

RAIL ALIGNMENT AND BENEFITS STUDY

DRAFT EXECUTIVE SUMMARY REPORT
MAY 2018



San Francisco Planning Department
Citywide Policy Planning

San Francisco
Planning

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ACRONYMS AND ABBREVIATIONS

CGS	California Geological Survey
CWG	Citizen Working Group as conveyed for the RAB study
CHSRA	California High Speed Rail Authority
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
DTX	Downtown Rail Extension
I	Interstate
HSR	High Speed Rail
MTC	Metropolitan Transportation Commission
PCJPB	Peninsula Corridor Joint Powers Board (Caltrain)
PUC	Public Utilities Commission
RAB	Rail Alignment and Benefits Study (previously known as Railyard Alternatives and I-280 Boulevard Feasibility Study)
SEIS/SEIR	Supplemental Environmental Impact Statement/Report
SEM	Sequential Excavation Method – a type of construction of tunnels
SCL	Sprayed Concrete Lined – a type of construction of tunnels
SFCTA	San Francisco County Transportation Authority
SFMTA	San Francisco Municipal Transit Agency
SFTC	Salesforce Transit Center – formerly called Transbay Transit Center (TTC)
TBM	Tunnel Boring Machine
TJPA	Transbay Joint Powers Authority
TTC	Transbay Transit Center now called Salesforce Transit Center (SFTC)
USGS	United States Geological Survey
WGCEP	Working Group on California Earthquake Probabilities

GLOSSARY

DTX – Downtown Rail Extension

Under the direction of TJPA; the DTX is a rail connection from the vicinity of 7th/Townsend to Salesforce Transit Center (SFTC) for use by both Caltrain and CHSRA.

Caltrain (PCEP) Electrification

The electrification of the Caltrain corridor from San Jose to San Francisco and purchase of 75% electrical multiple unit fleet. To be completed and operations to begin in 2022. The cost of this project is \$1.9 Billion.

Blended Service Operations

under the direction of CHSRA, and in coordination with Caltrain; the plan of how Caltrain and CHSRA trains will operate on the same tracks from Gilroy to San Jose and on to San Francisco. Includes shared stations in San Jose, Millbrae and San Francisco (4th/King initially and SFTC when DTX is built).The Blended Service Operations plan will be used as the starting point for the Caltrain Business Plan (anticipated mid 2019) and CHSRA draft environmental impact statement (San Jose – San Francisco segment– anticipated late 2019)

CHSRA Business Plan

updated biannually. The most recent version was adopted in June 2018. An overarching policy document used to inform the Legislature, the public, and stakeholders of the project's implementation, and assist the Legislature in making policy decisions regarding the project. The schedule and cost estimate are updated and provided in each revision.

Turnback track

included in the DTX SEIS/R. This track provides a way for trains stored at 4th/King railyard to access SFTC and vice versa. It is located south of 16th Street adjacent to the existing operational tracks. To move to or from one to the other (e.g., from storage and into operations),

SEIS/R – Supplemental Environmental Impact Statement/Report

Federal (NEPA) and State (CEQA) environmental process completed for projects the previously went through and received environmental clearance. A Supplemental is completed when changes are made to the original project that may change the impacts from previously anticipated levels. Example: the DTX recently received a Record of Decision (ROD) for the SEIS/R (June 2018) for the items included in Exhibit 9 within the Executive Summary

INTRODUCTION

The Rail Alignment and Benefits Study (RAB) (previously known as the Railyard Alternatives and I-280 Boulevard Feasibility Study) is a multi-agency study of transportation and land use alternatives in southeast San Francisco. The RAB study is comprised of five components: 1) rail alignment into the Salesforce Transit Center; 2) Railyard reconfiguration/relocation; and 3) urban form and land use opportunities; 4) Salesforce Transit Center extension/loop; and 5) assessment of a boulevard replacing the north end of I-280.

This Executive Summary is a companion to the Consultant's Technical Report¹ and provides the material points for the five components as well as a summary of the Planning Department's preliminary findings and recommendations. This executive summary provides high-level information that may be critical to decision-making, such as specific cost estimations and graphical representations of likely viewpoints of San Francisco under certain conditions. The Executive Summary is designed to be a stand alone summary of the complete study and process. The Consultant's Technical Report provides much more technical discussion around the scope of work of the five components as well as the additional quantitative and qualitative analysis requested as part of the study.

Background

The RAB study has focused on helping the city, region, State, and nation realize the goal of bringing High Speed Rail and Caltrain service to the Salesforce Transit Center (SFTC – Previously known as the Transbay Transit Center). Three years ago, the City and County of San Francisco recognized that if the projects went forward as planned, additional impacts to the City would need to be addressed if this regional vision was to become a reality. The RAB study is a comprehensive look for solutions – unbounded by jurisdictional boundaries and budget(s) that limited previously approved projects. This unconstrained approach, while difficult and sometimes controversial, is now pointing to concrete solutions that could solve for needed grade separation while delivering a better project encouraging local and regional economic development.

The Railyard Alternatives and I-280 Boulevard Feasibility Study (RAB) began in mid-2014 to gain better understanding of the transportation and land use

changes at the state, regional, city, and neighborhood level. The RAB study has looked at the southeast quadrant of the City, inclusive of both known and potential projects, to fully understand the impacts and benefits to the City and its residents in the most rapidly growing area of San Francisco.

Transportation systems throughout the Region and the State are about to change. Under construction now, the California High Speed Rail Authority (CHSRA) is building the Central Valley to San Francisco link (expected completion date 2029 with possible early service in 2027) (See Exhibit 1), Caltrain is electrifying the rail corridor from San Jose to San Francisco (4th-King – expected completion date 2022), the SFMTA is nearing completion on the Central Subway (opening in 2018), and the Salesforce Transit Center (SFTC) is scheduled to open (in August 2018). At the same time that transportation is transforming, the City is also changing. Central SoMa and Mission Bay neighborhoods are growing (See Exhibit 2), with major development approved for the coming decade. Fully understanding these transportation and land use changes in concert is essential to maximizing this major tax-payer investment most effectively and to fulfilling the vision of high-speed regional connections to/from the City.

The magnitude of the infrastructure investment demands that we not only understand the immediate changes that are upon us but also that we look forward to the future San Francisco and the region that must be served for the next 100+ years.

After decades of low density industrial activity east of the current alignment, the southeast quadrant of San Francisco is on track to contain 75% of the City's planned growth over the next 30 years including San Francisco's largest hospital and indoor entertainment venues along with an anticipated 20,000 new households and 35,000 jobs anticipated just in the Southern Bayfront area. Without good transit connections, this growth cannot be achieved.

While this Executive Summary compiles a list of specifics related to the RAB Consultant Final Report, it should be noted that the Final Consultant Report is based on the scope of services (including the project area, as well as identified alternatives for further development) as determined at the outset of the project. This Executive Summary provides an overview of the

Exhibit 1: Rail Corridors in California and the Bay Area



Consultant Final Report but goes beyond the report to provide staff analysis and preliminary findings by the Planning Department to identify a preferred policy direction of the City and County and to further conversations bey the City’s jurisdiction.

Exhibit 2: Population and Employment Growth

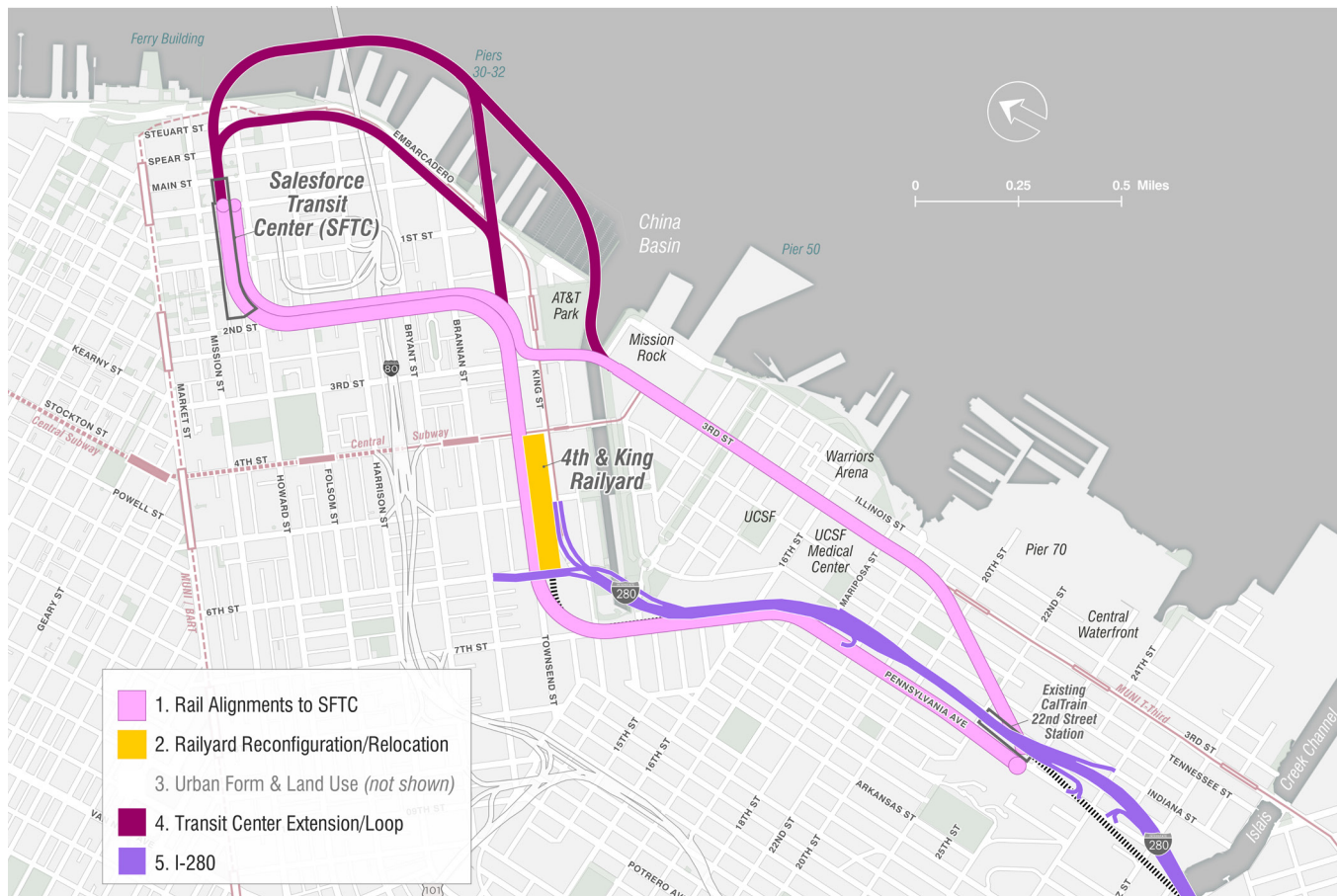
		2015	2065	GROWTH
California	Population	39M	52M	+33%
	Employees	16M	28M	+77%
Region	Population	7.6M	10.7M	+41%
	Employees	4.0M	5.8M	+44%
City	Population	0.86M	1.43M	+66%
	Employees	0.70M	.099M	+44%

Components

There were originally five components to the RAB study – each representing a major transportation and/or land use decision that must be determined in the next 1-15 years (See Exhibit 3). Each decision will likely affect the performance of both the state and regional transportation system and San Francisco itself for the next century. Those five components are:

1. Rail Alignment to Salesforce Transit Center (SFTC) – This component seeks to answer the most time sensitive question of the RAB: how to bring both Caltrain and High-Speed Rail from the county line into the Salesforce Transit Center (SFTC).
2. Railyard Reconfiguration/ Relocation – This component considers reknitting the fabric of the City by modifying or relocating some or all of the activities at the 4th/King Railyard.
3. Urban Design and Land Use Considerations – Relocating the Caltrain Railyard and/or other infrastructure changes could make new land available for the restoration of the street grid, improved bike/pedestrian connections, elimination of rail hazards and noise, and construction of housing, commercial development, and open space.
4. Transit Center (SFTC) Extension/Loop – This component explores future scenarios for train connections and operations beyond the initial connection to the SFTC to improve station capacity and/or rail connections beyond SFTC to the East Bay or back down the Peninsula.
5. Boulevard I-280 – This component analyzes the interaction between proposed rail alternatives and the I-280 structure to ensure that the rail alignment does not preclude the possibility of future changes to I-280 north of Mariposa.

Exhibit 3: RAB Study Components



As shown in the Consultant Technical Report, I-280 did not conflict with any of the alignments under further consideration. As the project progressed, the effort focused more on the potential rail alignment, railyard reconfiguration/relocation and related implications to urban design and land use (components 1, 2, and 3). Once it was determined that rail alignment were not dependent upon either the continued use of I-280 or the removal of I-280 north of Mariposa, the Boulevard and I-280 work scope became subordinate to the RAB's primary thrust. To be sure, any future decision about I-280 would require much more analysis and coordination with Caltrans, CalSTA, and federal partners at a minimum. Because that work was outside of the RAB scope, it was not further pursued.

While each component of the RAB has its own timeframe and is independent of each other, the Rail Alignment to Salesforce Transit Center (SFTC) is the most time sensitive and the immediate focus of the RAB study.

In the pages that follow, each component is represented and a summary of work completed is provided including the options under consideration for each component, and an assessment of each option using various criteria. The last section provides the preliminary findings and recommendations of the RAB Study.



COMPONENT #1: RAIL ALIGNMENT TO SALESFORCE TRANSIT CENTER

Description

Component #1 of the study sought to answer the most time sensitive question of the RAB: how to bring both Caltrain and High-Speed Rail from the county line into the Salesforce Transit Center (SFTC).

Common Issues Across All Rail Alignment Options Considered

The following issues and considerations are relevant to all alignments discussed in this report. These common issues and considerations are organized into two categories: (1) maximizing public benefit and public investment for a growing population and (2) managing train conflicts.

MAXIMIZING PUBLIC BENEFIT & PUBLIC INVESTMENT FOR A GROWING POPULATION:

- » Fast, frequent, and reliable Caltrain and High Speed Rail service to and within the City are essential to the Bay Area today and in the future.
- » The Downtown Rail Extension (aka “the DTX” which provides underground rail from the vicinity of the 4th/ King railyard to the Salesforce Transit Center) was selected in 2004, prior to the addition of thousands of new homes and jobs along the current Caltrain route.
- » High Speed Rail operations in the City begin within 15 years (planned for 2029 with potential for early service 2027).
- » State law establishes that High Speed Rail will terminate at the Transbay Transit Center (now known as the Salesforce Transit Center – SFTC)². Although the Salesforce Transit Center will open to bus service in August 2018, the train levels will not be in operation until after the DTX is built in 2027 or later.
- » To maximize operations and flexibility of rail service all platforms within the SFTC (and potentially the DTX underground 4th/Townsend station) will be constructed to one platform height.
- » No alignment option under consideration requires Caltrain to be out of service for any significant duration during construction.
- » The CHSRA’s Blended Service Operations Plan and Caltrain’s Business Plan (anticipated late 2018), and

future regional and state plans account for the recommendations from the RAB study. .

- » All rail alignment options include elements not currently costed. The DTX is the last mile of rail on the rail corridor and is estimated at \$4 billion dollars. Each alignment in this report would cover rail beyond the length of the DTX, as well as other infrastructure costs as appropriate, and each will therefore incur additional costs.
- » To maintain access and integrate Mission Bay with the City, the RAB studied rail alignment and elements that will preserve and expand access on existing and potential new streets and paths.

MANAGING TRAIN CONFLICTS

- » There are currently two at-grade intersections (7th/ Mission Bay Drive and 16th Street) that serve east/ west traffic between Mission Bay and the rest of the City. These are the only two connections for more than a mile providing east/west connections. Each time the intersections close for trains, traffic will stop.



Source: TJPA,

- » When Caltrain electrifies in 2022, the number of trains will increase by 20% during peak commute hours³.
- » When High Speed Rail begins operations in 2027, the number of trains will again increase by another 66% during peak commute hours⁴.
- » Both Caltrain and High Speed Rail anticipate the possibility of adding more and or longer trains in the future.
- » Continued Caltrain operation during construction can occur with minimal disruption of any alignment option under consideration
- » Each time a train moves across the two at-grade intersections, east/west traffic is blocked for 60-100 seconds. This will equate to more than 20 minutes in any peak hour in the future when both Caltrain and High Speed Rail operate on the corridor 2029 (with possible early service in 2027), unless grade separation is built.
- » Conflicts at the at-grade intersection of 16th Street would be particularly impactful as this street serves as 1) a Bus Rapid Transit line for the 22-Fillmore, 2) a primary ambulance route to UCSF Hospital, and 3) a vehicle path for 19,000 vehicles every weekday.
- » The continued use of the 4th/King Railyard is discussed in detail under Component #2. In this section, discussion of the railyard will occur relative to the fact that there is no direct connection between the railyard and the Salesforce Transit Center, yet trains will be expected to move from the railyard to the SFTC in the future⁵. While this movement of trains from a railyard to the SFTC will be cumbersome and time-consuming for all alignments, certain alignment options will make this movement more impactful.

Analysis

The following analysis is relevant to all alignments discussed in this report. Again, this section is organized into two categories: 1) maximizing public benefit and public investment for a growing population and 2) managing train conflicts.

MAXIMIZING PUBLIC BENEFIT & PUBLIC INVESTMENT FOR A GROWING POPULATION

The final rail alignment into San Francisco must meet regional needs. Additional train service to and from San Francisco is essential to support expected city, regional, and state population and employment growth. Maximizing train service and flexibility to one of California's major economic centers is crucial for both the region and the rail operators. The ability to move to and through the City is also a vital consideration. Careful consideration of these issues related to rail alignment will ensure that full potential of rail investments in the city, region, and state can be realized.

