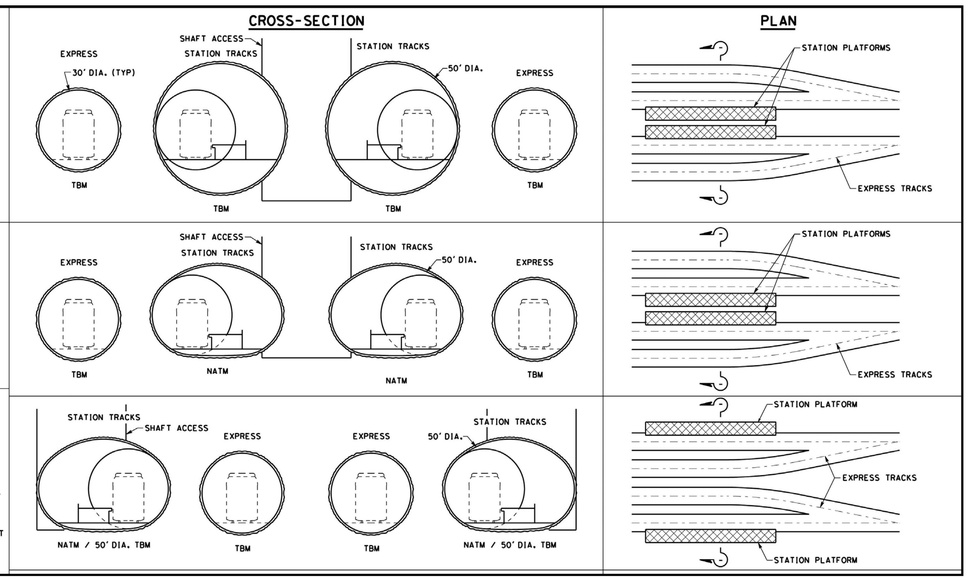
NOTES / COMMENTS:
- 2 - 50' WIDE NATM STATION CAVERNS
- OR, 2 - 50' DIA. TBM STATION TUNNELS
- 2 - 30' DIA. INSIDE TBM TUNNELS

TBM PROS:
- POSITIVE GROUND CONTROL

TBM CONS:
- MULTIPLE ACCESS SHAFTS
- TBM/TRAILING GEAR ALMOST AS LONG AS STATION
- COST: 1.28 X BASE
- SCHEDULE: VERY LONG (EQUIP)

NATM PROS:
- CAN EXCAVATE TO ACTUAL OUTLINE

NATM CONS:
- ADDITIONAL ACCESS SHAFT
- COST: 1.49 X BASE



ALTERNATIVE 4a/4b

NOTES / COMMENTS:
- 60' DIA. EPBM TUNNEL
- 2 - 30' DIA. TBM OUTSIDE TUNNELS
- OR, 1 - 60' WIDE NATM CAVERN WITH 2 - 30' DIA. OUTSIDE TBM TUNNELS

4a PROS:
- SAME PROS AS (1a)

4a CONS:
- SAME CONS AS (1a)
- COST: 1.07 X BASE
- SCH. LONGER THAN NATM
- LARGEST TBM IN WORLD
- RUNNING TRACK GEOMETRY

4b PROS:
- SAME PROS AS (3)

4b CONS:
- SAME CONS AS (3) EXCEPT AMPLIFY SIZE/RISK
- COST: 1.10 X BASE
- SCHEDULE: RELATIVELY SHORTER THAN TBM
- RUNNING TRACK GEOMETRY

ALTERNATIVE 5

NOTES / COMMENTS:
- 1 - 140' WIDE NATM CAVERN AT THE STATION
- 2 - 30' DIA. TBM TUNNELS TO STATION AREA

PROS:
- NONE PERCEIVED

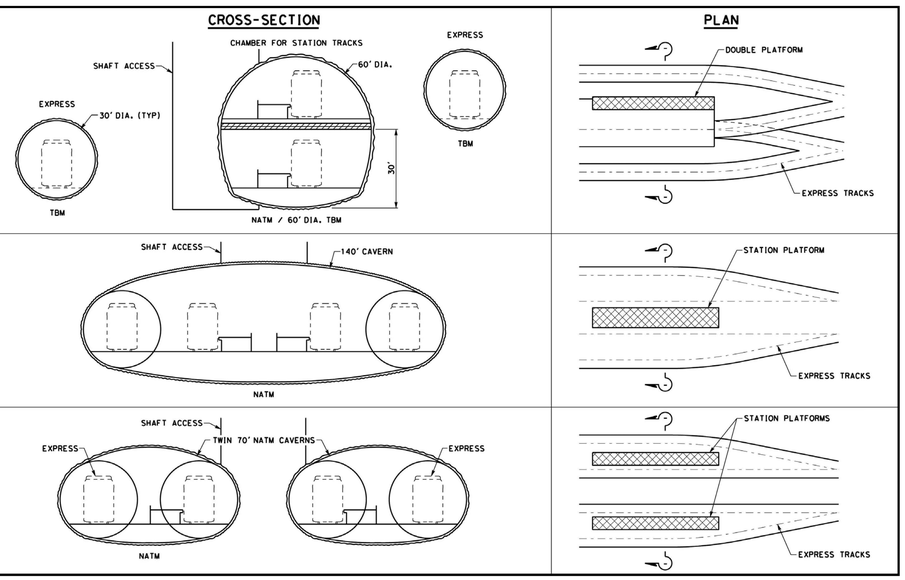
CONS:
- EXCAVATED OPENING SIZE PROHIBITIVELY LARGE
- NO ADVANTAGE TO CONSTRUCTING RUNNING TUNNELS BY NATM - MAKES ADJACENT RUNNING TUNNEL CONSTRUCTION MORE DIFFICULT
- COST: 2.76 X BASE

