SSIP PROCEDURAL SIGNATURES

Signatures below are required per Infrastructure Capital Improvement Program Procedure PD 2.02.

Department/Bureau	Name	Signature	Date
Project Engineer Hydraulic Engineering	Chung Linh		9/12/17
Section Manager, Hydraulic Engineering	Lesley Wong		9/14/17
Project Manager, SFPUC	Amy Kam		9/14/17
WWE Representative, SFPUC	Ed Ho		9.12.17
Health and Safety	N/A		
Homeland Security	N/A		
Corrosion	N/A		
SFPUC Floodplain Coordinator	N/A		

Revisions

Rev	Date	Reason	Originator	Initials	Project Engineer	Initials
1						
2						
3						

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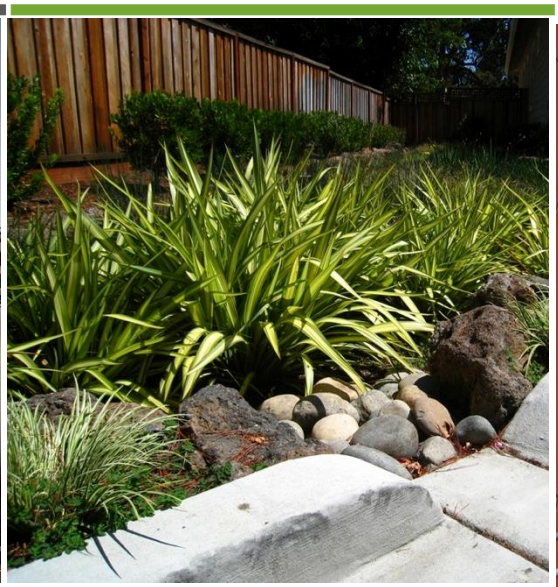
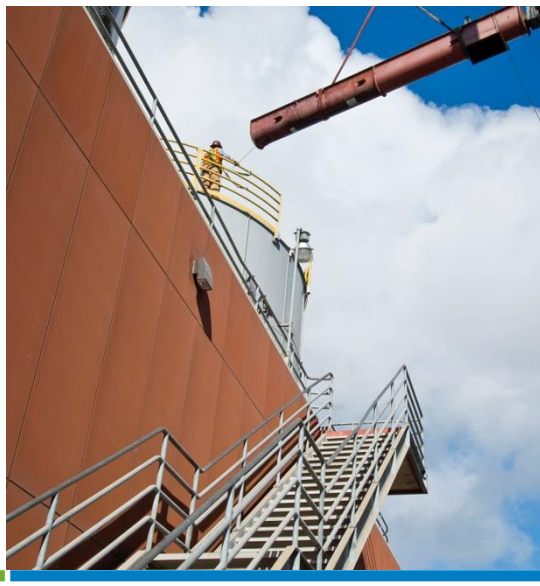
FOLSOM AREA STORMWATER IMPROVEMENT PROJECT

NEEDS ASSESSMENT AND ALTERNATIVES ANALYSIS REPORT

Prepared for:

San Francisco Public Utilities Commission
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San Francisco, California 94102

Prepared by:

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Design and Engineering/Hydraulic Engineering Section
Project ID ï CWWSIPFCDB14

SEPTEMBER 2017

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ACRONYMS / ABBREVIATIONS

Acronym / Abbreviation	Definition
1D	one-dimensional
2D	two-dimensional
CBSIP	Central Bayside System Improvement Project
CHTL	Channel Tunnel
City	City and County of San Francisco
CSD	combined sewer discharge
CSP	Collection System Plan
DTX	Downtown Extension
HSR	High-Speed Rail
LF	linear feet
LEED	Leadership in Energy and Environmental Design
LID	Low-impact development
LOS	level of service
Model	hydraulic and hydrologic simulation computer model
NPF	North Point Wet Weather Facility
PG&E	Pacific Gas & Electric Company
PMC	Program Management Consultant
Project	Folsom Area Stormwater Improvement Project
RCRA	Resource Conservation and Recovery Act
ROW	right-of-way
SEP	Southeast Water Pollution Control Plant
SFMTA	San Francisco Municipal Transportation Authority
SFPUC	San Francisco Public Utilities Commission
SFPW	San Francisco Public Works
SPCA	San Francisco Society for the Prevention of Cruelty to Animals
SSIP	Sewer System Improvement Program
TBL	triple bottom line
TBM	tunnel boring machine
UCSF	University of California, San Francisco
UWA	Urban Watershed Assessment
WWE	San Francisco Public Utilities Commission Wastewater Enterprise