There is a further need to fully electrify the Caltrain fleet⁶. Without a fully electrified fleet for Caltrain, future Caltrain service to SFTC is limited as ventilation requirements would preclude the use of diesels in any tunnel option (including the DTX) under consideration.

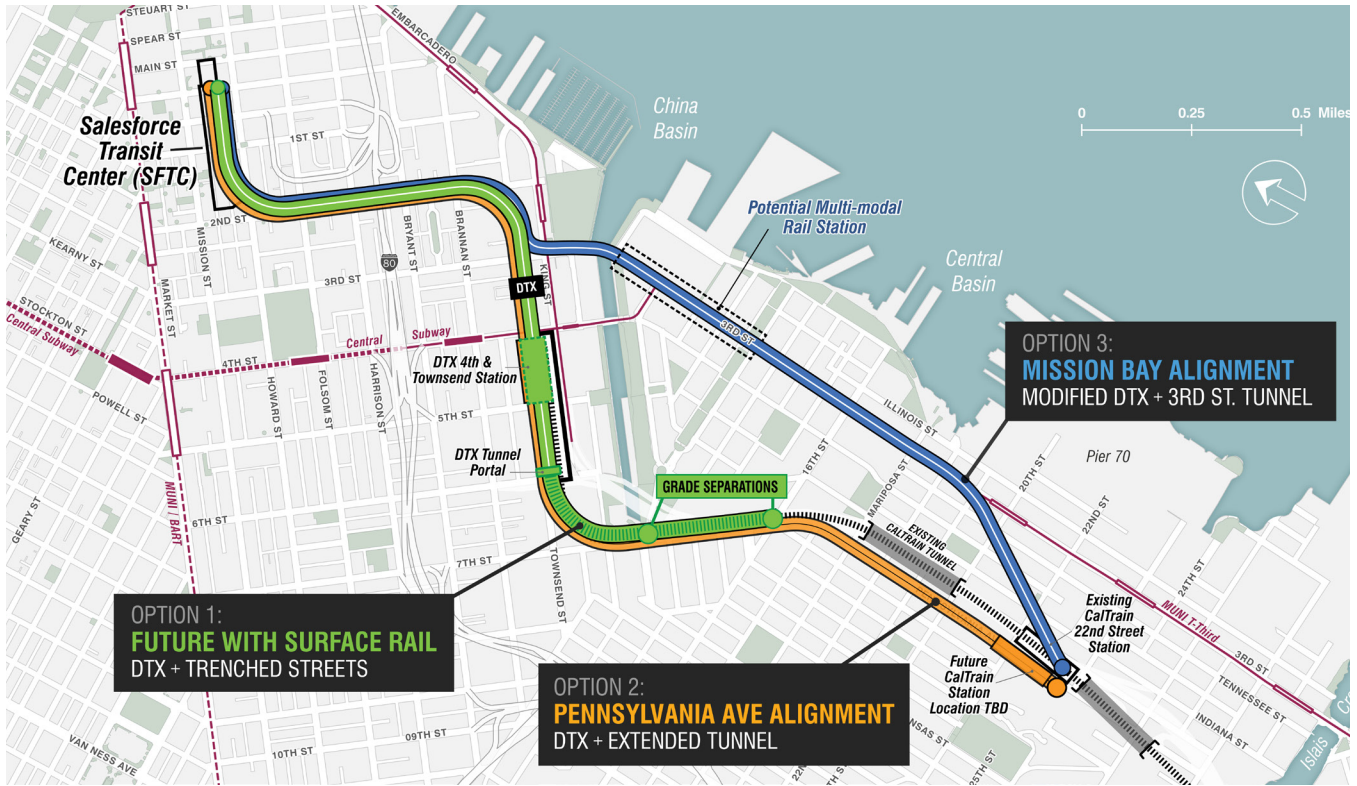
MANAGING TRAIN CONFLICTS

When Caltrain and HSR operate in San Francisco, there will be significant impacts to the two at-grade intersections at 7th/Mission Bay Drive and 16th Street. Currently, Caltrain trains interrupt east/west traffic from between 60 and 100 seconds per train. When both Caltrain and HSR are operating in San Francisco, this could result in more than 20-minutes of the peak hours being closed for east/west traffic movement⁷. With the current at-grade crossings, rail is prioritized above other modes such as local transit, bicycle, pedestrian and the personal vehicle at the points of access across the tracks.

If the planned projects, as currently designed and environmentally cleared, move forward, it is the City's position that the closure of the two at-grade intersections at 7th/Mission Bay Drive and 16th Street for 20 minutes or more during the peak hours unacceptable condition. To maintain access and integrate Mission Bay with the City, the RAB studied rail alignment and elements that improve rather than degrade these intersections.

After a review of the existing Caltrain rail alignment and the planned Downtown Rail Extension (DTX), the RAB study explored other alignment options and the varied benefits of each alignment to the City, region, and state. While numerous possible alignments were reviewed and analyzed at some level, four alignments were found to have merit for deeper analysis. During further study, one option (Tunnel under Existing Caltrain Tracks/I-280

Exhibit 4: Three Rail Alignments to Salesforce Center Explored in RAB Component #1



Alignment) was deemed infeasible⁸. The remaining alignment options that were further analyzed, are shown in Exhibit 4, and presented in the pages below. They are:

1. Future with Surface Rail: DTX + Trenched Streets
2. Pennsylvania Avenue: DTX + Extended Tunnel
3. Mission Bay (3rd Street): Modified DTX + 3rd Street Tunnel

The current TJPA plan for SFTC is to construct two separate platform heights and to dedicate separate platforms for Caltrain and HSR⁹. Construction of this current plan would permanently establish platforms that could only serve either Caltrain or HSR (but not both). This issue may be present at a second station as well. As CHSRA has stated that the agency may wish to

stop trains at the new DTX underground 4th/Townsend station. The current TJPA design for the new DTX underground 4th/Townsend station is a center platform height that only works for Caltrain. CHSRA will not have traincars that could access the lower Caltrain platforms. Notably, Caltrain is procuring cars that will have dual doors enabling use of both traditional Caltrain platforms as well as use of higher platforms that could serve platforms at the same height that HSR will use. Since Caltrain cars will have the flexibility to use either platform height, all platforms should be constructed at the higher height. This would maximize the operational capacity and flexibility of the both the SFTC and the 4th/Townsend Stations. Providing uniform platforms will provide the most flexibility for all operations and operators.

RAIL ALIGNMENT OPTION 1: FUTURE WITH SURFACE RAIL: DTX + TRENCHED STREETS

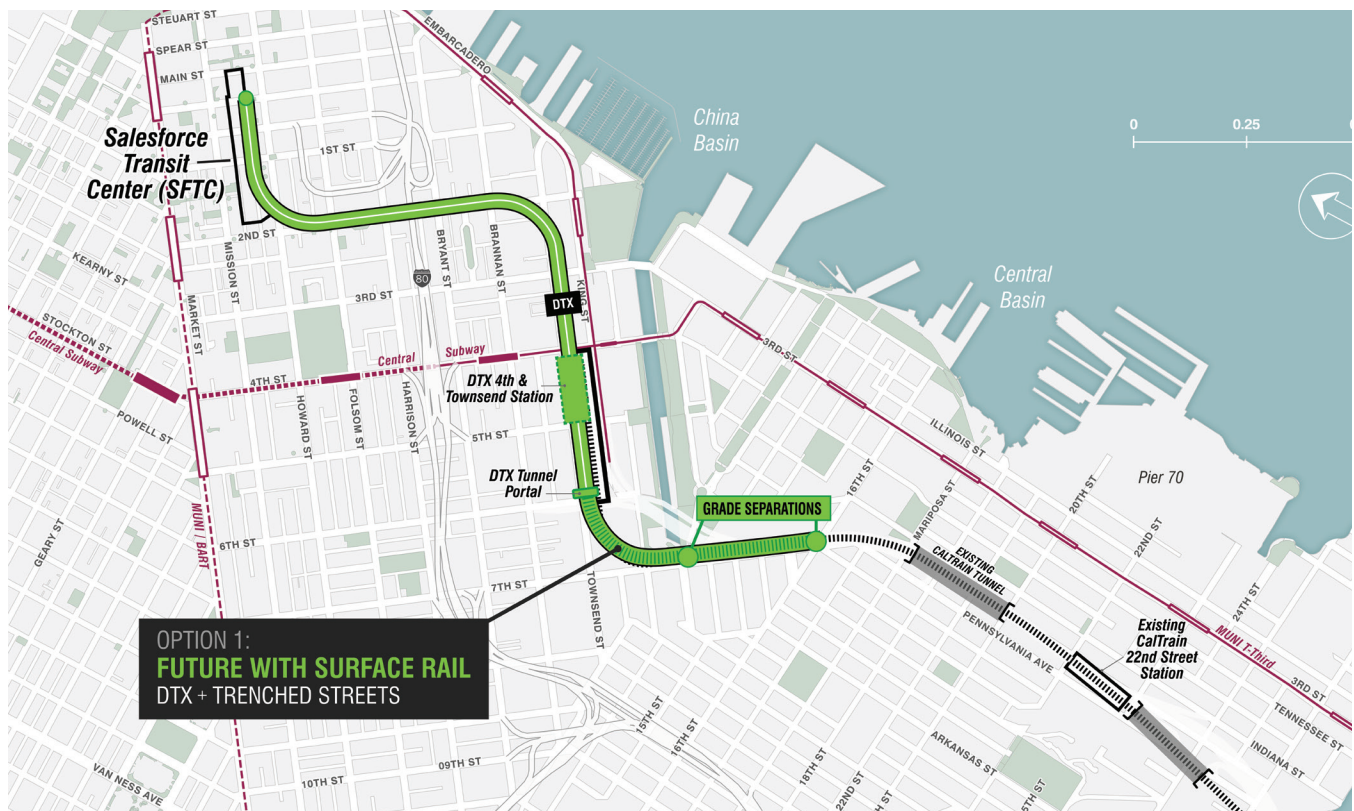
Description

The “Future with Surface Rail” alignment option (shown in green in Exhibit 5) reflects the conditions in 20 years, if current plans move forward when DTX is built and the City must trench it’s current at-grade intersections to ensure continued east/west access across the City. This option includes existing surface rail south of 7th/ Mission Bay Drive that would connect into either (1) 4th/ King railyard or (2) the Downtown Rail Extension (DTX) tunnel. The DTX tunnel then extends from the corner of the Caltrain yard to the Salesforce Transit Center (SFTC). Specific elements of the Future with Surface Rail alignment option include:

- » Use of the DTX tunnel as designed and environmentally cleared.
- » Assumed new underground 4th/Townsend Station as part of the designed and environmentally cleared DTX. Includes continued use of the 4th/King surface station as well.

- » Use of existing surface Caltrain tracks under I-280 south of 4th/King railyard connection.
- » Assumed two grade separated roadways (16th Street and 7th/Mission Bay Drive) that are currently at-grade intersections with the Caltrain tracks will be trenched to run below the Caltrain tracks to maintain vital east/west connections between the city and Mission Bay.
- » Assumed Caltrain Electrification consistent with current plans, including electrifying the Caltrain line from San Jose to San Francisco and electrify Caltrain 4th/King Railyard for operations, staging, storage, and maintenance.
- » Assumes 3 tracks in the DTX tunnel and predominantly 2 tracks south of the 16th Street as is provided today with crossovers as needed for safety and operational flexibility.

Exhibit 5: Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1)



Issues and Considerations

In addition to the common issues and considerations for all alignments identified above, the following issues are specific to consider with the “Future with Surface Rail” alignment option.

- » To solve for the issue of intermittent closures of the at-grade intersections of 16th Street and 7th/Mission Bay Drive for more than 20 minutes in the peak hours, this option included the necessary trenching of these two streets. Without achieving this grade separation through a significant trench, closures of 20+ minutes during peak hours would occur at these vital intersections. Such delays were deemed unacceptable and therefore were not further studied.
- » While the trenched streets assumed in this option would solve for untenable intersection closures, it would create additional issues as this trench would be double the depth of the Cesar Chavez or Geary underpasses and over one-half mile in length due to the depth required and maximum City grade. These trenched streets would also be vulnerable to sea level rise and/or flooding at any time.
- » There is no direct connection between the surface-level 4th/King Railyard and the underground Salesforce Transit Center. For all options, train movements between these destinations will be cumbersome and time-consuming.

- » Unique to this alignment, trains needing to travel from the railyard to the SFTC will need to travel backwards (south) for approximately 1.2 miles and across the two intersections (Exhibit 6 Item 12) in order to enter the DTX tunnel to access the SFTC.
- » This is particularly impactful for 16th Street as this street carries local bus rapid transit and is used by ambulances in route to the UCSF hospital.
- » In addition, a 2015 survey found that 16th Street currently provides access to approximately 36,000 persons and 23,000 jobs in this area of the city will add an additional 20,000 households and 35,000 jobs in the next 20 years.

Analysis

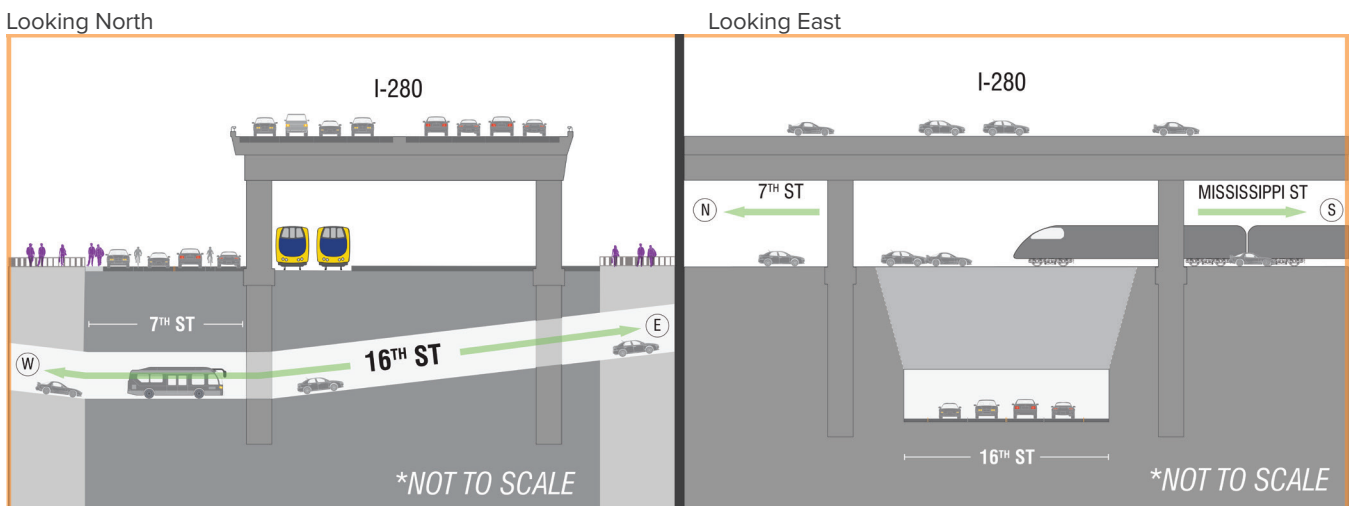
This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) direct impacts to other RAB components.

MANAGING TRAIN CONFLICTS

To solve for the issue of intermittent closures of the at-grade intersections of 16th Street and 7th/Mission Bay Drive for more than 20 minutes in the peak hours, this option requires the current design trench these two

Exhibit 6 - Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1)

Cross sections of the 16th/7th street intersection with 16th Street moved underground, below the rail operations. This produces a trench of 0.6 miles in length.



streets. In this alignment option, preventing significant conflicts across the two intersections is achieved by depressing the two streets into 45-foot deep, approximately 0.6 mile long trenches (See Exhibit 6)¹⁰. Any street currently intersecting these two streets (Mission Bay Drive and 16th Street) north/south in this stretch would either need to be severed, or the intersecting street would need to be depressed to meet the depth of 16th Street. That could result in buildings on corners where two sides are bounded by walls approximately 35-50 feet in height, increasing the visual separation between the Mission Bay district and the city at large.

Trenching 16th Street will affect operations and connections for the 22-Fillmore BRT, ambulance access to UCSF hospitals, and access to thousands of new homes and jobs in Mission Bay. The 22-Fillmore BRT is anticipated to run on 16th Street providing faster and more convenient transit access along the 16th Street corridor. For riders within the trench limit, additional vertical components (stairs/ramps) will be required to access the BRT stops. In addition, for an ambulance, directly connecting patients to UCSF hospital services is vital. Today, an ambulance patient can be delayed approximately 60-seconds when a train is crossing 16th Street. If the trench is put in place, the ambulance will never be stopped as a train moves west to east through this intersection under the Caltrain tracks. However, an ambulance user at the coming from the north or south would require a 6-12 block additional trip (including at least three additional left turns) to access UCSF depending on the street grid that is put in place

CHANGE MANAGEMENT

As this rail alignment option represents the current plans, no change management would be needed for train operators. .

- » The DTX remains as currently designed and environmentally cleared. The DTX is a 1.3 mile underground extension of the Caltrain tracks connecting the surface Caltrain tracks at 7th Street to the SFTC and includes a new underground station at 4th/Townsend (See Exhibit 9 Item 10).
- » Caltrain electrifies its corridor, as well as the 4th/King railyard. There would be no change in the connections provided to the existing Caltrain tracks.
- » CHSRA operates on the Caltrain tracks

The City would need to develop plans for the intersection grade separations to lower these streets 35-50 feet below current elevations. This work would include additional design development, completion of environmental clearance, securing funding, and construction of two grade separated intersections.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Under current operations analysis, not all Caltrain trains will complete the route at San Francisco's central transit hub, the SFTC. Current plans show some Caltrain trains originating and terminating at the 4th/King railyard. Caltrain and High-Speed Rail are currently developing a plan for their joint service operations which may change these service plans¹¹. With the proposed underground 4th/Townsend station, those traveling on to the SFTC would essentially make a mid-line station stop at this new station. Ideally, all trains to San Francisco would make the SFTC as the final destination. This would be in keeping with the designation of the SFTC as a multi-modal station connecting to BART, MUNI light rail, MUNI transit, AC Transit, bike share, and the downtown core of employment in San Francisco.