ALTERNATIVE 6

NOTES / COMMENTS:
- 2 - 70' WIDE NATM CAVERNS AT THE STATION

PROS:
- NONE PERCEIVED

CONS:
- UNNECESARILY COMPLICATED/RISKY COMPARED TO SINGLE CENTER PLATFORM CAVERN
- NO ADVANTAGE TO CONSTRUCTING RUNNING TUNNELS BY NATM - MAKES ADJACENT RUNNING TUNNEL CONSTRUCTION MORE DIFFICULT
- COST: 1.60 X BASE

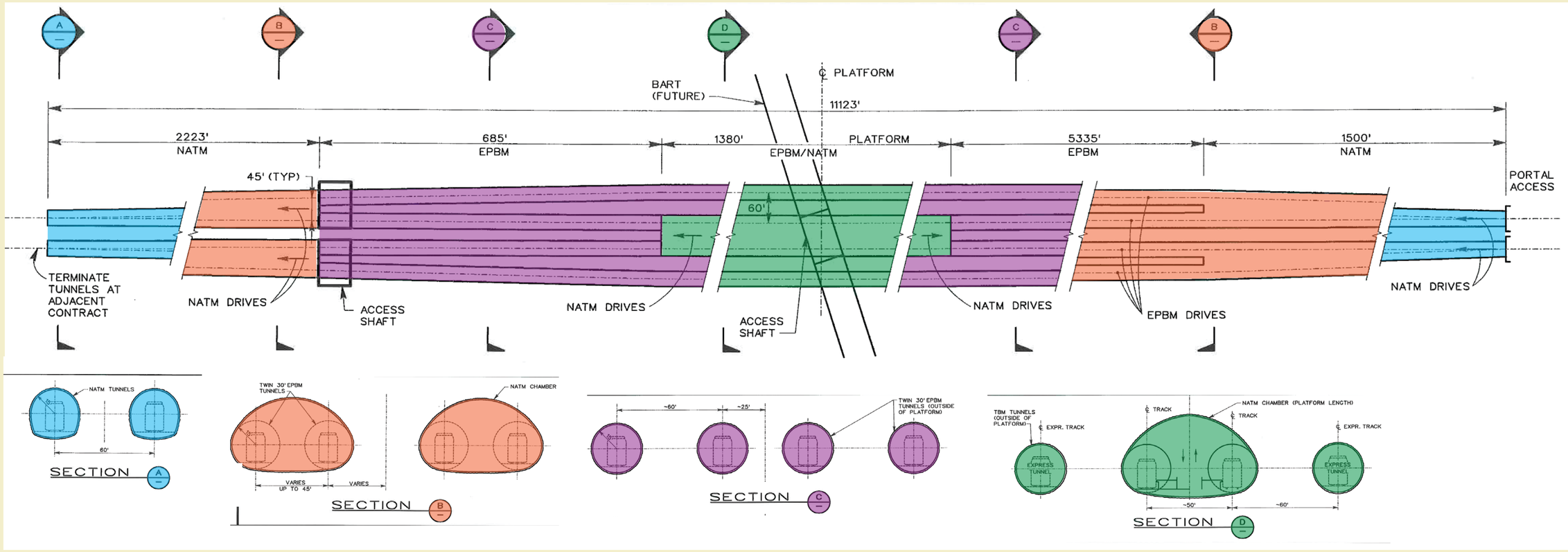


Project Specific Requirements for Deep Tunnel Alignments

- **Deep tunnel and station**
  - Alignment must traverse under I-280 interchange foundations, SR 87, Guadalupe River, Los Gatos Creek, planned BART station
  - At station, ~140 ft. depth anticipated
- **Large station**
  - ~1,380 ft. long with cross section of 40 ft. high by 70 ft. wide, includes a center platform and two tracks
- **Special track work required**
  - Multiple track configurations, including 2 bore, 4 bore, non-circular locations for track switching, turnouts and cross-overs

- **Variety of surface-level requirements**
  - Ground stabilization injected from the surface along the alignment, as needed prior to and during construction to reduce surface settlement and cave-ins at the station and tunnels
  - Vertical access shafts for tunnel entrance, vents, fire-life safety personnel and equipment
  - Construction access areas for concrete plants, contractor's "lay down" areas for equipment and excavated materials
  - Tunnel construction requires additional areas for assembly of the tunnel boring machine's (TBM) "trailing gear"
- **Cost and schedule must be compatible with Proposition 1A**