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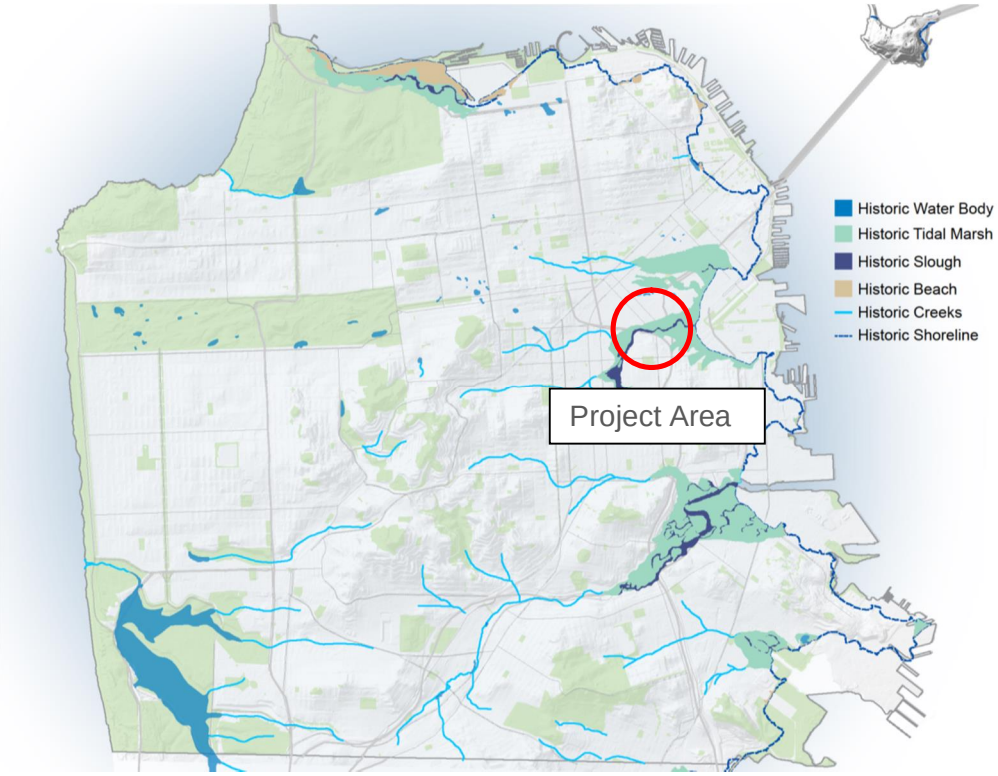
EXECUTIVE SUMMARY

The primary objective of the Folsom Area Stormwater Improvement Project (Project) is to address flooding for the Inner Mission neighborhood from 18th to 10th Streets shown in Figure ES-1 under the current Sewer System Improvement Program (SSIP) level of service (LOS). The LOS includes the integration of ñGreenòand ñGreyòinfrastructure to minimize flooding and manage flows from a statistically derived storm lasting 3 hours, with a total of 1.3 inches of rainfall and a defined peak rainfall intensity (i.e., 5-year 3-hour storm, LOS storm). The design alternatives under consideration will manage stormwater via conveyance and/or detention to meet the LOS storm within the Project study area as described in Subsection 3.3. The surrounding properties have been subject to stormwater inundation during moderate to heavy storms, including the statistically derived LOS storm. Lower-lying areas in the vicinity can experience several feet of flooding during rain events, which can potentially cause health and safety issues, as well as property damage.

Figure ES-1
Historical Map of San Francisco



The planning process considered three conveyance alternatives and one storage alternative to meet the LOS. Alternatives are divided into two general categories, Conveyance and Storage, and include the following features:

Conveyance

- Alternative A: Wet-weather connector tunnel to the future Central Bayside System Improvement Project main tunnel
- Alternative B: Wet-weather tunnel to other location
- Alternative C: Division Street box sewer expansion

Storage

Alternative D: Storage facility

These four alternatives were further expanded into sub-alternatives where multiple viable options exist. Each sub-alternative was compared first against others within the same family of alternatives. The best sub-alternative of each family of alternatives was then carried into alternatives analysis, to be analyzed against each other.