If current plans do not change, the 4th/King station would be an end-terminal essentially making San Francisco a two-terminal city. Creating two terminals less than one-mile apart that serve the same stations and operators increases the potential to confuse the occasional rider without significant improvement to the overall system.

Given the transportation system connectivity and the density of hotels, jobs and homes near the SFTC, the City of San Francisco prefers that future service plans maximize the number of trains to the end of the line station. Turning trains back at 4th/King potentially leaves thousands of rail passengers short of their desired destination (connection) each day and requiring at least a change in location or mode to reach their final destination.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » Component #2 Railyard Reconfiguration/Relocation – This option provides minimal possibility for relocation or reconfiguration on the 4th/King railyard. Under this option the railyard remains as is for operations, staging, and storage and maintenance.

- » Component #3 Urban Form and Land Use Considerations – This option does not increase nor reduce a significant amount of developable land. This option, assuming that trenches are built, would create extensive stretches of concrete retaining walls and inactive facades where buildings would meet the intersecting street but 16th Street would be deep within a trench. This option does not allow for new connections between Mission Bay and the rest of the City.
- » Component #4 Extension/Loop – This option does not affect the possibility of creating an extension/loop out of the east end of the SFTC.
- » Component #5 I-280 – This option likely requires the elevated I-280 structure and touchdown ramps to 4th/King and 6th/Brannan to remain in place indefinitely; surface rail tracks will likely continue to run directly under the freeway due to the difficulty of removal of the elevated freeway segment(s) over an active railroad/yard.

Cost Considerations

The current cost estimate for the DTX portion only is \$4 billion. This rail alignment would incur additional costs for the construction of two grade-separated (trenched) streets at Mission Bay Drive and 16th Street to maintain east/west movement across the City. For a summary of costs see *Preliminary Estimate of Probable Costs* later in this component.

Summary: Option #1 Future with Surface Rail Alignment

PROS	CONS
<ul style="list-style-type: none"> » Provides for additional capacity along the Caltrain corridor for increased future rail service. » Allows Caltrain to continue phasing towards full electrification of their fleet. » Provides rail access to SFTC. » DTX portion of rail has an approved environmental clearance. » Provides access and mobility for critical life-saving services to the hospital across 16th Street although via a trenched street. » Allows rail providers to proceed on their schedule and could allow the City to pursue a phased construction schedule with trenching streets to follow. » Requires the least amount of reassessment by the partner agencies and jurisdictions. » Remains the least expensive option 	<ul style="list-style-type: none"> » Uses a plan that was determined when land use in the area was more industrial. With the more intense and dense uses that exist now and will be built in the future, there will be more impacts. The surface rail: <ul style="list-style-type: none"> » precludes new east/west crossings and access points; » limits access points east/west to two (2) locations. » To solve for the issue of intermittent closures of the at-grade intersections, the City expects to include trenching. The trenches would: <ul style="list-style-type: none"> » be four to five stories deep, which is double the depth of the Cesar Chavez or Geary underpasses. » disrupt circulation and further isolate the Mission Bay, Dogpatch, Potrero Hill, and other communities. » create more disjointed environments for pedestrians, bicyclists, and drivers. » be susceptible to sea level rise and/or flooding at any time. » Potentially provides two rail facilities near each other but without direct rail connections (4th/King Railyard and the new underground 4th/Townsend station). » Not all trains are planned to terminate at SFTC.



RAIL ALIGNMENT OPTION 2: PENNSYLVANIA AVENUE: DTX + EXTENDED TUNNEL

Description

The “Pennsylvania Avenue” alignment: DTX + Extended Tunnel option (shown in orange in Exhibit 7 and referred to as Pennsylvania Avenue throughout this summary) moves the trains underground near the 22nd Street Caltrain station. All rail then travels via an underground tunnel beneath Pennsylvania Avenue. The rail travels north, adjacent to and underneath the current tracks up 7th Street connecting to the DTX tunnel stub box. Trains use the Downtown Rail Extension (DTX) to pass through the new underground 4th/Townsend station towards a final destination at the SFTC. Specific elements of the Pennsylvania Avenue alignment option include:

- » Includes the DTX as designed and environmentally cleared. Allows for operation in the DTX while Pennsylvania Avenue extension is being constructed. Doesn't delay DTX design and/or construction.
- » Assumes Caltrain electrification. Requires 100% electrification of fleet servicing San Francisco
- » Assumes new underground 4th/Townsend Station as part of the DTX.
- » Proposes the rail is moved underground in the area around the 22nd Street Caltrain station using a tunnel boring machine. Surface tracks are removed after tunnel is operational.
- » Intersections of 7th/Mission Bay Drive and 16th Street no longer have rail conflicts, as there would be no train movements through these intersections.
- » Removes rail access to 4th/King rail yard and requires construction of a new southern rail yard.
- » Provides for opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission

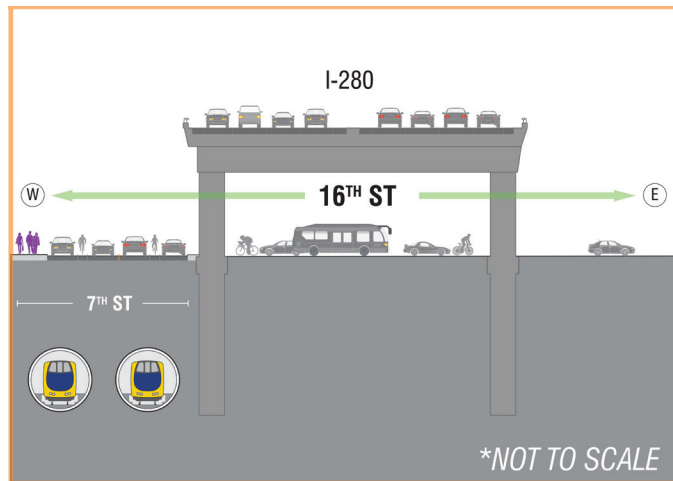
Exhibit 7: Pennsylvania Avenue: DTX + Extended Tunnel Rail Alignment (Option 2)



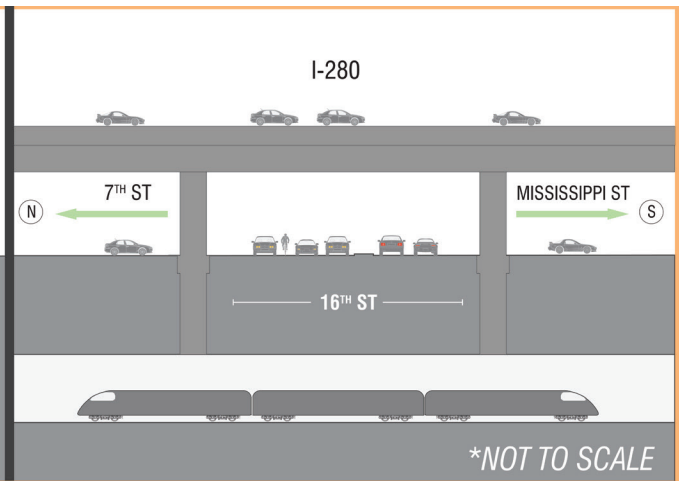
Exhibit 8: Pennsylvania Avenue: DTX + Extended Tunnel Alignment (Option 2)

Cross sections of the 16th/7th street intersection with trains moved underground, below the streets

Looking North



Looking East



- Bay neighborhood and the west and north/south across existing tracks and railyard.
- » Repurposes the 4th/King railyard for improved urban form and increased land use considerations.
- » Assumes 3 tracks in the DTX tunnel and predominantly 2 tracks south of the 4th/Townsend underground station with crossovers as needed to allow for flexibility in operations.

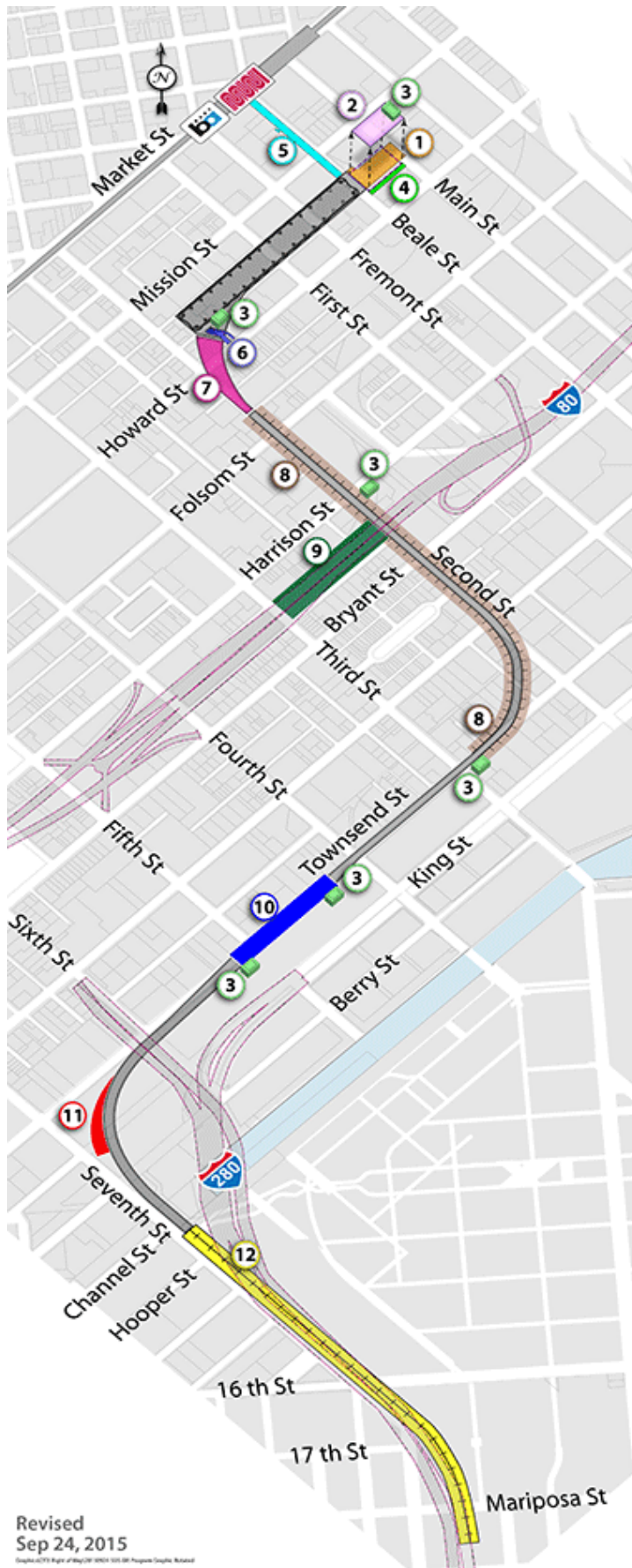
Issues and Considerations

In addition to the common issues and considerations for all alignments identified previously, the following issues are specific to consider under the Pennsylvania Avenue alignment option:

- » To avoid the outcomes of the “Future with Surface Rail: DTX + Trenched Streets” alignment of either intermittent closures of the at-grade intersections or significant trenching, this option moves the trains underground. (See Exhibit 8)
- » Requires 100% electrification of Caltrain.
- » Allows for a phased construction where DTX is built and Pennsylvania Avenue extension could be designed and environmentally cleared separately and connected to the DTX with minimal service impacts.
- » Allows for many more east/west connections in the area, as rail is moved underground.

- » All trains serve the SFTC, because of the removal of the 4th/King Railyard.
- » Maintains rider access to the 4th/King area via the underground DTX station at 4th/Townsend.
- » Requires the construction and use of a new southern railyard for Caltrain storage and maintenance.
- » Separates passenger operations at 4th/Townsend from storage and maintenance at the new southern railyard.
- » Requires additional environmental clearance for tunnel portion south of the DTX tunnel stub box.
- » Potentially increases tunnel boring efficiency by using the same boring machine for both a portion of the DTX alignment¹² and this “Pennsylvania” alignment¹³.
- » Provides increased possibility of relocating the 22nd Street station for greater accessibility.
- » Potential to repurpose the 4th/King Railyard for improved urban design and land use considerations.
- » Removes rail use in up to two of the four Caltrain tunnels in San Francisco. These existing tunnels are eligible for historic register, are susceptible to sea level rise and flooding, and are currently difficult to maintain.

Exhibit 9: The elements of the DTX evaluated in the TJPA SEIS/EIR are shown below:



Revised
Sep 24, 2015
Source: TJPA, 2015

1. **Train Box Extension** – The underground train box could be extended east one block to Main Street.
2. **Intercity Bus Facility** – A new bus facility would be constructed above the extended train box between Beale and Main streets. It would serve operators such as Amtrak and Greyhound.
3. **Ventilation and Emergency Egress Structures** – Six emergency ventilation/evacuation structures would be co-located with emergency tunnel exits at various locations along the DTX alignment.
4. **Taxi Staging Areas** – Curbside passenger loading and unloading spaces for taxis would be provided on Natoma Street alongside the new intercity bus facility.
5. **BART/Muni Underground Pedestrian Connector** – A pedestrian connection would link the Embarcadero BART/Muni Metro Station to the Transit Center.
6. **Bicycle/Controlled Vehicle Ramp** – A bicycle ramp would lead to below-grade bicycle facilities within the Transit Center. A separate controlled-access vehicle ramp to the Lower Concourse (for use by emergency and approved maintenance vehicles) would run parallel to the bicycle ramp.
7. **Widened Throat Structure** – The proposed widened throat structure provides the connection between the underground tracks and the train box below the Transit Center. It will conform to design specifications required for high-speed rail service.
8. **Rock Dowels** – Rock dowels are approximately 15-foot-long rods that would be installed along the mined tunnel segment.
9. **Parking at AC Transit Bus Storage Facility** – The AC Transit bus storage facility would be used for off-hours/nighttime or special event parking when not in use by AC Transit for regular operations.
10. **Fourth and Townsend Underground Station Realignment** – The underground station would be realigned to parallel Townsend Street.
11. **Tunnel Stub Box** – A new below-grade train box at the west end of the Caltrain railyard near Townsend and Seventh streets would be constructed to accommodate future grade separations and expedite future arrival of below-grade Caltrain and high-speed trains.
12. **Additional Trackwork** – A turnback track and maintenance of way storage track would be constructed within the existing Caltrain right-of-way between Hooper Street and Mariposa Street, immediately east of Seventh Street.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) direct impacts to other RAB components.

MANAGING TRAIN CONFLICTS

With the movement of trains underground, the issues identified in the Future with Surface Rail: DTX + Trenched Streets alignment option around the two at-grade intersections are removed. The two intersections could operate as regular 4-way intersections – without the train operations interrupting traffic flow. In addition, north of the tunnel portal location, the surface tracks and the 4th/King Railyard would be removed. With the removal of train operations at the surface, up to six (6) new east/west roads could connect Mission Bay and its adjoining neighborhoods to the rest of the City north of 16th Street. These changes would also enable new north/south connections across the existing railyard.

CHANGE MANAGEMENT

The Pennsylvania Avenue: DTX + Extended Tunnel alignment minimizes disruptions in train service. The operational changes to Caltrain are balanced with improved urban design outcomes and increased potential for more intense urban land uses. Specifically, change management associated with this alignment includes:

- » Connection of the Pennsylvania Avenue extension alignment would be made through the use of the DTX tunnel stub box, as included in the DTX (See Exhibit 10, item 11).
- » This alignment would allow a phased construction whereby the DTX would be completed and could start operations with a later connection to the Pennsylvania Avenue alignment section. This would enable train operations to start within the DTX and continue without major interruptions while the Pennsylvania Avenue alignment is completed. Connections between the Pennsylvania Avenue portion and the operating DTX could be completed with a limited number of weekend service impacts.
- » Additional environmental clearance would be required for the underground portion of Pennsylvania

Avenue Extension outside of the DTX. This additional environmental work is anticipated to be simpler than the DTX environmental clearance as well as the potential environmental clearance for Mission Bay as surface impacts under the Pennsylvania Avenue Extension alignment would be minimal.

- » A 22nd Street re-location study would be required¹⁴. This proposed study would provide a full analysis of connections to existing and future transit lines, bicycle and pedestrian routes, and for complete ADA accessibility.
- » A new southern railyard could add operating expenses for Caltrain to move trains into and out of service.
 - » This change would eliminate the need for a turnback track as provided under “Future with Surface Rail” alignment (Exhibit-10, item 12).

Exhibit 10: Location of Tunnel Stub Box in DTX Plans



Source: TJPA, 2015

- » To allow for additional storage or event staging of trains, there are possibilities (not included in the cost estimates provided, and not fully engineered) for an expanded underground DTX 4th/Townsend station. While an expanded underground 4th/Townsend station would provide some additional tracks, the remainder of the storage needs and likely all maintenance needs for Caltrain would be completed at the new southern railyard ¹⁵.
- » No change needed to Caltrain electrification schedule as both CHSRA and Caltrain both can use the Caltrain tracks. But as noted, Caltrain would be required to fully electrify its fleet.