Diridon Station to Tamien Station Track Configuration

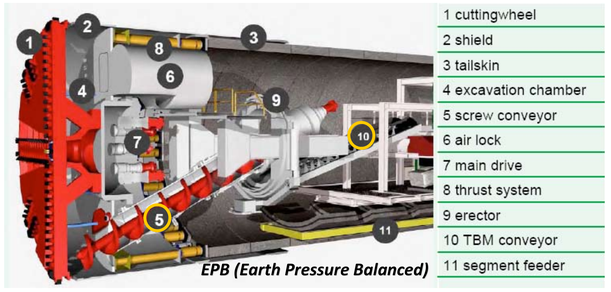


Tunnel Construction Methods

Investigate and Prepare Soil

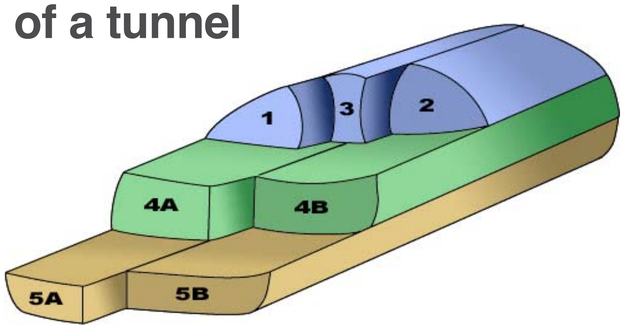
A slurry wall consists of vertical panels constructed end-to-end around the opening shaft perimeter to provide a watertight support system during excavation of the shaft

Tunnel Boring



Station Excavation

Sequential excavation of a tunnel



Step 1: Site Preparations

- Soil needs to be stabilized to prevent the flow of groundwater, reduce surface settlement and cave-ins during mining
- Soil stabilization measures appropriate for the HST tunnel and station include ground freezing or installing a slurry wall
- Significant surface disruptions will occur for multiple reasons and at multiple locations: All access points and work areas, including tunnel portal, vents, fire-life safety access
- Station construction would require additional ground stabilization improvements

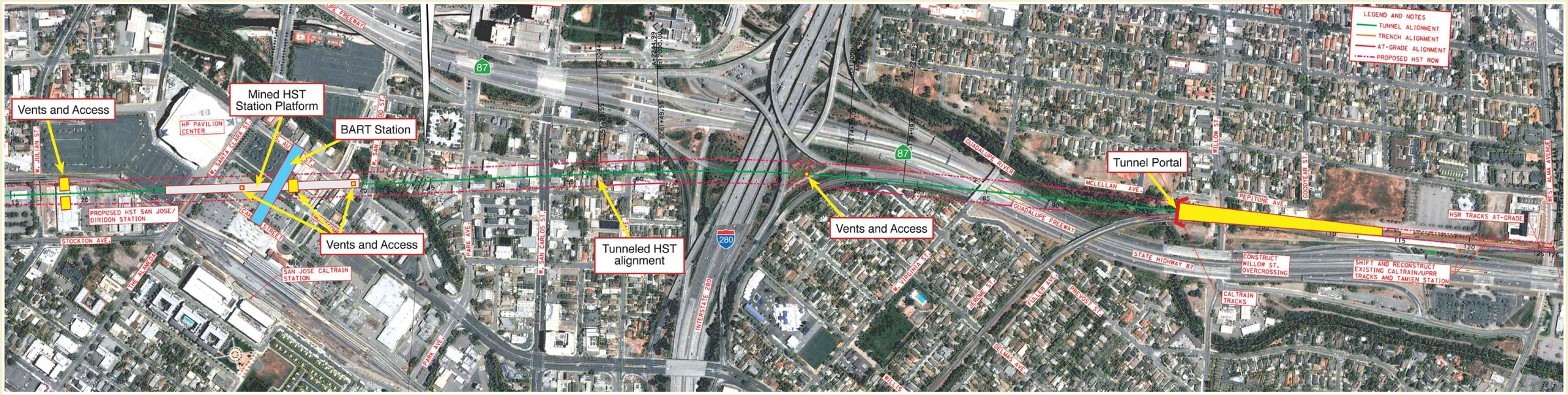
Step 2: Construction and Excavation for a Tunnel

- Requires use of a Tunnel Boring Machine (TBM), which simultaneously advances and supports construction
- A TBM's trailing support gear (up to 1000' long) would be massive
- TBMs reduce (but do not eliminate) the risk of ground settlement and cave-ins
- TBMs do not work for non-circular openings (such as the track switches and cross-overs required for the HST project)
- TBMs of the size required are custom-made, which adds cost and time to the project

Step 3: Construction and Excavation for a Station

- Requires use of the Sequential Excavation Method/New Austrian Tunnel (SEM/NATM) Method
- Capable of constructing non-circular openings, unlike a TBM
- Allows for "real-time" monitoring of soil conditions as construction advances
- High groundwater table poses significant issues, including increased ground instability
- Reduces (but does not eliminate) the risk of cave-ins
- Extremely expensive and custom equipment will increase delivery time