The alternatives were evaluated based on 15 distinct criteria that were weighted with importance factors as summarized in Table ES-1. This table presents a qualitative evaluation of the main components of each alternative against each of the screening criteria. The summary highlights key aspects of each criterion, providing qualitative ratings of (+1), (0), and (-1) to indicate whether the alternative is advantageous, neutral, or disadvantageous, respectively, and were then weighted with importance factors of 1, 2 or 3 to indicate whether the criterion is of lower importance, neutral importance, or higher importance, respectively. The analysis treats construction costs as capital costs only and does not include operating and lifecycle cost considerations. A triple bottom line analysis that does include operating and lifecycle cost considerations has been conducted and is summarized in Section 4.6

The highest ranked alternative was determined using selected criteria that exhibited noteworthy distinctions between alternatives. The highest ranked alternative, based on the evaluation criteria identified in Table ES-1, and feedback from management, is Alternative B1/B1a. This alternative emerges with the highest weighted rating, which includes advantageous (+) criteria of Potential Utility Concerns, Potential Environmental Impact, Hydraulic Performance ï Flooding LOS Storm, Hydraulic Performance ï Flooding Sensitivity, and Hydraulic Performance ï CSDs. The highest ranked alternative was (-) disadvantageous for only one criterion, Present Ownership. Factors considered for each evaluation criterion are further detailed in Section 4.4.

At managementôs request, further analysis was performed to determine whether there is any significant flood reduction benefits at a marginal increase in cost and tunnel diameter. Cost analysis indicates that there is no ñknee-of-the-curveòfor a tunnel inside diameter range from 12 feet through 19 feet, and the minor additional benefits of an incrementally larger tunnel did not warrant the relative high increase in cost. After review of the analyses, management directed the project team to proceed with the highest ranked alternative at the proposed tunnel size.

The major scope of work for the highest ranked alternative includes the construction of 4,200 linear feet of 12ôinside diameter tunnel or (3,500 linear feet of 12ôinside diameter tunnel and 1,600 linear feet open-cut box sewer) from approximately the intersection of Alameda Street and Treat Avenue connecting to the Channel Transport/Storage Box near the intersection of 7th Street and Berry Street. The final alignment, taking into account location of shafts and easements, will be determined in the Conceptual Engineering phase. In addition to the major tunnel component, minor components are also required to divert flow toward the new conveyance infrastructure. These elements are shown in Figure ES-2 and further discussed in Section 4.3

The estimated construction cost for these elements, in 2017 dollars, is $132.2 million, and construction is expected to require 23 months.

The findings of this report have been presented to the San Francisco Public Utility Commission (SFPUC) Management Oversight Committee for decision and approval. The project team has been directed to further develop the selected alternative, Alternative B1/B1a, including all associated project components and design criteria definition, in the Conceptual Engineering phase.

Table ES-1
Alternatives Evaluation Criteria

		Alternative A: Connector Tunnel with CBSIP	**Alternative B1/B1a:** Connector Tunnel w/o CBSIP	**Alternative C1/C2:** Division Box Sewer Expansion	**Alternative D4:** Distributed Storage with Minor Components
PROJECT SCOPE		9.5' diameter inside diameter tunnel 6,450 LF Launching shaft Receiving shaft	4,200 LF of 12' inside diameter tunnel OR 3,500 LF of 12' inside diameter tunnel and 1,600 LF cut-cover Launching shaft Receiving shaft Junction structure	Expand 5,070 linear feet of one or two compartment(s) of Division Street Sewer	Construct 2.3 MG detention tank Construct 3.0 MG detention tank Construct 2.3 MGD pump station Construct 3.0 MGD pump station
	Importance Factor				
Commentary	1	Present Ownership (0)	Present Ownership (-1)	Present Ownership (+1)	Present Ownership (-1)
	1	Site Availability/Acquisition (-1)	Site Availability/Acquisition (0)	Site Availability/Acquisition (+1)	Site Availability/Acquisition (-1)
	2	Potential Utility Concerns (+2)	Potential Utility Concerns (+2)	Potential Utility Concerns (0)	Potential Utility Concerns (+2)
	2	Preliminary Geologic Conditions (-2)	Preliminary Geologic Conditions (0)	Preliminary Geologic Conditions (+2)	Preliminary Geologic Conditions (0)
	2	Future Impact (0)	Future Impact (0)	Future Impact (+2)	Future Impact (-2)
	3	Traffic Impact (+3)	Traffic Impact (0)	Traffic Impact (-3)	Traffic Impact (+3)
	3	Potential Environmental Impact (+3)	Potential Environmental Impact (+3)	Potential Environmental Impact (-3)	Potential Environmental Impact (+3)
	3	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)
	2	Hydraulic Performance - Flooding, Sensitivity (0)	Hydraulic Performance - Flooding, Sensitivity (+2)	Hydraulic Performance - Flooding, Sensitivity (+2)	Hydraulic Performance - Flooding, Sensitivity (-2)
	2	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (0)
	2	Maintenance (-2)	Maintenance (0)	Maintenance (+2)	Maintenance (-2)
	2	Constructability (-2)	Constructability (0)	Constructability (+2)	Constructability (+2)
	2	Construction Cost (0)	Construction Cost (0)	Construction Cost (0)	Construction Cost (+2)
	3	Construction Duration (0)	Construction Duration (0)	Construction Duration (-3)	Construction Duration (0)
	1	Synergistic Opportunities (-1)	Synergistic Opportunities (0)	Synergistic Opportunities (+1)	Synergistic Opportunities (0)
Weighted Rating (IF)		**Net Rating: +5**	**Net Rating: +11**	**Net Rating: +9**	**Net Rating: +7**