MAXIMIZING PUBLIC INVESTMENT IN SFTC

With the removal of the surface tracks north of the 22nd Street for the new Pennsylvania alignment tunnel, all trains traveling to and from San Francisco would terminate at SFTC. This maximizes the public investment in the new transit center, which has one of the highest modal connection opportunities and job densities in the western United States.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » Component #2 Railyard Relocation/Reconfiguration— Under this option, the railyard is removed and repurposed for improved urban design and land use more compatible with high-density neighborhood.
- » Component #3 Urban Design and Land Use Considerations— Provides opportunity for new east/west pedestrian, bike, and vehicular connections between the Mission Bay neighborhood and adjacent neighborhoods to the west as well as new connections across the existing railyard. Adds land use opportunities. Avoids the need to trench streets.
- » Component #4 Extension/Loop – this alignment maintains the potential for future connections out of the east end of the SFTC.
- » Component #5 I-280 – Assumes continued use of elevated I-280; compatible with the potential future removal of I-280.

Cost Considerations

Costs will exceed the current DTX estimate (\$4Billion). This alignment would include the environmental clearance, construction of an additional 1.6 miles of underground rail tunnel ¹⁶, and a new southern railyard. For a summary of costs see *Preliminary Estimate of Probable Costs* later in this Component.

Summary: Option #2 Pennsylvania Avenue Alignment

PROS	CONS
<ul style="list-style-type: none"> » Provides access and mobility for critical life-saving service to the Mission Bay hospitals across 16th Street; eliminates conflicts with trains. » Avoids a long, deep trenching of the street network to maintain east/west connections to Mission Bay. » Provides opportunity to re-knit over 1-mile of the city longitudinally with up to six additional east/west connections across existing surface rail. » Improves urban design and creates land use opportunities at 4th/King Railyard; provides up to two additional north/south connections across existing railyard. » Provides dedicated right-of-way resulting in safer surface streets » Provides for nominally faster rail travel times over Future with Surface Rail and current conditions. » Increases the opportunity to improve access to 22nd Street Station. » Allows for more direct train movement from storage into operations for trains than the “Future with Surface Rail” alignment option by creating a new storage and maintenance location to the south. » Allows possibility of expanding 4th/Townsend underground for additional storage opportunities. » Includes flexibility of construction phasing by allowing the construction of the Pennsylvania Avenue extension after the DTX is in operation with minimal disruptions to Caltrain/HSR. » Provides for all trains to utilize SFTC 	<ul style="list-style-type: none"> » Increases project costs » Requires additional environmental review on the underground segment south of 7th/Townsend. » Requires relocation of storage and maintenance functions to a new southern location. » Likely requires the relocation of a substantial number of underground utilities. » May impact overall capacity of 4th/King station area as removing 4th/King. Future analysis to be completed and 4th/Townsend underground station may be revised to improve capacity if needed.

RAIL ALIGNMENT OPTION 3: MISSION BAY: MODIFIED DTX + 3RD STREET TUNNEL

Description

The “Mission Bay” rail alignment proposes to tunnel from the vicinity of 23rd Street below the existing I-280 elevated freeway (see Exhibit 11). From there, the tunnel would veer east traveling below 3rd Street, across China Basin to the southwest corner of AT&T Park and then into the existing DTX alignment. This alignment would travel at a deeper depth¹⁷ than the approved DTX and climb to the DTX elevation at the throat of the SFTC near 2nd Street. Notably, this alignment would require abandoning the DTX alignment which has completed preliminary design and is environmentally cleared. Specific elements of the Mission Bay alignment option include:

- » Forges a new alignment that largely falls west of the Downtown Rail Extension (DTX) alignment. Only the last segment along 2nd Street would follow the DTX into the SFTC. Even here, the depth would be different than the approved DTX.
- » Assumes Caltrain electrification. Requires 100% electrification of fleet servicing San Francisco.
- » Proposes to move rail underground in the vicinity of 22nd Street and then veer east into an alignment under 3rd Street.
- » Proposes a new underground Third Street Station to serve the Mission Bay community. This would operate as a replacement to 4th/King Station and/or 4th/Townsend Station.
- » Assumes surface rail is removed north of 22nd Street Station and thereby removes 4th/King surface railyard access.
- » Intersections of 7th/Mission Bay Drive and 16th Street no longer have rail conflicts, as there would be no train movements through these intersections.
- » locates 4th/King storage and maintenance functions and assumes new southern railyard. Provides for opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission Bay neighborhood and the west.
- » Provides the opportunity for new north/south connections across existing railyard.

- » Enables repurposing of the 4th/King railyard for improved urban form and additional land use opportunities.
- » Assumes two to three tracks throughout the entire new alignment section with crossovers as needed for operations flexibility.

Issues and Considerations

In addition to the common issues and considerations for all alignments shown above, the following issues are specific to consider with the Mission Bay alignment option:

- » To avoid the outcomes of the “Future with Surface Rail” alignment of either intermittent closures of the at-grade intersections or significant trenching, this option moves the trains underground. (See Exhibit 11)
- » Requires 100% electrification of Caltrain fleet.
- » Placement of trains underground allows for many more east/west connections in the area.
- » Elimination of Caltrain tracks north of 25th Street creates new potential east/west connections to Mission Bay
- » Elimination of 4th/King Railyard creates new potential north/south connections in a dense, urban environment.
- » All trains terminate/begin at SFTC.
- » Train users who would exit at 4th/King or 4th/Townsend vicinity would use the new underground Third Street Station.
- » Requires the construction and use of a new southern railyard for Caltrain for storage and maintenance.
- » Separates operations to occur at Third Street Station from storage and maintenance to occur at new southern railyard.
- » Requires additional environmental clearance for tunnel portion south of the DTX throat including impacts to major substructures (e.g., 3rd Street Bridge, AT&T, and I-280), poor and unknown soil conditions, impacts from construction and operation of a new, underground, deep station, and potentially

use of the largest tunnel boring machine used in the US to date.

- » This tunnel cannot be phased and the work and time spent on the DTX design and environmental clearance would be a loss.
- » Although this alignment is a straighter shot into the SFTC, there is not significant time savings over the other alignments due to traveling to the depth needed to travel under Mission Creek and climbing back to the SFTC depth, and the likelihood of a required double reverse curve around AT&T Park to minimize impacts to the substructure of the ballpark.
- » The location of a tunnel boring machine launch pit will need to be determined.
- » Provides possibility of relocating the 22nd Street station to provide more accessibility.
- » 4th/King would be repurposed for urban design and land use opportunities.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) direct impacts to other RAB components.

MANAGING TRAIN CONFLICTS

As the trains are moved underground south of 16th Street, the possibilities of train conflicts are removed. In addition, the issues identified in the Future with Surface Rail alignment option around the two at-grade intersections are also removed. The two intersections could operate as regular 4-way intersections – without the train operations interrupting traffic flow. In addition, north of the tunnel portal location, the surface tracks and the 4th/King Railyard would be removed. With the removal of train operations at the surface, up to six (6) new east/west roads could make new connections north of 16th Street. These changes would also enable new north/south connections across the existing railyard.

Exhibit 11: Mission Bay: Modified DTX + 3rd Street Tunnel Rail Alignment (Option 3)



While the lack of conflict just described is the final state of this alignment, there is an interim condition of this alignment where the train conflicts with surface traffic will continue (after Caltrain electrifies and HSR is operating but the Mission Bay alignment is not constructed as yet¹⁸). Unlike the Pennsylvania Avenue alignment, the Mission Bay alignment cannot be constructed in a phased manner. Trains would continue to run at surface until the Mission Bay tunnel is complete and trains are relocated underground. The interim state would include disruption to the 16th Street Bus Rapid Transit (22-Fillmore), critical access to the hospital and general delay for all in the neighborhood.

This interim period of conflict could continue as the potential for delays is difficult to estimate. This tunnel utilizes 2nd Street but would be at a different elevation than previously cleared under the DTX, so additional environmental study would be needed and the work. In addition, the impacts to major substructures (e.g., 3rd Street Bridge, AT&T Park, and I-280), poor and unknown soil conditions, impacts from construction and operation of a new, underground, deep station, and potentially use of the largest tunnel boring machine used in the US to date. All of these items will add time and money to the design, environmental clearance, and construction costs.

CHANGE MANAGEMENT

Mission Bay Alignment requires the most change for execution with the following items impacted:

- » This alignment cannot use the vast majority of the DTX alignment, with the only common element being at the throat of the SFTC. (See Exhibit 13, item 7) Further, the portion of this alignment at 2nd Street is at a different elevation than the current DTX. The tunnel would be constructed while Caltrain remained in service with a limited number of weekend service impacts as the connection is made to the new tunnel.
- » Additional environmental clearance would be required for the underground portion outside of the DTX throat. The environmental clearance of this tunnel would include more impacts than the Pennsylvania alignment tunnel. This is because the Mission Bay alignment not only includes vent structures but also a new, likely deep, underground station somewhere along 3rd Street¹⁹ and negotiation around the 3rd Street Bascule (Swing) Bridge, AT&T Park substructures—all of which need to be analyzed. Therefore, the environmental clearance process for the Mission Bay alignment is anticipated to be more lengthy and in-depth than other options.
- » A 22nd Street re-location study would be required²⁰. This proposed study would provide a full analysis of connections to existing and future transit lines,

Exhibit 12: Mission Bay Alignment - Modified DTX + 3rd Street Tunnel (Option 3)

Cross sections of the 16th/7th street intersection with trains moved underground, below 3rd Street

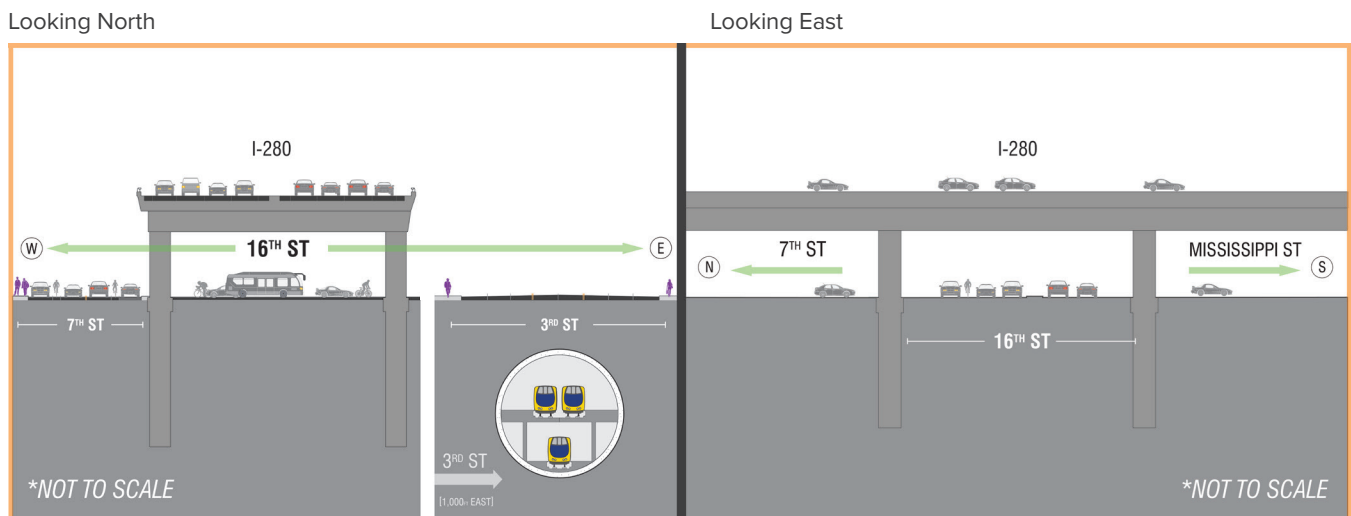
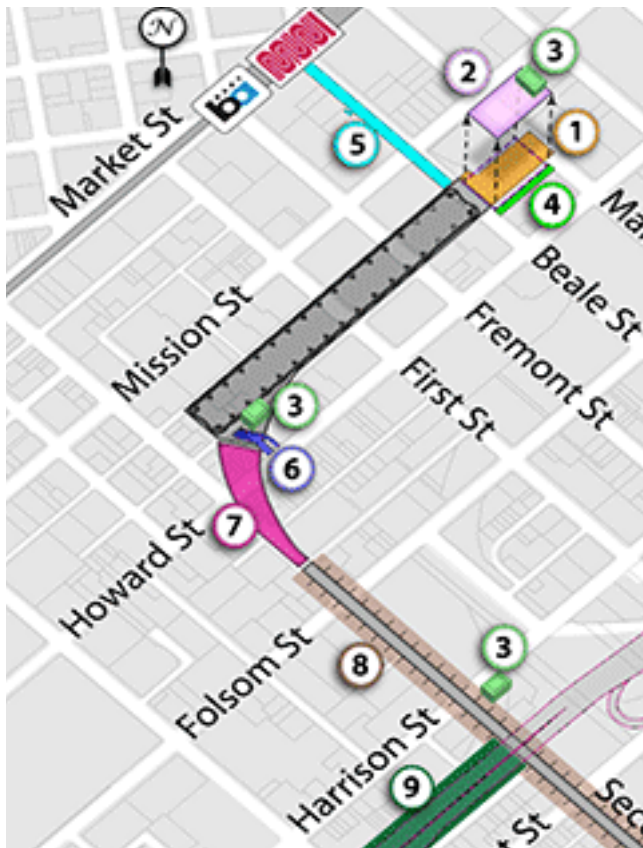


Exhibit 13: Location of SFTC throat in DTX



Source: TJPA, 2015

bicycle and pedestrian routes, and for complete ADA accessibility.

- » Changes to Caltrain functionality would include separating passenger loading operations which would occur at the new Third Street Station from storage and maintenance which would occur at the new southern railyard. This would add operating expenses to move trains into and out of service.
 - » This change would eliminate the need for a turnback track as provided under “Future with Surface Rail” alignment (see Exhibit 10, item 12).
 - » There is the possibility of double-berthing for staging but likely not storage at the new underground Mission Bay station. Logistics and costing of providing additional staging or storage in the Mission Bay alignment was not included in the cost estimates and the Blended Service Operations Plan would need to be completed before additional work is undertaken.
- » No change needed to Caltrain electrification schedule as both CHSRA and Caltrain both can use

the Caltrain tracks, but as noted. Caltrain would be required to fully electrify its fleet.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

With the removal of the surface tracks north of the 22nd Street for the new Mission Bay alignment tunnel, all trains traveling to and from San Francisco would terminate at SFTC. This maximizes the immense public investment in building the new transit center. The result would be many more modal connection opportunities in one centralized, mega terminal station. This consistent, high-quality landing place for all rail users in San Francisco improves the user experience.

INTERACTIONS WITH RAB COMPONENTS

- » Component #2 Railyard Reconfiguration/Relocation— Under this option, the railyard is removed and repurposed for improved urban design and land use more compatible with high-density neighborhood.
- » Component #3 Urban Design and Land Use Considerations— Provides opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission Bay neighborhood and to the west as well as new connections across the existing railyard. Adds land use opportunities. Avoids the need for trenching of streets. The Third Street Station would serve the growing Mission Bay neighborhood; however, ridership would be somewhat reduced from other alignments.
- » Component #4 Extension/Loop – this alignment maintains the potential for future connections out of the east end of the SFTC.
- » Component #5 I-280 – Continues use of elevated I-280 would improve compatibility for future options as this alignment would work with either I-280 remaining or future removal.

COST CONSIDERATIONS

Costs differences from the current DTX estimate (\$4 billion) for this rail alignment are due to requirements additional, complicated environmental review of a new 2.6 mile underground rail tunnel, a new southern railyard, and construction costs associated with building a tunnel in an area with many unknowns. For a summary of costs see *Preliminary Estimate of Probable Costs* later in this Component.