Ground Surface Impacts for Tunnel Alignments



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Station Area

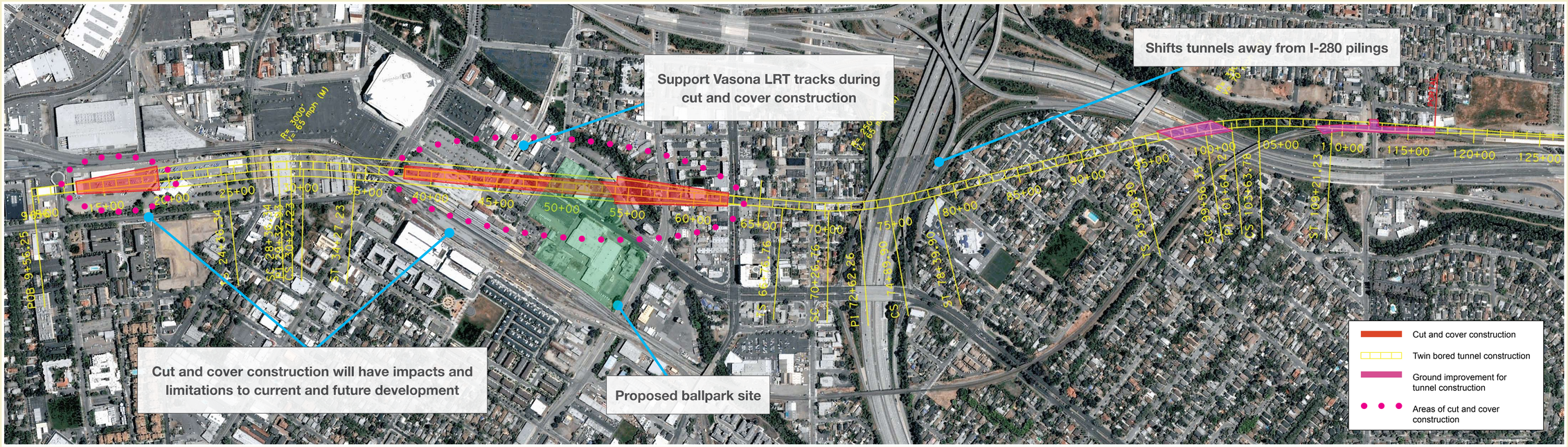
- **Soil stabilization and ground improvements from surface above station for SEM station construction**
- **Right-of-way requirements for ventilation, access shafts at station**
- **Future development above station limited**

Entire Alignment

- **Soil stabilization and ground improvements at varying locations along entire alignment**
- **Right-of-way requirements (both temporary and permanent)**
  - Tunnel entrance/exit (portals)
  - Vents
  - Access shafts for fire-life safety personnel and equipment
  - Construction “lay down” areas for equipment, TBM “trailing gear”, concrete plants and other construction staging needs
- **Ground-borne vibration (from tunneling and high-speed trains)**
- **Ground movement and settlement**
- **Future development above tunnels may be limited in some areas**

San Jose Shallow Tunnel Alignment

The City of San Jose requested the study of a shallow tunnel alignment in response to issues with a deep tunnel/station. Beginning at Tamien station, tunnels would be constructed with boring machines to cross under SR 87 and I-280. With shallower depth, the transition to cut and cover construction methods would occur north of I-280 for special track work and the station. North of the station, tunnel boring would resume until cut and cover could be utilized for additional special track work.



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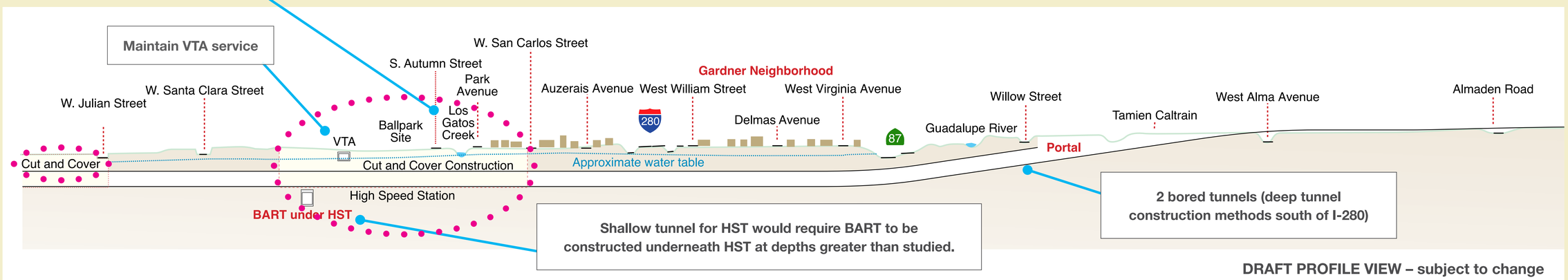
SURFACE IMPACTS

- Open cut at station and track transitions, ventilation structures and access shafts, ground stabilization, traffic/bus/emergency vehicle detours, additional right-of-way and construction noise and vibration

IMPACTS TO DEVELOPMENT

- Limits to basement floors located over cut and cover structures, and construction of a 5-foot deep concrete slab supported by piles spanning HST facilities for protection of HST (cost approximately $85 million to $100 million)



DRAFT PROFILE VIEW – subject to change

Project Specific Requirements for Shallow Tunnel / Station Alignment

Shallow tunnel station

- Shallow tunnel alignment crosses under SR 87, I-280, Los Gatos Creek and Guadalupe River
- Station box is 1,380 ft. long, 90 ft. wide and 80 ft. deep
- Includes a center platform and two tracks
- Similar requirements to deep tunnel alignment between Tamien and I-280