Summary: Mission Bay: Modified DTX + 3rd Street Tunnel Alignment (Option #3)

PROS	CONS
<ul style="list-style-type: none"> » Provides access and mobility for critical life-saving service to the hospital across 16th Street. » Avoids a long, deep trenching of the street network to maintain east/west connections to Mission Bay. » Improves neighborhood connectivity and safety by eliminating conflicts with trains. » Provides opportunity to re-knit over 1-mile of the city longitudinally with up to 6 additional east/west connections across existing surface rail. » Provides up to 2 additional north/south connections across existing railyard. » Provides for nominally faster rail travel times. » Provides an opportunity to improve access to 22nd Street Station » Increases the opportunity to improve access to 22nd Street Station. » Allows for more direct train movement from storage into operations for trains than the “Future with Surface Rail” alignment option by creating a new storage and maintenance location to the south. » Improves urban design and creates land use opportunities at 4th/King Railyard. » Provides a direct connection to Caltrain and HSR for Mission Bay » Provides for all trains to utilize SFTC 	<ul style="list-style-type: none"> » Requires additional environmental review on the entire new segment from the Caltrain alignment to the throat of the SFTC. » Requires a change in Caltrain operations with the storage and maintenance at a new location. » Requires new rail storage and maintenance location. » Constrains space for underground storage tracks at Mission Bay station. » May require the largest bore constructed in US to date, depending upon how many tracks are required. » Likely increases in costs for design, difficulty of environmental review, and costs of construction due to poor soils and in some cases unknown soil conditions. » Increases in engineering unknowns and potential difficulties due to alignment’s interaction with substructures such as the 3rd Street Bascule (Swing) Bridge and AT&T Park, and potentially I-280. » Eliminates the potential for phased construction. Trains would continue to run to/from 4th/King until the new tunnel to SFTC is completed. » Results in the longest schedule for completion of alignments under consideration. » Highest costs of alignments further analyzed

Comparitive Analysis Between Rail Alignment Options

CONSTRUCTION TIMELINE

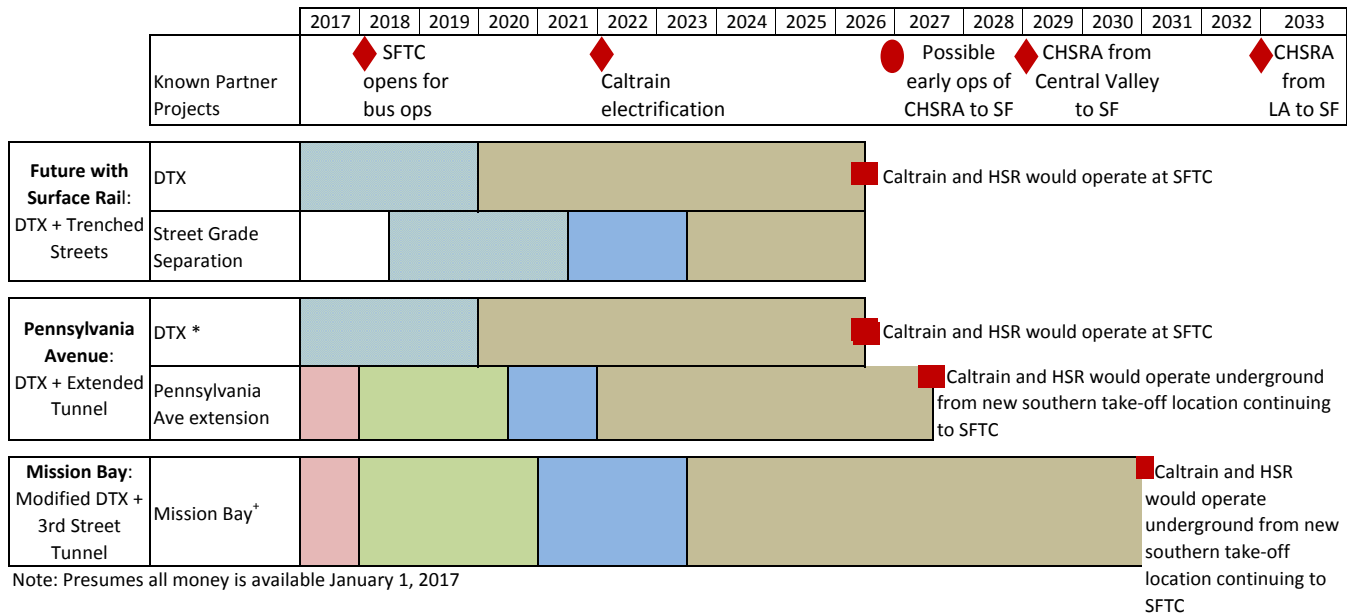
To provide comparison of construction timeline for each of the rail alignments under consideration, the analysis looked at how quickly each could be constructed if all the money became available (when needed) starting in January 2017. The three rail alignments would still be constructed and opened on different timelines. The “Future with Surface Rail” alignment has completed its environmental clearance (SEIS/R, 2018) for the DTX tunnel while the two trenched streets would still need to have environmental clearance completed prior to their construction. Similarly, both the “Pennsylvania Avenue” alignment and the “Mission Bay” alignment would need additional environmental work prior to construction for the tunnel portions outside of the DTX (See Exhibit 14).

PRELIMINARY ESTIMATES OF PROBABLE COSTS

The preliminary estimates of probable costs were completed to allow for a preliminary financial comparison of the rail alignment options. Please note:

- » These estimates were based on between 5-10% design documents and represent the comparative costs based on the TJPA’s estimates of the DTX, and validated using costs of similar projects.
- » These estimates were expressed in 2016 dollars and have been escalated on a 5% per year basis to mid-construction year.
- » These estimates are not meant to be a line-by-line cost estimate that would be available when 30% design is complete. These estimates are intended to provide decision-makers with an order of magnitude analysis²¹.

Exhibit 14: Construction Timeline for Rail Alignments



* Project approach of the DTX should be revisited to take advantage of potential efficiencies in boring parts of the DTX in combination with the Pennsylvania Avenue Extension. These efficiencies could have beneficial schedule implications

† Example of big bore in bad soil conditions: Bertha (Seattle) 57 feet in diameter. 1.7 miles - rate of 1 year

LEGEND

- Selection of Rail Alignment
- Additional Engineering & Property Acquisition
- Additional Design & Environmental Clearance (if needed)
- Property Acquisition
- Construction

» All alignment option cost estimates included the DTX elements²², with some variations²³. In addition, specific alignment elements were added including but not limited to:

- » A new railyard is included in both the Pennsylvania Avenue and Mission Bay alignments.
- » Grade separation of the two at-grade intersections is included in the Future with Surface Rail alignment.
- » Rail alignment elements and construction costs vary under each alignment.
- » The estimates provided below are all inclusive. They include all elements for each rail alignment as identified below. (e.g., Future with Surface Rail includes both the DTX and the cost for trenching the City Streets; Pennsylvania Avenue includes the DTX, environmental and construction of extending the tunnel underground, and providing for a southern railyard to replace 4th/King; Mission Bay includes environmental and construction of a new tunnel, as well as providing for a new southern railyard.)

Development opportunities

The Pennsylvania Avenue and Mission Bay alignments make land available that is more compatible with a growing population and job base. Additional space for more urban land uses could off-set some of the costs of construction. The largest opportunity for reuse is the 4th/King railyard. Looking only at the 4th/King railyard, and utilizing the zoning in the surrounding Central SoMa area, an estimation of the potential increased land opportunity is included. Not included in the estimates provided would be increased property values associated with the removal of heavy industrial rail yards and improved street connectivity.

Unlike other development opportunities, such as the land around the Salesforce Transit Center that was owned by Caltrans and transferred to the City, the land under the 4th/King railyard is owned by a private developer who has provided Caltrain with an operating lease on that land. While the 4th/King railyard may become available for future development, the value increase available to the city would not include the sale of the land as was the case in the Transbay District – In this area, proceeds would be accrued from: bonding potential, property value conferred, transfer taxes, and

a Community Facilities District (CFD – “Mello Roos district”) onto any development on the 4th/King railyard. Please note, funds may not all be attributed to a single CFD.

Grade Separation Cost estimation

The two current at-grade intersections (7th/Mission Bay Drive and 16th Street/Mississippi) under the “Future with Surface Rail” alignment option would be depressed into trenches within the City. San Francisco Department of Public Works provided preliminary estimates of probable costs for each of these two intersections based on known utility conflicts and City standards. Those estimates are included in the estimate separately.

While there are other costs that were identified and estimated within the report, given the magnitude of this type of construction, private sector costs and benefits including disruption costs, property impacts, and rider travel time savings while significant (on the order of millions), were excluded from the summary calculations provided below as they did not accrue to the project or the agencies seeking to fund it. Specifics on those estimates can be found in Appendix D and Appendix E of the Consultant Technical Report.

Exhibit 15: Preliminary Estimates of Probable Costs - Rail Alignments

Estimated Probable Construction Costs

	Option 1: Future with Surface Rail: DTX + Trenched Streets (2026)	Option 2: Pennsylvania Avenue: DTX + Extended Tunnel (2027)	Option 3: Mission Bay: Modified DTX + 3rd Street Tunnel (2030)
Alignment Construction Probable Cost	-\$4,075	-\$6,842	-\$10,196
Grade Separation (escalated to mid-year construction 2024, completion 2026)	-\$1,116	\$0	\$0
TOTAL (\$millions, escalated to mid-year of construction 2023, 2024, 2027)	-\$5,191	-\$6,842	-\$10,196

City Revenue Bonding Potential

	Option 1	Option 2	Option 3
Railyard Site Development Fiscal Benefit Bonding Potential ¹	\$0	\$235	\$235
Adjacent Property Value attributable to rail: Tax Increment Bonding Potential	\$214	\$214	\$147
Railyard Site Land Secured Financing Bonding Potential - CFD on area 0.1% Assessed value	\$0	\$32	\$32
Diminished Bonding Potential from Trenching	-\$8	\$0	\$0
TOTAL BONDING POTENTIAL (millions of 2026 \$)	\$206	\$481	\$414

¹ Assumes 25% of revenues dedicated to costs associated with development (e.g., increased sewer costs, etc)

Private Sector Benefits(+)/Costs(-)

	Option 1	Option 2	Option 3
Railyard Land Value Conferred	\$0	\$352	\$352
Diminished Property Value from Trenching intersections at Mission Bay Dr and 16th St	-\$114	\$0	\$0
Potential Rail Passenger Travel time Savings over 50 years	\$0	\$0	\$82
TOTAL PRIVATE SECTOR BENEFITS/COSTS (millions of 2026\$)	-\$114	\$352	\$434

Overall Benefit/Cost Summary

	Option 1: Future with Surface Rail: DTX + Trenched Streets (2026)	Option 2: Pennsylvania Avenue: DTX + Extended Tunnel (2027)	Option 3: Mission Bay: Modified DTX + 3rd Street Tunnel (2030)
Estimated Project Costs (escalated to estimated mid-year of construction 2023, 2024, 2027)	-\$5,191	-\$6,842	-\$10,196
City Bonding Potential	\$206	\$481	\$414
Private Sector +Benefits/-Costs (estimated to 2026\$ millions)	-\$114	\$352	\$434
TOTAL (millions)	-\$5,099	-\$6,010	-\$9,349

COMPONENT #2: RAILYARD RECONFIGURATION/RELOCATION

Description

The 4th/King Railyard provides multiple services that are essential to Caltrain. Today, this railyard operates as a station for boarding Caltrain riders. It performs important staging tasks so that multiple trains may come into service quickly after a big event such as a Giants baseball game. The railyard also provides space for storage and maintenance of Caltrain trains.

As the City, region, and state consider how to best bring HSR and Caltrain to the Salesforce Transit Center (SFTC), the future of the railyard should be carefully considered. There are some rail alignments which would create more opportunity for reuse of part or all of the railyard. To help explore the potential issues and opportunities, the RAB study considered how the current functions of the railyard could be adapted to require less space. For example, Caltrain could separate station operations from staging needs, and storage and maintenance functions. Separation of these functions could enable relocation of some or all of the functions to free up space at the railyard assuming a replacement location is secured as discussed in Component 1: Rail Alignment to Salesforce Transit Center (SFTC). There are additional benefits to considering how the function of the railyard would change under the current plan to bring rail to the SFTC. As discussed in Component #1 of this report, the current planned alignment, titled “Future with Surface Rail” requires a cumbersome backtrack movement to connect trains at the 4th/King Railyard to the SFTC. (See Exhibit 17, item 12) This 9-step movement will take approximately 10 minutes (LTK, 2015)²⁴. To understand alternatives to this movement and examine the potential benefits of reducing the space needs of the current railyard, the RAB conducted a reconfiguration and/or relocation study²⁵.

Five sites for potential relocation of the 4th/King railyard were originally studied without consideration of jurisdictional boundaries. After preliminary analysis, two (2) locations were found to have had serious flaws, and one (1) was less desirable as it produced a stub-end yard rather than a run-through yard. After application of minimum requirements for relocation were applied, two locations remained for further study.



Exhibit 16: Existing 4th/King Railyard

Issues and Considerations

It is important to consider the following issues when evaluating potential Railyard Reconfiguration/Relocation options: 1) the needs of rail operators, 2) efficiency of movements, 3) potential impacts and benefits to the wider public.

THE NEEDS OF RAIL OPERATORS

- » If the railyard is moved from the 4th/King Railyard, there may be additional operating costs to move trains into/out of service.

Exhibit 17: Turnback Track as identified in DTX SEIS/R



Source: TJPA, 2015

- » Operations analysis based on the Blended Service Plan and a storage and maintenance plan are required before further consideration of either reconfiguration or relocation of the 4th/King railyard. The Blended Service Operations Plan and the Caltrain Business Plan are both anticipated in December 2018. There is currently no timeline for a storage and maintenance plan.
- » Caltrain will need to update its facilities to account for the new electrified and larger fleet of train cars. A new southern yard could address future needs via a ground-up design account for the fleet and possible shared operations/facility with CHSRA.

EFFICIENCY OF MOVEMENTS

- » The movement of Caltrain trains in and out of service currently occurs up to six (6) times per weekday.²⁶ If the current 4th/King Railyard remains with the “Future with Surface Rail” alignment this would require six time-consuming “turn-back” periods per weekday.
- » Caltrain and HSR wish to use more trains in the peak hours which would require more turn-back track usage from the 4th/King Railyard in the future.
- » Each use of the turnback track requires a temporary suspension of opposing track usage at least twice during the movement limiting the capacity of the Caltrain line.
- » A southern railyard would reduce the need for track closures as trains move between storage and the SFTC.²⁷

POTENTIAL IMPACTS AND BENEFITS TO THE WIDER PUBLIC

- » One site under consideration is located in San Francisco while one is south of the City. Coordination with a second jurisdiction would be required if that site is chosen.
- » If a southern location could be found, the 4th/King Railyard could be repurposed for improved urban design and land use considerations that could be more compatible with a high-density neighborhood.
- » If a southern location cannot be found and secured, other conversations with Caltrain (and other stakeholders) will be needed.

Analysis

This section analyzes the issues and considerations within seven categories: 1) opportunities at the 4th/Townsend Underground Station, 2) the needs of train operators, 3) Potential impacts and benefits to the wider public, 4) managing train conflicts and potential connections to the 4th/King Surface Railyard, 5) change management, 6) maximizing public investment in the Salesforce Transit Center, and 7) direct impacts to other RAB components.

OPPORTUNITIES AT THE 4TH/TOWNSEND UNDERGROUND STATION

In both the “Future with Surface Rail” and “Pennsylvania Avenue” alignment options, there is the possibility to expand the underground 4th/Townsend Station. Such expansion would allow for additional storage and service opportunities for Caltrain underground and decrease the need for this element to be provided at the surface at the 4th/King Railyard. Expanding the proposed new underground 4th/Townsend Station could limit the height of any development on the surface of 4th/King. Although more study is needed, it is likely not possible to fully replace the 4th/King railyard underground and also develop on the surface because of structural requirements and train operations.

THE NEEDS OF RAIL OPERATORS

If the railyard is moved from the 4th/King Railyard location, there may be additional operating costs to move trains into/out of service. Added operational costs are not unique to using a southern railyard. There would also be additional operational costs associated with trains moving from storage at the 4th/King Railyard and into operations at SFTC²⁸ as described above in Efficiency of Movements.

Both potential southern railyard locations further analyzed would meet requirements as outlined by Caltrain in 2016²⁹.

Exhibit 18 below is an example of a sketch-level conceptual design proposed for one of the sites further studied. The example site laid out below would accommodate up to 10 Caltrain 8-car trains and includes required maintenance tracks. In addition, the two tracks at the top of the site could be used as run-through tracks providing for direct connection (in this case in the southbound direction) to the Caltrain tracks.

POTENTIAL IMPACTS AND BENEFITS TO THE WIDER PUBLIC

The current Caltrain tracks and the 4th/King surface railyard result in a barrier across the city both in the east/west direction (across the Caltrain at-surface tracks) and north/south (across the railyard between 4th and 7th Streets). As the region grows in both population and employment in the coming years it will be essential to allow for additional connections by all modes to get to and through the City. Reconfiguring/Relocation of the railyard provides up to 20+ acres of potential land to:

- » Restore the street grid in both the east/west direction connecting Mission Bay and the City.
- » Restore the street grid in the north/south direction through the 4th/King railyard and potential across Mission Creek.
- » Improve bicycle and pedestrian connections including the 5th Street bicycle/pedestrian bridge planned across Mission Creek).
- » Eliminate rail hazards and noise.
- » Create land for housing, open space and office/retail opportunities.

This reconfiguration/relocation of the surface railyard could only be possible with the creation and construction of a satisfactory southern railyard.

MANAGING TRAIN CONFLICTS AND POTENTIAL CONNECTIONS TO THE 4TH/KING SURFACE RAILYARD

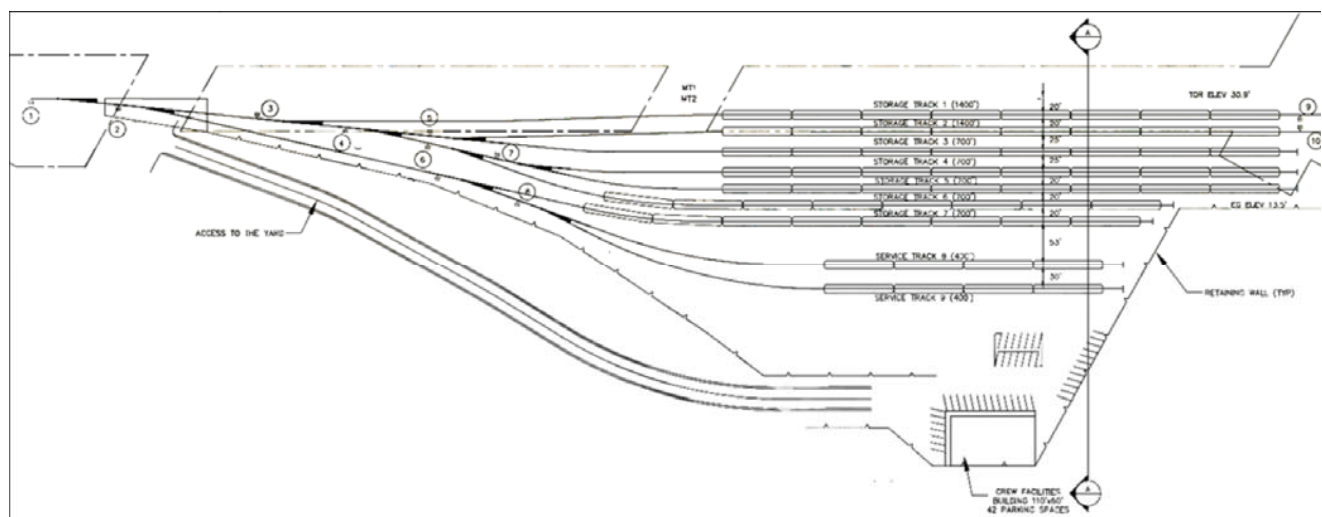
Two potential rail alignments into San Francisco would not experience train and traffic conflicts. Both the “Pennsylvania Avenue” and “Mission Bay” rail alignments move trains underground and do not include surface access to the 4th/King railyard. Both of these alignments would require a southern railyard location to be used for storage and maintenance, and potentially staging.