Track work

- Express tunnels constructed by tunnel boring machine (TBM) methods and will run outside the station

Cut and Cover requirements

- Extensive site preparations, including utility relocations, and muck removal
- Extensive right-of-way required for full access to the ground/surface along the cut and cover alignment, as well as for areas adjacent to and outside the cut and cover footprint for staging and equipment
- Up to 1-2 acres adjacent to and outside the cut and cover footprint required for staging and equipment
- Support VTA LRT during construction
- Maintain Los Gatos Creek flows during construction

Diridon Station to Tamien Station Track Configuration

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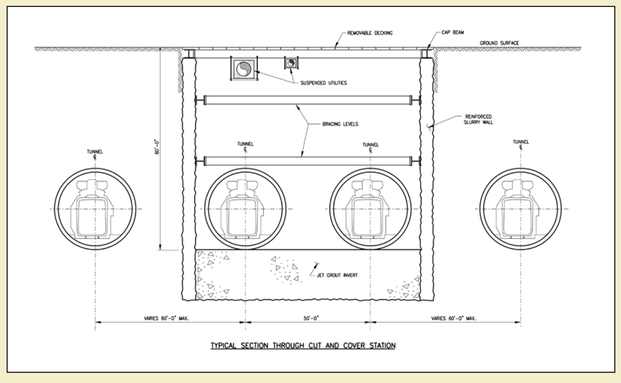
1



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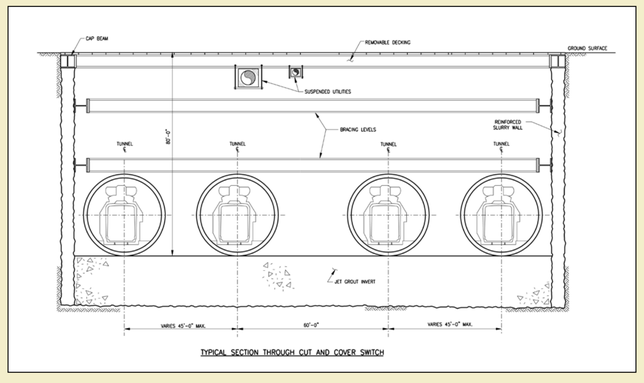

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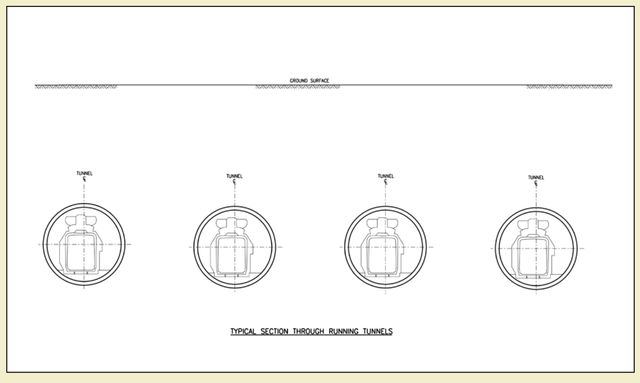


Shallow Tunnel / Station Construction Overview

TECHNIQUES

- Construction methods south of I-280 would be similar to those identified for the downtown tunnel alignment, only shallower (depths of approximately 60 ft. rather than 100 ft.)
- Transition to cut and cover methods for the tunnel and station would occur north of I-280
- Cut and cover methods would be used for the construction and excavation of the transition sections (2–4 tracks) and station
- Portal north of Diridon Station would be cut and cover with necessary right-of-way requirements and surface impacts

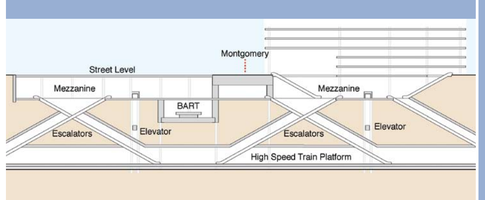
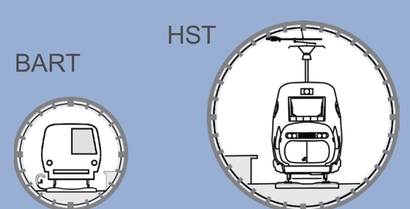
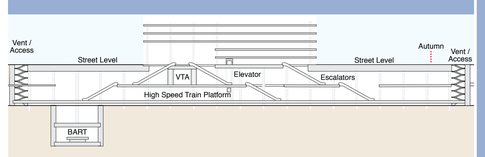
In cut and cover construction, a trench is excavated and a roof is built over it. Ground modification occurs at every location where tunnels meet with cut and cover structures.

L.A. Metro (Wilshire to Vermont)

RISKS / IMPACTS

- Site preparations, including soil stabilization, utility relocations, dewatering, and muck removal, would occur at all portal locations, access points, and where needed for safety
- Disruption to existing railroad (Caltrain, Amtrak, PACE, UPRR, Freight VTA-Vasona Line), traffic (vehicular, pedestrian, bicycle, bus transit), utilities, communities, residences and businesses
- Surface disruptions for access points
- Vibration
- Ground movement and settlement
- Extensive right-of-way for construction and staging
- Existing buildings need to be removed
- Limits on types of future development
- Land on top of the tunnel/ station cannot be developed for approximately 5-7 years

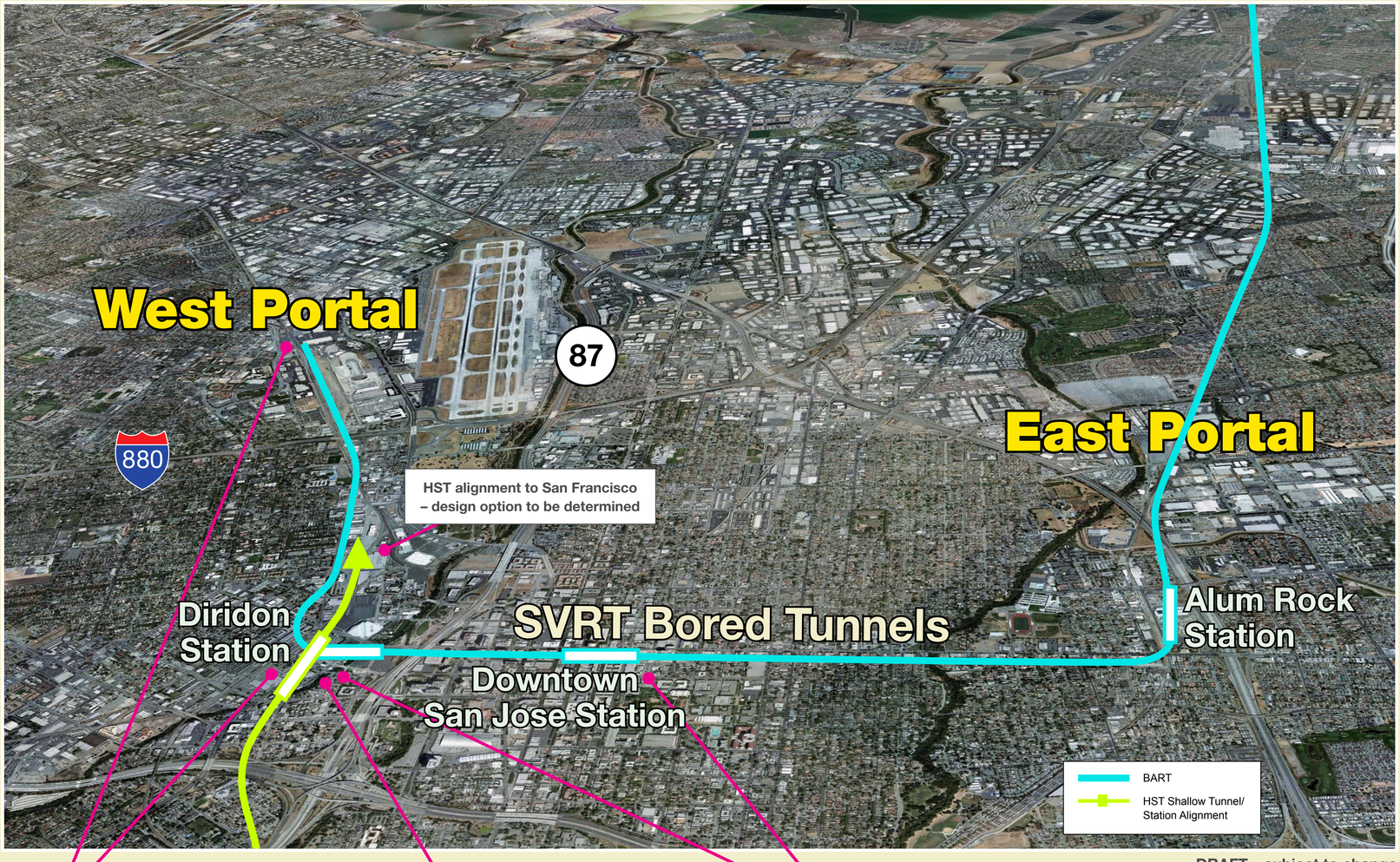
Comparison to BART Tunnel and Underground Station

	HST DEEP TUNNEL / STATION		HST SHALLOW TUNNEL / STATION	
	HST	**BART**	**HST**	**BART***
Construction methods – Station	Conventional segmental mining (SEM) requires ground improvements from the surface	Cut and cover – requiring acquisition and access to entire surface area above tunnel	Cut and cover for track and transition sections	Conventional segmental mining (SEM) requires ground improvements from the surface
Construction methods – Tunnel	SEM for turnouts, cross-overs and cross passages; EPBM for tunnels	Earth Pressure Balance tunnel boring machine (EPBM) or Slurry Tunnel Boring Machine; SEM for cross passages	EPBM or slurry tunnel boring machine south of San Carlos Ave.; cut and cover north of San Carlos Ave.; SEM for cross passages	Earth Pressure Balance tunnel boring machine (EPBM) or Slurry Tunnel Boring Machine; SEM for cross passages
Size & depth of station	Platforms 1380 ft. long; approximately 140 ft. deep, 70 ft. wide by 40 ft. high	Approximately 50 ft. wide by 900 ft. long, and 60 ft. deep	1,380 ft. long by 90 ft. wide, and 80 ft. deep	Approximately 900 ft. long by 50 ft. wide, and 140 ft. deep
Approximate cost	Stations and tunnels at Diridon $3 billion	Multiple stations and tunnels $3.1 billion	$1.3 billion	Multiple stations and tunnels $3.2 billion (includes the additional proportional cost of $140-200M for constructing a deep BART station underneath HST)
Relative size comparisons	Relative station size 	Relative tunnel size 	Relative station size 	Relative tunnel size 