CHANGE MANAGEMENT

A reconfiguration or relocation of the 4th/King railyard would affect Caltrain operations and require additional environmental study.

- » Caltrain Operations. Caltrain functionality may be changed from a single location to separate locations for user operations, staging and storage/maintenance functions. This may cause some additional operational costs. While this is a different, and possibly more expensive, way of operating for Caltrain, it may actually serve Caltrain and the City better in the future. Some specific improvements could be:
 - » If a partial reconfiguration and relocation were completed, the movement into operations from the remaining storage at 4th/King would require a “turnback” track as provided under the “Future

Exhibit 18: Railyard Conceptual Level layout Design



with Surface Rail” alignment. This use of a “turnback” track closes the tracks to operations in the opposite direction twice as a train utilizes the opposite direction track to use the turnback track. This limits capacity of the rail corridor, and due to the usage of the turnback track, these operations can be slower than point-to point (see below) movements.

- » If a full relocation of the railyard is completed, the movement from storage into operations would be from point to point from a southern railyard into SFTC or vice versa. Closure of tracks to operations in the opposite direction for this movement could occur at higher speeds than usage of a turnback track movement required in the Future with Surface Rail alignment. This change would be required under both the “Pennsylvania Avenue” and “Mission Bay” rail alignments. While this movement would impact the capacity of the line in the opposite direction, it is less impactful than that of trains utilizing the turnback track under the “Future with Surface Rail” alignment. Storage and maintenance for HSR is being contemplated under the Environmental Analysis currently underway by CHSRA. Two locations for HSR are being analyzed; both in Brisbane near the Brisbane Caltrain Station.
- » To allow for additional storage or event staging of trains, there are possibilities for an expanded underground DTX 4th/Townsend station in both the “Future with Surface Rail” and “Pennsylvania Avenue” alignments³⁰. While an expanded underground 4th/Townsend station would provide some additional tracks, it is likely that the 12 tracks currently at the 4th/King surface rail yard could not be fully replaced. It is likely that up to three (3) additional tracks could be provided underground³¹. The remainder of the storage needs and likely all maintenance needs for Caltrain would be completed at the new southern railyard.
- » Environmental Study. Additional environmental review would be required for any reconfiguration or relocation of the railyard.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Providing for all trains to terminate at the SFTC results in many more modal connection opportunities for rail users. It is important to maximize train use of the SFTC as this station is intended to serve as the multi-modal connection point in San Francisco. The SFTC has direct connections to BART, MUNI light rail and bus, AC Transit and other transit agencies, bike share, pedestrian connections, transportation networks companies such as Uber, Lyft, Flywheel, etc., and taxis.

INTERACTIONS WITH RAB COMPONENTS

- » Component #1 Rail Alignments – Under the “Future with Surface Rail” alignment, partial or full relocation/reconfiguration of the surface railyard would be possible. With both “Pennsylvania Avenue” and the “Mission Bay” alignments a new southern railyard would be required and the 4th/King railyard would be removed.
- » Component #3 Urban Design and Land Use Considerations – Provides for various opportunities for partial reconfiguration or full relocation possible. Depending upon decisions made, new pedestrian, bike, and vehicular connections could be made between the Mission Bay neighborhood and the west and across the existing railyard.
- » Component #4 Extension/Loop – Under this component, there is no impact on either option for a potential future SFTC extension/loop.
- » Component #5 I-280 – This component is compatible with I-280 either remaining “as is” or with future removal of the overpass. It should be noted that if the removal of I-280 moves forward sometime in the future, the demolition of the two off-ramps at 6th/ Brannan that extend over the existing railyard would greatly impact operations of the yard.

Cost Considerations

Costs for the “Pennsylvania Avenue” or “Mission Bay” rail alignments included an estimate for acquiring land, engineering, environmental clearance, and construction of a new southern railyard. As the amount of relocation possible under the “Future with Surface Rail” alignment was not known, no additional cost was included in the analysis. For a summary of costs see the section of the report titled Preliminary Estimate of Probable Costs later in Component 1.

Summary: Component #2: Railyard Reconfiguration/Relocation

PROS	CONS
<ul style="list-style-type: none"> » Improves neighborhood connectivity and safety by eliminating conflicts with trains if full relocation to a southern yard is achieved³². » With the surface rail alignment and the railyard removed in either the Pennsylvania Avenue or Mission Bay alignment options, an opportunity to re-knit over 1-mile of the city with up to 6 additional east/west connections and up to 2 additional north/south connections, if full relocation to a southern yard is achieved. » Provides improved opportunities for urban form and land use considerations. » Builds new state of the art railyard and facilities <p>FOR FUTURE EVALUATION</p> <ul style="list-style-type: none"> » Potential more efficient movement from storage into operations for trains using the new storage/maintenance location to the south 	<ul style="list-style-type: none"> » Requires additional environmental clearance on any reconfiguration or relocation of the 4th/King railyard. » Requires a change in Caltrain operations with the storage and maintenance at a new location. » Adds potential operating costs for Caltrain. » May result in longer waits for event specific trains as currently they are handled with staged trains at 4th/King Railyard. » Full analysis of the Blended Service Plan and Caltrain Business Plan are required to understand impacts of the 4th/King Railyard reconfiguration/relocation (draft plans anticipated 2018). <p>FOR FUTURE EVALUATION</p> <ul style="list-style-type: none"> » Full analysis of the Blended Service Plan and Caltrain Business Plan are required to understand impacts of the 4th/King Railyard reconfiguration/relocation (draft plans anticipated 2018). » Adds potential operating costs for Caltrain.

COMPONENT #3: URBAN FORM AND LAND USE CONSIDERATIONS

Description

After a rail alignment to the DTX has been chosen, parcels of land could become available for development, repurposing, and public uses. Such changes could help pay for some of the transportation improvements needed in the area. The largest of these is the 4th/King Railyard which has more than 20 acres of contiguous land. Part of this acreage could potentially become available under the “Future with Surface Rail” alignment. The potential for reuse increases under both the “Pennsylvania Avenue” and “Mission Bay” alignments. If these alignments are used, the railyard site could be fully reprogrammed with improvements to the existing street network, and alternative land uses (See Exhibit 19). Of course, any change in use of the railyard would be predicated upon Caltrain’s assessment of how such change would affect the viability, efficiency and effectiveness of their service.

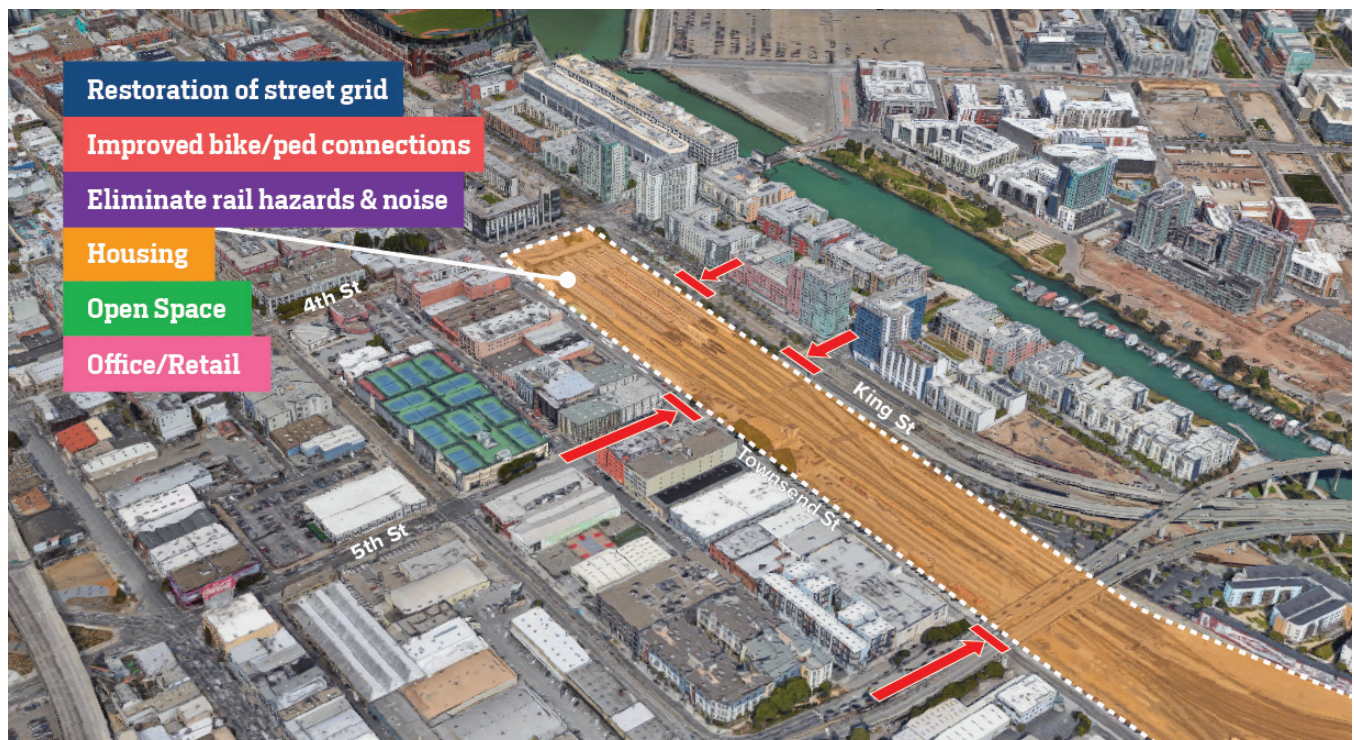
As with all aspects of this study, this consideration of alternative uses of the railyard is provided for decision-makers. Any decisions regarding the balance of land uses, building intensity and public amenities would

require an extensive community planning process. The RAB study assumed zoning comparable to that in the area to estimate possible land value changes. The RAB study did not determine specifically how the land should be developed or when that development should occur. If this reuse of the site moves forward, further studies and public input would be needed to fully explore the possibilities. The RAB study provides a baseline for future considerations. Public benefits, including affordable housing, open space, and other community facilities, would be needed and would offset financial benefits for transportation uses.

Using the surrounding zoning as a template for the purpose of the “Urban Form and Land Use Considerations”, the railyard site could accommodate:

- » 1.46 million square feet of residential space and
- » 1.05-2.43 million square feet of commercial space.

Exhibit 19: Urban Form and Land Use Considerations for Rail Yards Site (Explored In Component #3)



Issues and Considerations

The following issues are specific to the “Urban Form and Land Use” component:

- » A rail alignment option must first be chosen before changes to the railyard could be further considered.
- » Analysis of Caltrain’s operations would be required before further consideration of reconfiguration or relocation of the 4th/King Railyard. The Blended Service Operations (CHSRA and Caltrain) Plan and the Caltrain Business Plan are both anticipated in December 2018.
- » Caltrain has an operating lease on the 4th/King railyard. The land is privately owned. If the railyard is reconfigured or relocated, the private entity would retain the ownership and could sell the property as one unit, subdivide it, or develop it. The City would establish the zoning regulations and remain involved in the development as occurs with any major development project.
- » Additional analysis, including environmental analysis, would be needed for any development of the site.
- » If Caltrain did not need the site for train operations, staging, and storage and maintenance, there is the possibility of creating two (2) north/south connections at 5th and 6th Streets through the railyard. Similarly, up to six (6) east/west streets connections could be made across the Caltrain tracks from Mission Bay Drive to 16th Street that currently do not exist because of the surface tracks. This would result in several new connections between Mission Bay, the waterfront, and the rest of the City.

Analysis

MANAGING TRAIN CONFLICTS

The current Caltrain tracks create a barrier in the east/west direction across the Caltrain surface tracks. The current 4th/King Railyard creates a barrier in the north/south direction across the railyard. As San Francisco grows in both population and employment in the coming years it will be essential to create additional connections by all modes to get to and through the City.

Reconfiguring/Relocation of the railyard could create those connections and significantly improve the neighborhood design by:

- » Restoring the street grid in the east/west direction to/from Mission Bay.
- » Extending the street grid in the north/south direction through the 4th/King railyard and potentially across Mission Creek.
- » Improving bicycle and pedestrian connections including the 5th Street bicycle/pedestrian bridge planned across Mission Creek). Currently it would be difficult to get to/from this proposed bridge.

In addition, if the railyard isn’t needed for trains, approximately twenty (20) acres of land could be repurposed for new uses, thereby:

- » Creating opportunity for open space, libraries, schools, housing, open space, office/retail opportunities, and more.
- » Eliminating industrial externalities such as rail hazards and noise.
- » Offering design features consistent with a high-density, urban environment.

Under the “Future with Surface Rail” alignment, the surface rail corridor remains and the 4th/King Railyard remains. Still, there may be the possibility of some reconfiguration of the 4th/King Railyard. A full analysis of Caltrain and HSR operations can further inform this possibility. Under this alignment, a change reduced railyard would not change to potential train conflicts from the description under the “Future with Surface Rail” alignment.

Under both the “Pennsylvania Avenue” and “Mission Bay” rail alignments, trains would be relocated underground. There would be no surface access to the 4th/King railyard. Both of these alignments would require a southern railyard location to be used for storage, maintenance, and potentially, for train staging. In both alignments, the entire 4th/King Railyard and the surface conflicts at 7th/Mission Bay and 16th Street are removed and up to six (6) east/west and two (2) north/south roadways can be connected.

CHANGE MANAGEMENT

Any modification to the Caltrain tracks including potential reconfiguration/relocation of the railyard would result in significant changes to Caltrain as identified under Component #1—Rail Alignment to SFTC and Component #2 – Railyard Reconfiguration/Relocation. Urban form and land use changes such as

those contemplated in this component would require extensive community and stakeholder dialog.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Since the urban form and land use changes contemplated in this component necessitate alteration of the 4th/King Railyard, these changes may increase the likelihood that all trains would terminate at the SFTC. Providing for all trains to terminate at the SFTC results in many more modal connection opportunities for rail users.

DIRECT IMPACTS TO OTHER RAB COMPONENTS

- » Component #1 - Rail Alignment – Under the Future with Surface Rail alignment, partial or full relocation/reconfiguration could be possible. With both Pennsylvania Avenue and Mission Bay alignment options a new southern railyard would be required and the 4th/King railyard would be removed.
- » Component #2—Railyard Reconfiguration/Relocation— Amount of land available for re-use would depend on the extent of the railyard that could be relocated.

- » Component #4 – Extension/Loop— There is no impact on either option for a potential future SFTC extension/loop.
- » Component #5 – I-280— this component is compatible with I-280 remaining or future removal.

Cost Considerations

As stated, Caltrain has an operations lease for the 4th/King Railyard. The land under the lease is owned privately. If development were allowed to occur on this site under a reconfiguration or relocation of Caltrain, the City could employ funding mechanisms such as parcel transfer costs, Community Facilities District (“CFD” also known as “Mello Roos” district) funding, and bonding potential. A summary of these potential revenues for each rail alignment is provided in the *Preliminary Estimates of Probable Costs* table above. The sale of the land to developers would not be available as part of the revenue stream to the City or Caltrain because the land is privately-owned. Since development impact fees are typically required in San Francisco as mitigation, they are not considered here as potential City revenue.

Summary: Component #3: Urban Form and Land Use Considerations

PROS	CONS
<ul style="list-style-type: none"> » Provides pros as identified in Component #2 related to reconfiguration/relocation of 4th/King railyard including: <ul style="list-style-type: none"> » improves neighborhood connectivity and safety by eliminating conflicts with trains if full location to a southern yard is achieved. » provides opportunity to re-knit over 1-mile of the city longitudinally with east/west connections and north/south connections, if full relocation to a southern yard is achieved. » Provides additional housing, open space and retail/commercial space. » Increases potential funding mechanisms to support needed infrastructure. » Enables great potential for public uses such as open space, libraries, schools and more. » Eliminates industrial externalities such as rail hazards and noise. » Offers design features consistent with a high-density, urban environment. 	<ul style="list-style-type: none"> » Cons as identified in Component #2 related to reconfiguration/relocation of 4th/King railyard including: <ul style="list-style-type: none"> » requires additional environmental clearance, » a change in Caltrain operations, and » potential additional operational costs for any change at the 4th/King railyard. • Full analysis of the HSR and Caltrain operations and service needs are required to understand impacts of reconfiguration/relocation.

COMPONENT #4: TRANSIT CENTER (SFTC) EXTENSION/LOOP

Description

The Salesforce Transit Center (SFTC) is a “stub end” station using one access point for trains to go both in and out. It is the planned terminus for Caltrain and High Speed Rail (HSR) Trains. It is important to maximize the number of trains that use the SFTC as it was designed to serve as the multi-modal connection point in downtown San Francisco in the heart of the financial district. The SFTC has direct connections to BART, MUNI light rail and bus, AC Transit, SamTrans, Golden Gate Transit, and other transit agencies, bike share, and a short walk to thousands of jobs, hotels, hotel rooms and numerous tourist destinations. To accommodate these connections and future riders, it will be constructed with three (3) platforms and six (6) tracks (See Exhibit 19).