***Subject to validation by VTA and BART**

Implications of a Deep BART Tunnel / Station Underneath HST

A shallow HST tunnel alignment would require BART to construct its station and tunnels below the HST shallow tunnel/station at Diridon Station. It is anticipated that a deep BART tunnel and station would face some of the same challenges and risks identified with the downtown deep tunnel alignment for HST, and would likely have higher construction costs and longer construction schedules.



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Large vertical grade difference between Diridon Station and BART West Portal

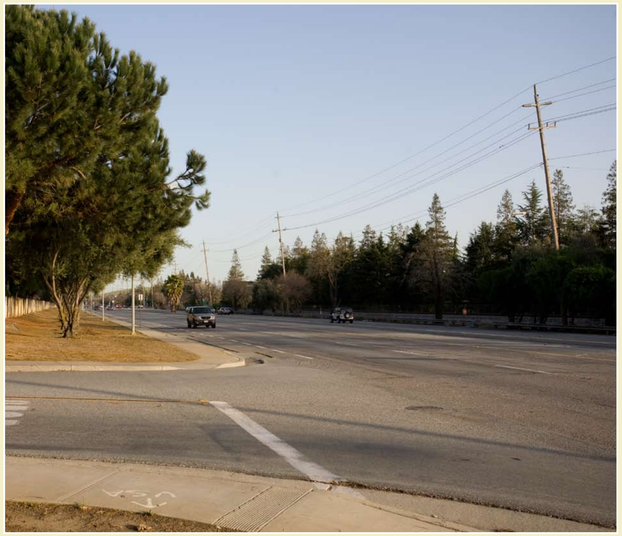
BART will be built underneath HST shallow station, approximately 140-160 ft. below ground

Large vertical grade difference between proposed Downtown Station (1st & Santa Clara) and Diridon Station, a distance of less than 1 mile that requires increasing track grade up to 1.5%

BART will experience the same construction impacts and challenges identified for the deep HST station and tunnels, including:

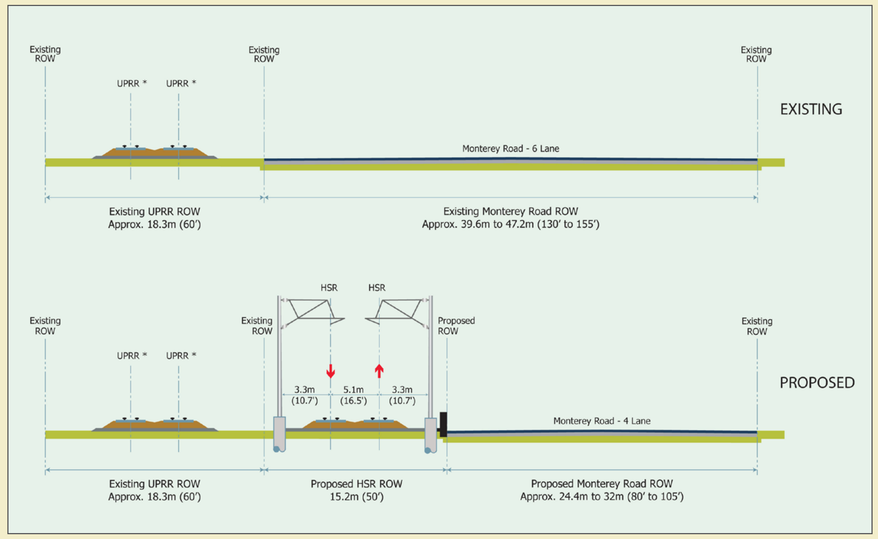
- Excavation of station and tunnels in an area with poor soil and a high water table
- Soil stabilization
- Ground improvements
- Extensive right-of-way
- Vibration
- Ground movement and settlement
- Limited future development in some areas above the tunnel and station