In terminus stations, there are activities that must occur while the train is occupying the platform including not only loading/unloading of passengers and luggage, but also cleaning, stocking, and security checks for the trains. Each of these activities adds time to how long the train occupies the platform reducing the number of trains that can serve the SFTC on a daily basis. Because of these terminus activities, and the expected demand for train service to the SFTC, an expansion of capacity will be needed in the future. As the SFTC cannot accommodate additional platforms, the only way to expand capacity is to extend the underground trainbox to the east and either 1) return to the south, via a “loop” or 2) extend from the current trainbox across the Bay into either Alameda or Oakland, aka “extension”³³ (See Exhibit 20). With either the loop or extension option, the terminus activities would move to another location

Exhibit 19: Salesforce Transit Center



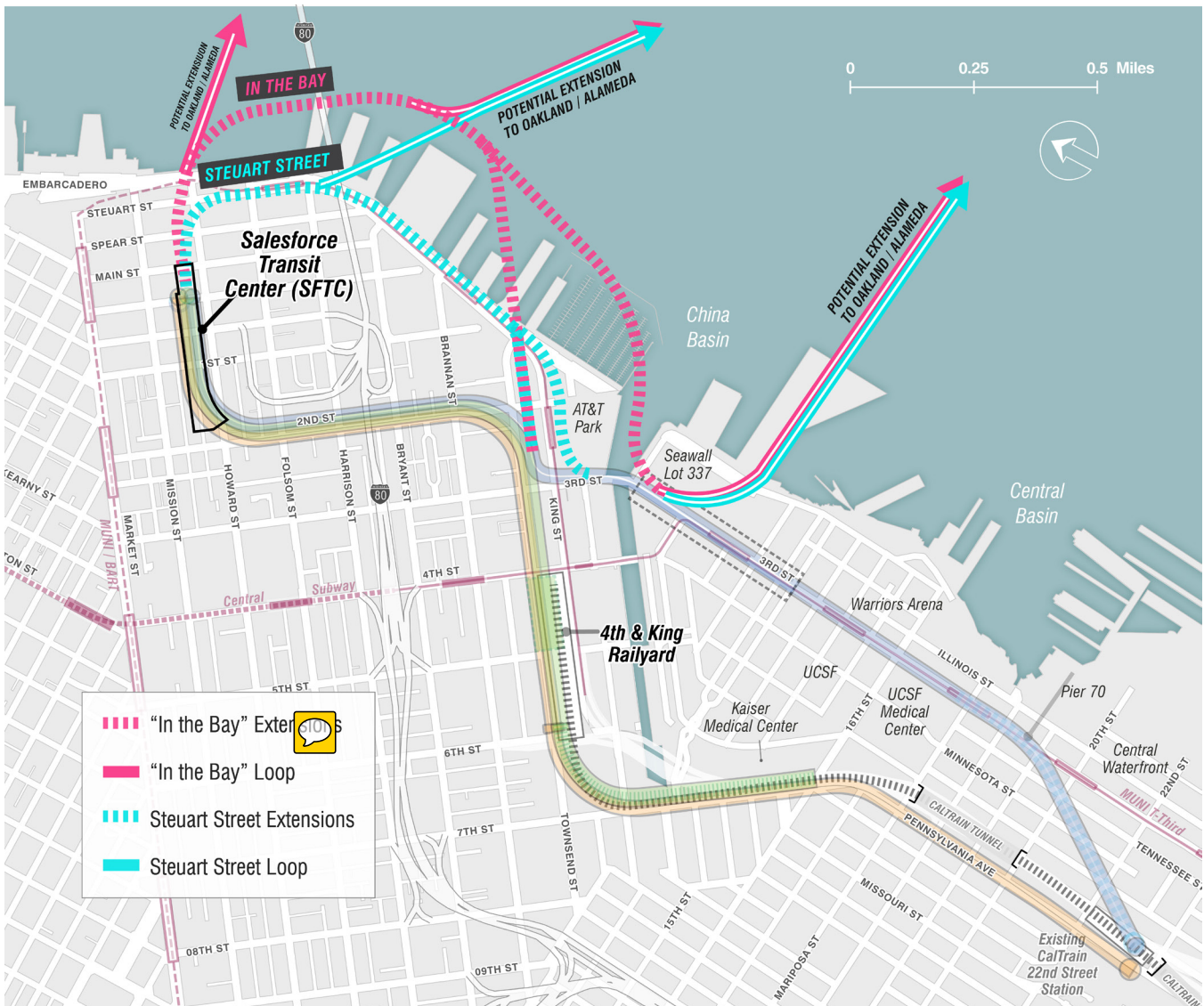
(at a new terminus) and the SFTC would operate like a through station with only unloading and loading of passengers.

Issues And Considerations

The following issues and considerations are relevant to construction of either the “extension” or “loop” out of the east end of the SFTC:

- » Continued population and employment growth in San Francisco, the Region, and the State will require more rail service than currently planned.
- » Caltrain and HSR would like to run more frequent service. The Blended Service Operations Plan and Caltrain Business Plan (both anticipated in late 2018) will provide more information about the amount and timeframe(s) of anticipated additional rail service in the Caltrain corridor.
- » Only 5 of the 6 tracks at the SFTC could be extended. The sixth is inhibited by substructure supports of a neighboring building.
- » Requires 100% electrification of Caltrain; due to funds needed, current plan includes 75% of the fleet and the corridor from San Jose – San Francisco will be electrified³⁴. Diesel trains do not operate in tunnels beyond a certain length³⁵ as adequate ventilation is required. Stations are not allowed in tunnels with diesel trains (such as the SFTC or the 4th/Townsend station designed in the DTX). In addition, diesel trains do not accelerate/decelerate easily so they will continue to be used on the baby bullet service which runs from Gilroy to San Francisco (must terminate at 4th/King) until such time as Caltrain can obtain the funds to fully electrify their fleet (TBD). No diesels could use either the DTX or the extension/loop out of the east end of the SFTC as both travel significant distance underground.
- » The rail service at the SFTC is limited by three factors.
 - » First, the potential number of trains served is limited by design as a terminal station. The activities necessary at the terminal station (not only passenger unloading/loading but also stocking of materials, security check, cleaning, etc) require

Exhibit 20: Extension/Loop Options (Component #4)



a certain amount of time to complete which keeps a train at a platform for this period of time affecting turnaround times between northbound arrivals and southbound departures.

- » Second, the potential number of trains serving the SFTC is limited by the number of trains (Caltrain and HSR) that the rail corridor can accommodate (predominantly a 2-track system).
- » Third, the current plan (TJPA) calls for dedicated platforms for Caltrain and HSR trains. As stated previously, to maximize the capacity of the SFTC, all platforms must be constructed to one height with trains having cars that can access that platform height³⁶. Access to all platforms allow train operators to maximize the available capacity at

SFTC and would allow for both Caltrain and HSR to utilize a future extension/loop if built.

- » Today, there is not a conventional rail connection across The Bay. Bart operates on a unique rail gauge that is not compatible with standard gauge trains.
- » If a seawall rehabilitation or new seawall project moves forward, it would be beneficial to design a “breakout” panel in the seawall for a future in the Bay extension.
- » Does not preclude or determine any heavy rail and/or BART bay crossings in the future.

Analysis

Current designs provide the capacity to handle initial operations at SFTC³⁷, and an extension/loop is not necessary at the time of opening service. Knowing when the SFTC will reach capacity and will limit additional capacity for the peninsula will be essential. The Blended Service Operations, the Caltrain Business Plan, and modeling work being completed for the DTX will identify when an expansion to the SFTC will be needed. Understanding that timeline will allow for sufficient planning, design, and financing to be in place before capacity is exceeded.

All rail alignments under consideration (Component #1) enter the SFTC at the SW corner to accommodate the structural layout as designed for the SFTC. The selection of any one rail alignment would not preclude the future construction of a loop or extension.

While only 5 of the 6 tracks in the SFTC could be extended to the east, those tracks would pare down to two (2) in a tunnel to return south or to continue under the Bay. A trans-bay tunnel would be of considerable length and, it would require that Caltrain fully electrify.

A similar expansion of Union Station in Los Angeles is transforming that stub-end station to a through station by extending tracks south over US-101. This transformation is anticipated to increase capacity at Union Station by at least 40%.

BART is currently beginning a study to further the work completed under MTC called the “Core Capacity Project” which identified 4 promising departure/landing points in San Francisco connecting to either Alameda/Oakland for a new BART tube (See Exhibit 20, promising landing points are shown with red circles). In all cases, the possibility of combining both Bart and conventional rail (Caltrain/HSR) tracks in the same tunnel are expected to be studied.

Because there is not a conventional rail connection across the Bay for Caltrain/H SR use, persons currently traveling by train and wishing to access San Francisco from the East Bay must switch to other modes.

The analysis for an Extension/Loop was focused on concept development and operations analysis rather than engineering specifications. Therefore, while these alignments are feasible, additional study would be necessary to determine 1) final alignment, 2) construction timeline, and 3) cost estimates. If future work on the San Francisco Seawall is to be completed, analyzing

where a break-through panel could exist would maximize potential for future expansion of BART and Caltrain/HSR while also minimizing impacts and retro-fit costs in the future.

MANAGING TRAIN CONFLICTS

No train conflicts are anticipated.

CHANGE MANAGEMENT

No additional change management is needed at this time as any future loop or extension would not disrupt existing rail services or impede any known rail plans.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Transforming SFTC from a stub-end station to a through station would allow for many more trains to utilize the platforms as dwell times will be greatly shortened because terminal activities such as stocking, cleaning, etc. would be moved to another location. Providing for more capacity at SFTC could provide a direct transbay connection where currently a mode change is required – there would be a seamless route from San Francisco to Oakland and Sacramento by train rather than the train to bus/ferry/BART connection that is required now.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » Component #1 Rail Alignment– Future construction of any extension/loop option does not affect any of the three rail alignments under consideration.
- » Component #2 Railyard Reconfiguration/Relocation– There is no impact to the 4th/King railyard in any extension/loop option under consideration.
- » Component #3 Urban Form and Land Use Considerations– minimal to no possibility for improvement to urban form and land use capacity.
- » Component #5 I-280 – Either a loop or extension would be compatible with I-280 remaining as is or future removal.

Cost Considerations

Since the necessary timing of an extension/loop is currently unknown, costs were not included in this study. Once the Blended Service Operations Plan and the Caltrain Business Plan are completed (drafts expected in 2018), planning and operations analysis should begin to ensure there is enough time to plan, engineer, and environmentally clear future infrastructure needed for expanded rail service to and from San Francisco.

Summary: Transit Center (SFTC) Extension and Loop

PROS	CONS
<ul style="list-style-type: none">» Provides for additional capacity along the Caltrain corridor essential for future additional rail service.» Potentially provides rail access to/from Alameda/Oakland.» Provides enough time to plan, engineer, and environmentally clear the project.	<ul style="list-style-type: none">» Requires additional planning, engineering, and environmental clearance.» Costs are not known.» Funding could likely be secured only after Caltrain operates a fully electrified fleet (TBD) and HSR is in operation in the City in 2029 with potential early service in 2027.

COMPONENT #5: BOULEVARD I-280

Interstate-280 runs along the eastern side of the City on approach to Interstate 80, without making a final connection. The initial design would have connected I-280 to I-80, the Embarcadero Freeway, and the Bay Bridge, ultimately creating a ring road around the City as it connected to the Golden Gate Bridge.

Between the Freeway revolt and the Loma Prieta earthquake, I-280 never completed these connections and is now a long off-ramp terminating at 4th/King and 6th/Brannan intersections (See Exhibit 22). There is a decades-long, recurring discussion about whether or not the touch-down of this off-ramp should be changed, and what effect any change might have on the neighborhood and the City.

Specific changes to I-280 are not the primary focus of the RAB study. What is pertinent to the RAB study is an understanding of evolving traffic patterns and predicted traffic volumes that will help inform decisions made now regarding the major investment of rail infrastructure. The significant decisions about investing in rail infrastructure should also be informed on how these decisions might allow or preclude the possibility of future changes to the I-280 north of Mariposa.

For this reason, even though no specific boulevard designs have ever been proposed in the RAB, high-level traffic flow models were used to consider how traffic might flow if moved off of the current freeway and onto a theoretical surface boulevard.

Issues and Considerations

The following issues and considerations are relevant to a potential future removal of the I-280 north of Mariposa:

- » Both the Embarcadero Freeway and the Central Freeway segments were removed following the Loma Prieta earthquake for safety reasons.
- » The former freeway right-of-way have been reclaimed for improved urban form and land uses more compatible with an urban city.
- » Even with a force of nature acting as the impetus, both freeway removals were time-consuming and controversial. Removal of each freeway included

three separate ballot measures and required the City to fund removal of the structure in exchange for the land under it.

Analysis

In the “Future with Surface Rail” alignment, there would not be sufficient right-of-way to accommodate both Caltrain and a surfaced I-280. In both the “Pennsylvania Avenue” and the “Mission Bay” rail alignments, the rail moves underground creating sufficient right-of-way for a theoretical surface boulevard³⁸. These two alignments would still result in a large street footprint and additional congestion within the City street grid beyond just peak hours.

The I-280 is a usable freeway and is expected to remain viable for the foreseeable future. To continue development of this boulevard component, future analysis with Caltrans is required including:

Exhibit 22: Boulevard I-280 (explored in RAB Study Component #5)



- » Determining the total impacts of taking down this segment to the overall interstate system and the City intersecting streets.
- » Building understanding and support of those impacts among decision-makers and the public.
- » Discussing with Caltrans the usable life of the greater I-280 corridor.
- » Determining how to pay for the delta between unsafe usable life and zero usable life as the City would be responsible for the tear-down costs of the elevated section.

None of the rail alignment options under consideration in Component #1 would require the continued use or removal of I-280. The RAB findings did not further pursue the potential to remove I-280 once it was determined that the freeway segment has considerable useful life remaining. However, the potential for removal should be included in the City’s future analysis.

MANAGING TRAIN CONFLICTS

The I-280 freeway segment would be very difficult to transition to a boulevard under the “Future with Surface Rail” alignment option for four reasons:

- » There is not sufficient space to accomplish both a surface boulevard to replace the freeway segment and the surface rail tracks needed by Caltrain and HSR. The available land for a boulevard is currently being used for rail.
- » If there were enough room to co-locate both rail and a surface boulevard, surfacing I-280 would not allow for sufficient intersection flow. There would be significant delays resulting from train closures of the two existing intersections of 7th/Mission Bay Drive and 16th Street. All traffic from the freeway would have to be directed through these intersections and would complicate travel patterns.
- » The I-280 corridor is directly above the Caltrain tracks from Mariposa to Mission Bay Drive. A temporary structure would need to be constructed over the Caltrain tracks but under the I-280 structure to protect the train tracks from any falling debris. Necessary equipment for removal could impact train movements along the corridor for what could be months or years.
- » The I-280 existing off-ramps at 6th/Brannan fly over the existing 4th/King railyard. During removal, necessary equipment would greatly impact the operations

of the 4th/King railyard for what could be many months or years.

CHANGE MANAGEMENT

No additional change management is needed at this time. If, in the future, more study is completed, and acceptance by Caltrans, CalSTA, and San Francisco residents is achieved; only then can discussions surrounding the timing of the takedown of I-280 begin and money for demolition can be secured³⁹. The RAB study does not provide enough information to determine if the I-280 freeway segment should be removed. The RAB does conclude that future analysis should be pursued at a later date.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Retaining or removing the I-280 does not affect the SFTC.

INTERACTIONS WITH RAB COMPONENTS

- » Component #1 Rail Alignments – The “Surface with Future Rail” alignment does not provide enough land area for both a surface running rail line and a surfaced freeway or boulevard. In this alignment option, the I-280 freeway must be retained. Under both the “Pennsylvania Avenue” and “Mission Bay” alignments, the rail is moved underground and the I-280 segment north of Mariposa could be retained or removed in the future.
- » Component #2 Railyard Reconfiguration/Relocation– Options for changes to the railyard are not specifically tied to the retention or removal of the I-280 freeway north of Mariposa. Instead, changes to the railyard are tied to the rail alignment choice. That said, the demolition of the I-280 freeway segment above the railyard would impact the railyard. During demolition, the railyard operations would be impacted for several months and possibly years in the railyard and also along the surface tracks north of Mariposa. Under both the “Pennsylvania Avenue” or “Mission Bay” rail alignments, the rails are moved underground and the 4th/King railyard is relocated. Under either of these alignments, the freeway could be retained or removed in the future. If development on the 4th/King railyard were completed prior to future removal of I-280, there may be some impacts to future development.

- » Component #3 Urban Design and Land Use Considerations –A surface boulevard is more compatible with a dense, urban city than an elevated freeway. Opportunities for creating room for additional, urban land uses are not specifically tied to the retention or removal of the I-280 freeway. If the “Future with Surface Rail” alignment is chosen, I-280 will likely remain as there is not enough physical space to co-locate a surface rail adjacent to a surfaced boulevard. If either the “Pennsylvania Avenue” or the “Mission Bay” rail alignment is chosen, I-280 could remain or be removed in the future. Due to having Caltrain underground, the existing operating easement at the surface (under the freeway) would be relinquished, and could provide some urban form and land use potential.
- » Component #4 Extension/Loop – There is no impact to any extension/loop option.

Cost Considerations

Due to the independent nature of the decision and remote date of when I-280 changes could be seriously considered, costs for the removal and replacement of I-280 north of Mariposa with a surface boulevard were not included in the RAB study. The I-280 freeway is still a usable freeway so there are many more considerations and costs as associated with removal.

Summary: Boulevard I-280 (Component #5)

PROS	CONS
<ul style="list-style-type: none"> » May provide for better overall traffic flow in the area but with some roads experiencing higher flows than current. Specifically, improvement may be seen at the intersections around 6th/Brannan » Removing an elevated freeway could achieve aesthetic improvements. 	<ul style="list-style-type: none"> » Only a very preliminary study has been completed to date. Costs are not known and funding is not, and would not be, secured until much more analysis and preliminary assessment and consideration by Caltrans is completed. » I-280 remains a usable freeway segment. » Some roads would experience higher traffic volumes under the boulevard option. » Removal of the I-280 segment would require significant additional planning, engineering, and environmental clearance.