Monterey Highway – Typical Cross Section and Visual Simulations

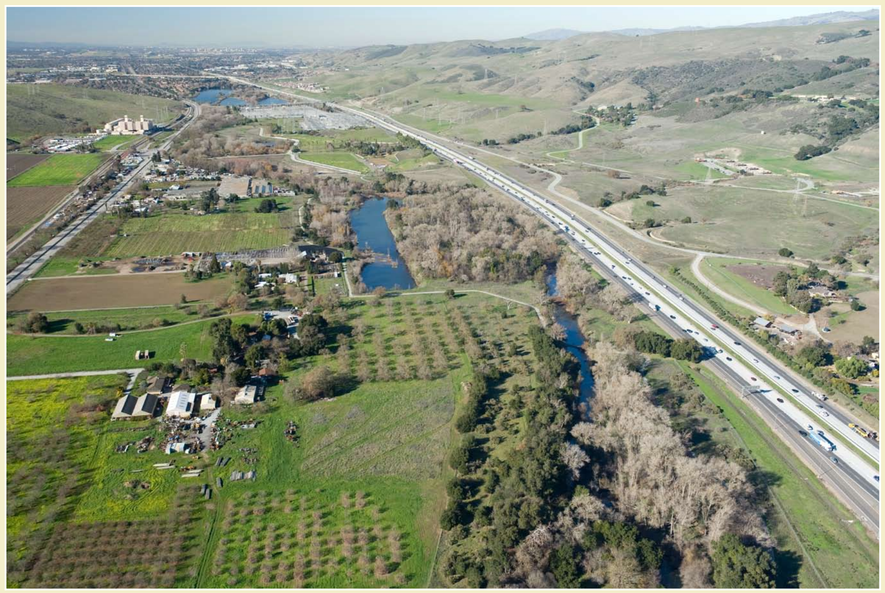


Monterey Highway – Existing

Monterey Highway – Proposed



Representative cross section of at-grade HST where Monterey Highway lane reduction is proposed



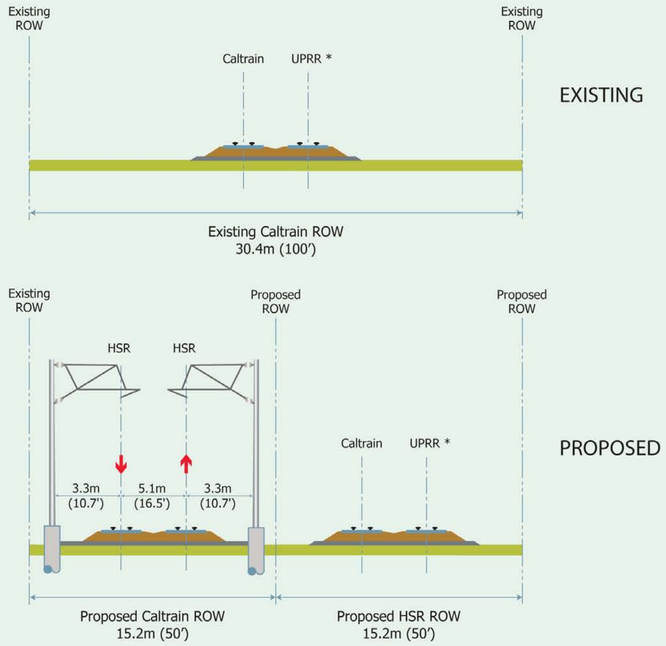
Coyote Creek – Existing

Coyote Creek – Proposed

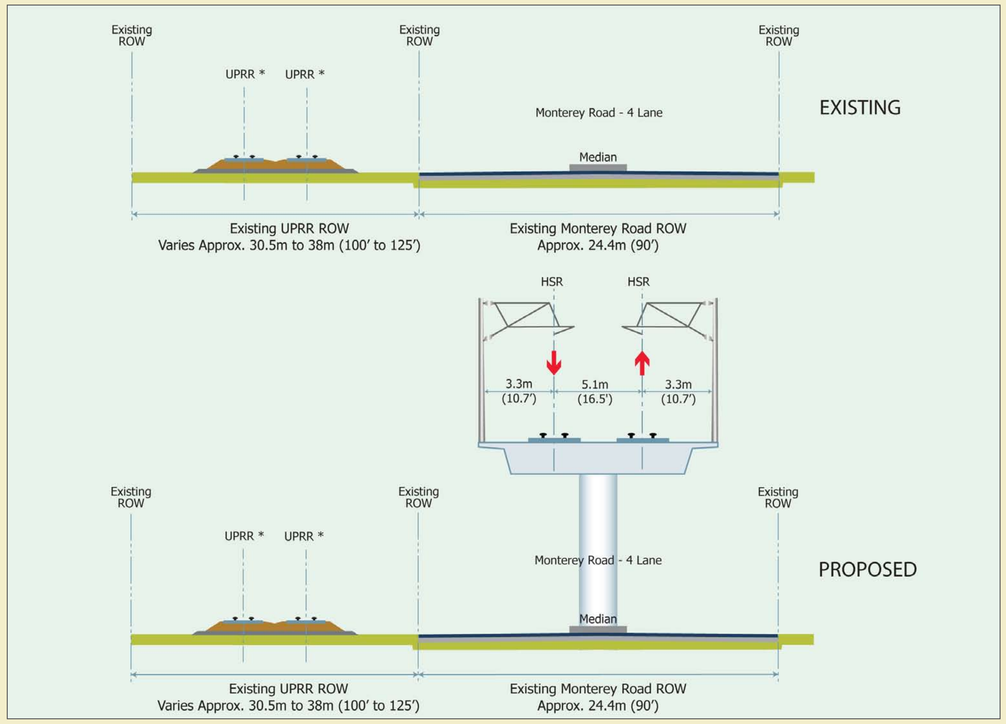
DRAFT – subject to change

Monterey Highway – Typical Cross Sections

Representative cross section of at-grade HST within existing Caltrain right-of-way



Representative cross section of aerial HST within Montery Highway median



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How to Participate

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Visit: www.cahighspeedrail.ca.gov

E-Mail: san.jose_merced@hsr.ca.gov