PRELIMINARY FINDINGS AND RECOMMENDATIONS:

Based on a careful analysis of trade-offs, implementation considerations, and needs known in the study area, San Francisco staff recommends the following for each component under the RAB study. For in-depth data on any of these components, their analysis, or preliminary recommendations/findings, please see the Consultants Technical Report.

1. RAIL ALIGNMENT:

PRELIMINARY RECOMMENDED ALIGNMENT: PENNSYLVANIA AVENUE: DTX + EXTENDED TUNNEL

The Pennsylvania Avenue : DTX + Extended Tunnel alignment:

- » Solves the significant conflicts that currently exist at the 16th Street at-grade intersection and the 7th/Mission Bay Drive at-grade intersection. This alignment unites Mission Bay with the City, removes the barrier of the Caltrain line as well as the anticipated 20+ minute closures of these two essential intersections during the peak hour, avoids a long, deep trenching of streets to maintain east/west connections and maintains access and mobility for critical life-saving services.
- » Provides for opportunity to reknit over 1 mile of the city east/west. This creates at least six additional east/west street connections with the removal of surface rail north of 22nd Street.
- » Provides the opportunity to increase access north/south with up to two additional north/south street connections with the removal of the 4th/King railyard
- » Maximizes the public investment in the Salesforce Transit Center (SFTC), by ensuring that all Caltrain and high-speed rail trains utilize the SFTC as the terminal station.
- » Creates the opportunity to improve the design of the 22nd Street Caltrain Station. It allows for further study of a potentially more accessible station location so as to achieve improved performance for both Caltrain and San Francisco.
- » Provides for potential underground expansion of the 4th/Townsend station to allow for additional storage opportunities for Caltrain and relieving the continued need for the surface 4th/King railyard.
- » Minimizes the need for additional environmental work that would need to be completed to only the portion from 7th/Townsend south.
- » Maximizes flexibility during construction and improves opportunities for future rail expansion. This is achieved through the options for phasing the project (DTX first, Pennsylvania Avenue extension opening quickly after).
- » Minimizes any duplicative efforts or throw-away money on projects in the area.
- » Provides the opportunity to connect conventional rail (Caltrain and HSR) from San Francisco – Oakland via the east side of the SFTC through a future additional Transbay Crossing.
- » Maximizes the potential land for available development and public benefit opportunities at 4th/King Railyard.
- » Provides maximal public benefit for the amount of cost and time required to realize the project.

Preliminary estimates of probable costs & estimated timing of the three Rail alignment options is as follows:

ALIGNMENT OPTION	COST	EXPECTED COMPLETION DATE ²
Future with Surface Rail: DTX + Trenched Streets	\$ 5.1 Billion	2026
Pennsylvania Avenue: DTX + Extended Tunnel	\$ 6.0 Billion ¹	2027
Mission Bay: Modified DTX + 3 rd Street Tunnel	\$ 9.3 Billion ¹	2031

1. Includes costs of construction and moving railyard, as well as value capture and impact costs associated with each alignment.

2. Date for completion based on if all money were available on January 1, 2017

2. RAILYARD RECONFIGURATION/RELOCATION

If the Pennsylvania Avenue alignment is built, the 4th/King station operations could be accommodated in the underground 4th/Townsend DTX station and the storage and maintenance requirements could be moved to a new southern railyard. If the underground 4th/Townsend station were expanded to allow for additional storage/maintenance underground, this could limit the ability to develop on the site and would likely result in a reduction in the number of total platforms/tracks available at the current 4th/King Railyard.

3. URBAN DESIGN AND LAND USE CONSIDERATIONS

Preliminary analysis shows that the railyard site alone could accommodate, at a minimum, between 1.05 and 2.43 million square feet of commercial and up to 1.46 million square feet of residential space based on current zoning in the area. As the land is owned by a private entity with an operating lease for Caltrain on the land, the value capture of this estimated land use is calculated at approximately \$832M (\$481M in City bonding potential and \$352M in Private Sector Benefits (land value conferred)). This \$832M is included in the totals as listed above for each rail alignment alternatives. Further, the possibility to remove a current barrier to north/south travel in the area and provide more connections for pedestrian, bicycle, transit and personal vehicles should be considered in association with providing needed public facilities (parks, libraries, schools, etc).

4. TRANSIT CENTER (SFTC) EXTENSION/LOOP

Either of the two extension/loops described will provide significant benefits by both increasing capacity along the rail line and by potentially providing a conventional rail extension to the East Bay. The extension/loops could be achieved with any one of the railway alignment options. At the present time, an extension/loop is not required under any of the studied alignment options. By having these two extension/loops identified, even in rough form, the City preserves the proposed alignment for extension/loop as development or redevelopment continues around the SFTC. The lines enable the City to prevent substructures from being placed in direct conflict with proposed extension paths.

5. BOULEVARD I-280

This element is substantially more speculative than the other components of the study. While preliminary analysis shows removal is feasible, such dramatic change will require future analysis with Caltrans and other regional and city partners. Further, the immediate RAB components do not require the removal of I-280.

NEXT STEPS

There are still many unknowns and studies underway, or to be completed, that may affect any of the recommendations above. The items that should be further explored include but are not limited to:

Ongoing projects:

- » Blended Service Operations Plan – As stated previously, CHSRA and Caltrain will complete the Blended Service Operations Plan at the end of 2018 which details what the rail service will look like at any given time of day and what is necessary to maintain operations.
- » Caltrain Business Plan - Understanding how Caltrain would like to grow in the future, including fully electrifying their fleet (anticipated late 2018)
- » Caltrain Storage and Maintenance Plan—this is needed for Caltrain and should be included in the Caltrain Business Plan. (anticipated late 2018)
- » CHSRA EIS/R for the San Jose to San Francisco section – this environmental documentation will take into account the Blended Service Operations (see above) and identify additional improvements needed. (Draft anticipated December 2019)
- » DTX Final Design – With the Record of Decision (ROD) on the SEIS/R provided in May 2018, TJPA is authorized to continue the design from 30% to 100% design drawings in preparation for a design/bid/build contract in approximately 2 years (2020).

New and expanded efforts:

- » Project Delivery Method – Currently DTX is planned to be Design/Bid/Build which takes the longest construction time but least risk on the contractor. Other delivery methods should be explored with the expansion of the work for Pennsylvania Avenue including Design/Build or a Public Private Partnership (P3).
- » Pennsylvania Avenue Preliminary Design and Environmental Clearance – TJPA would start analysis and preliminary design on the extension of the DTX using the Pennsylvania Avenue alignment as conceptually analyzed in the RAB documents. This would include additional work completed under the 22nd Street Station study as well as other studies underway including the Blended Service Operations, Caltrain

Business Plan, etc. Work would commence late 2018 with a 2-5 year minimum completion horizon)

- » 22nd Street Station Study – this would be a follow-on study completed by SF-Planning in coordination with Caltrain on the potential to relocate the 22nd Street Station for better accessibility. Anticipated to start in late 2018 with a 2-4 year process.
- » Continued study on a southern railyard location – building on the work completed under the RAB study and after the Blended Service Plan and Caltrain Business Plan are completed (late 2018), an analysis of the needs of Caltrain to utilize a southern railyard location for some or all of its current activities performed at 4th/King will begin.
- » Continued conversations about a Transbay Crossing – A second Transbay rail crossing would be studied. Included will be an analysis of whether it will contain BART and/or conventional rail (HSR/Caltrain)? BART is currently furthering the conversation that MTC began in the Core Capacity Project (completed in 2017).
- » 4th/King District Land Use Plan – SF-Planning (in coordination with others) would undertake a land use study to further understand the possibility of development in and around the 4th/King railyard location. This would begin after the Blended Service Plan and the Caltrain Business Plan are completed to ensure the needs of the rail operators are met.
- » Seawall Coordination – coordination between CCSF departments and others as appropriate, to ensure that a punchout is located within the vicinity of a future extension to the East Bay that could carry conventional rail (Caltrain/HSR), BART, or both. By providing a punchout within the wall, minimal disruption to existing structures can be achieved.

ENDNOTES

- 1 CH2MHill provided consultant support on the RAB project. The Technical Report can be found at: www.sf-planning.org/rab
- 2 Senate Bill 1, The Road Repair and Accountability Act of 2017, was signed into law on April 28, 2017.
- 3 High Speed Rail plans to run four (4) trains per peak hour per direction (total of 8 train movements) upon completion of Phase I from San Francisco to Los Angeles. HSR may operate less than that during the portion between early operations (2027/2029) and full service in Phase I (2033).
- 4 High Speed Rail plans to run four (4) trains per peak hour per direction (total of 8 train movements) upon completion of Phase I from San Francisco to Los Angeles. HSR may operate less than that during the portion between early operations (2027/2029) and full service in Phase I (2033).
- 5 Specifically, trains moving between these two stations will require a 9-step movement “turnback” movement affecting rail service on the main line and the two at-grade intersections twice for each train. See Component #2 for description of 9-step movement.
- 6 In the electrification project Caltrain is currently undertaking, the Caltrain line would be electrified from San Jose to San Francisco (including the 4th/King railyard) and 75% of the Caltrain fleet would be converted to electrical multiple units (EMUs which pull electricity from overhead wires and have a driver’s cab in either end. As current plans do not include the electrification of the Gilroy to San Jose portion of Caltrain (served only by baby bullet service) and as diesels do not accelerate/decelerate as easily as EMU’s, the diesel fleet will not be retired after electrification, but will be used on the baby bullet service, co-mingling with the EMU’s (providing more of the express and local service), to/from 4th/King.it is the plan to operate, store and maintain the Caltrain dual fleet at 4th/King into the future. There is not a current plan to fully electrify the Caltrain fleet. This would mean that even after the DTX is built (under the Future with Surface Rail and Pennsylvania Avenue alignment options presented below), diesels would remain at 4th/King as they are prohibited from operating in these tunnels (not enough ventilation).
- 7 20 minute calculation is based on 6 trains/peak hour/direction for Caltrain (12 trains total) and 4 trains/peak hour/direction for HSR (8 trains total). That totals 20 trains. Each train closing the intersection at a minimum of 60 seconds equates to a minimum of 20 minutes of the peak hour where east/west traffic is impeded by train movements.
- 8 This option would require Caltrain to be taken out of service north of the 22nd Street Caltrain station for two or more year, And it would also require significant structural work to I-280.
- 9 Platform requirements are respectively 24-inches above top of rail for Caltrain and 48-51 inches above top of rail for HSR.
- 10 For 16th Street, this trench would run approximately from Wisconsin Street to 3rd Street
- 11 This joint operation plans is known as “the Blended Service Plan”. The proposal is currently for 4 high speed rail and 4 Caltrain trains to/from SFTC and 2 Caltrain trains to/from 4th/King each peak hour.
- 12 Currently the DTX is to be constructed using a cut-and-cover method but TJPA is looking at options for tunneling at least a portion of the DTX alignment.
- 13 The location of a tunnel boring machine launch pit will need to be determined.
- 14 The 10% design drawings show that the tunnel would likely not have a common boundary with the existing 22nd Street station. Currently the 22nd Street station is not easily accessed and does not provide ADA accessibility.
- 15 If the 4th King Railyard is eliminated, it is likely that the number of tracks currently at the 4th/King Railyard (12) could not be fully replaced underground. It is likely that up to three (3) additional storage tracks could terminate at the underground 4th/Townsend station.

- 16 The amount of underground rail of the combined Pennsylvania Alignment and the DTX would total of 2.9 miles.
- 17 The increased depth is needed so that the tunnel would be below the navigable Mission Creek. The depth of Mission Creek is around 80 feet in depth so the top of the tunnel would need to be below that depth, and then climb at the maximum grade to match the DTX throat location.
- 18 This interim condition is approximately at a minimum of 3 years in length but depends on the timing of the items above.
- 19 For purposes of the study we located it just south of Mission Creek but the final location would require a further study and analysis
- 20 The 10% design drawings show that the tunnel would likely not have a common boundary with the existing 22nd Street station. Currently the 22nd Street station is not easily accessed and does not provide ADA accessibility.
- 21 The estimates here were developed using general categories, industry norms, and similar projects throughout the United States. An independent analysis of the DTX was completed and validated the MTC updated cost estimate of the DTX completed in December 2015 which calculated the cost of construction of the DTX at \$4Billion (see Appendix D & E of the Consultant Technical Report). The validated DTX cost estimation was then used as the basis for the same type of work for the other two alignments taking into account risks and unknowns. Contingency factors correlating to the risks of various alignments were applied as well to the final calculations.
- 22 Elements of the DTX as currently designed and environmentally cleared are shown in Exhibit ES-10 and listed here: a Trainbox extension, the intercity bus facility, vents, taxi staging area, BART/MUNI underground pedestrian connection, bicycle/controlled vehicle ramp, widened throat structure, AC Transit Bus Storage Facility, an underground station at 4th/Townsend, the tunnel stub box for future connection underground (as described in the Pennsylvania Avenue extension above), and the additional trackwork including the turnback track and maintenance of way storage track.
- 23 It should be noted that some DTX elements may be relocated depending on alignment – e.g., the 4th/Townsend station in the Future with Surface Rail and Pennsylvania Avenue alignments is replaced with a new, underground station in 3rd Street in the Mission Bay alignment.
- 24 The nine-step backtrack movement includes: (1) a train is started up (2) the train (with no one except the conductor onboard) must leave 4th/King, (3) travel south to Mariposa and use the turnback track. (4) The train comes to a stop (5) The conductor would then turn off the train, (6) walks the length of the train, (7) turn the train back on – now sitting in the north facing cab, and (8) travels north entering into the DTX at 7th/Townsend, go past the underground 4th/Townsend station (without stopping) and (9) into the SFTC where operations would commence by loading passengers and then returning south into operations
- 25 Minimum requirements for potential relocation sites included: 1) meeting the requirements for the number and length of storage tracks as provided by Caltrain in 2016, 2) allowance for “run-through” or entering and existing the new off-line storage/maintenance site from the existing tracks, and 3) being consistent with Caltrain’s locational needs to be within the “10 minute from 4th/King bumpers”.
- 26 Caltrain trains current move in or out of service in the following conditions: (1) to charge the system (start operations), (2) for AM peak, (3) after AM peak, (4) for PM peak, (5) after PM peak, (6) to discharge the system (end operations for the day)
- 27 Trains approaching the SFTC from directly from storage in the new Southern Railyard could do so without using the turnback track and would require the closure of opposing track no more once per trip. Trains moving from the SFTC to storage in the new Southern Railyard would require zero closures of opposing track usage as trains would be traveling in the correct direction.

28 As both the potential southern railyard locations under consideration are within the prescribed 10-minute limit from 4th/King Railyards that the same movement using the turnback track requires, only those trains that would move from storage at 4th/King Railyard into operations starting at 4th/King (and not SFTC) would be affected. Current plans show this may be up to 2 trains per peak hour that would have terminated at 4th/King instead of SFTC that could require additional operational costs.

29 These Caltrain requirements include: 1) 10 Electrical Multiple Unit (EMU) Caltrain 8-car trainsets, 2) construction of a building to hold a crew room, management office, employee parking, maintenance of way functions, storage for tools and equipment, etc., and 3) being located within 10 minutes from the current 4th/King terminus bumpers.

30 No cost estimates have yet been provided about such potential underground expansions as this concept has not yet be fully designed nor engineered.

31 All three of these additional storage tracks would terminate at the underground 4th/Townsend Station and would not continue to SFTC.

32 This improvement describes the relationship between moving trains between storage (at 4th/King) into operations (at SFTC) and further assumes that use of either the “Pennsylvania Avenue” or “Mission Bay” alignments or the use of the “Future with Surface Rail” alignment with the extended trench for grade-separation of trains and traffic.

33 Originally four (4) extension/loop concepts were further analyzed. All exit the east end of the SFTC and continue for some distance to the east. Then either return to the south or continue across the Bay. The acceptable minimum radii for HSR trains (650-feet) was not met on two options (Main Street and Spear Street), and they were dismissed. Two other options were further analyzed (see Consultant Technical Report at www.sf-planning.org/rab).

34 As the Caltrain rail from San Jose to Gilroy is not to be electrified at this time, Caltrain “baby bullets” (traveling from Gilroy to San Francisco (4th/King railyard)) will remain diesel trains for the foreseeable future.

35 The length a diesel train is allowed to travel in without additional ventilation is a factor of various characteristics including length of tunnel, average run time of trains in the tunnel, etc.

36 Caltrain is procuring electric trainsets with two sets of doors to accommodate both platform heights.

37 Current plans have a total of six (6) Caltrain trains and four (4) High Speed Rail trains per peak hour per direction. This, in total, would be 10 trains per peak hour per direction or 20 train movements in/out of the station that would be traveling on the Caltrain corridor in peak hours.

38 To estimate the right-of-way for a surface level boulevard, preliminary modeling suggested that a “small” six-lane configuration would be compatible with the existing traffic. Note, such a change would likely cause backups on I-280 northbound back to Islais Creek in the morning peak hours. Preliminary modeling also suggested that a “large” eight-lane configuration would likely accommodate anticipated traffic without adding delays to predicted vehicle trips. To further develop any boulevard option, additional public transportation options in the area would be needed.

39 If these conditions occur, Caltrain would also need to relinquish their operating easements north of 25th Street under the “Future with Surface Rail” alignment. Under both Pennsylvania Avenue and Mission Bay alignment, the rail is moved underground, so Caltrain would already have relinquished their operating easements north of 25th Street.