CSD = combined sewer discharge; LF = linear feet; LOS = level of service; MG =million gallons; MGD = million gallons per day

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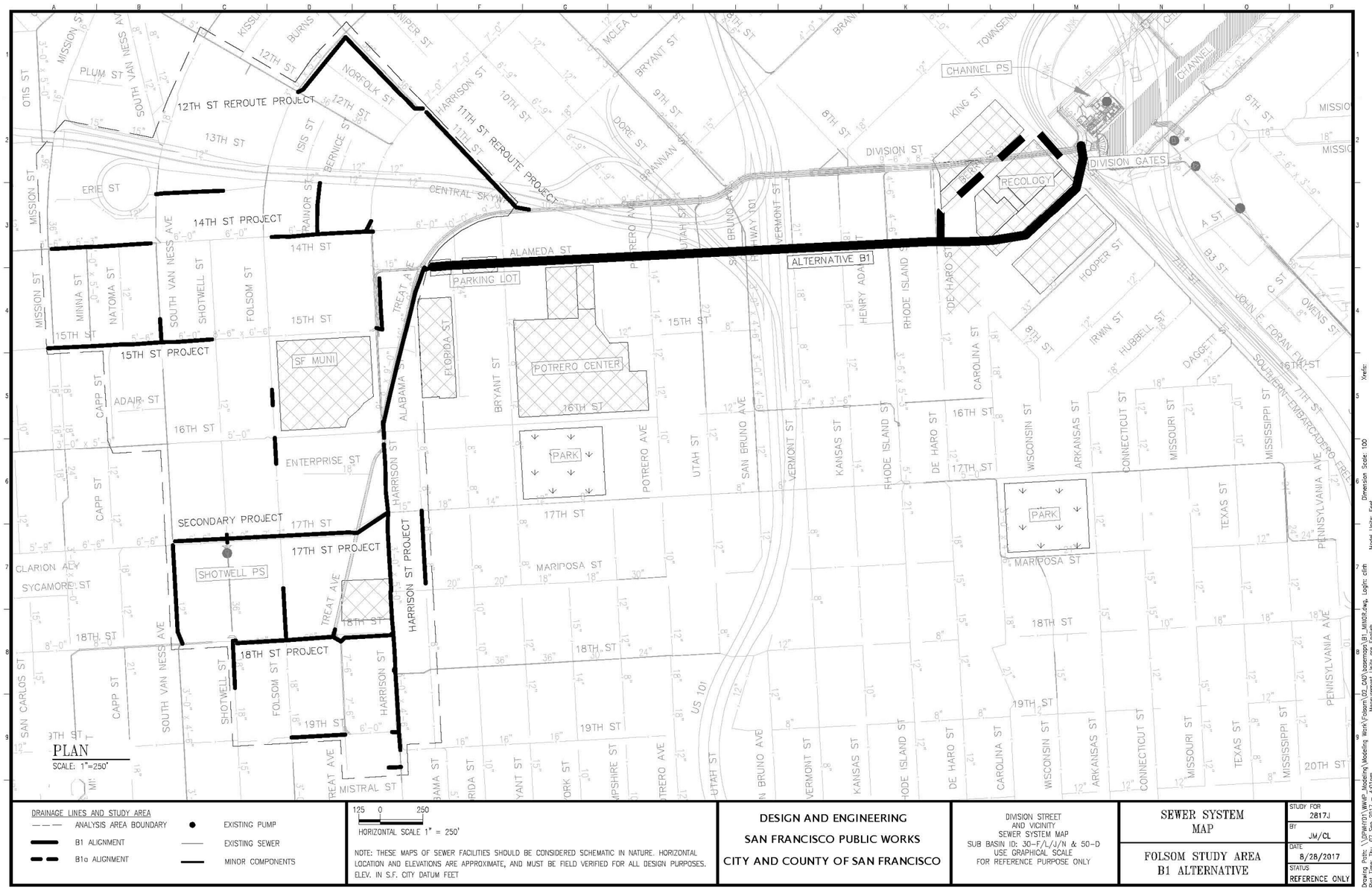
Figure ES-2
Highest Ranked Alternative



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1.0 BACKGROUND

1.1 Introduction

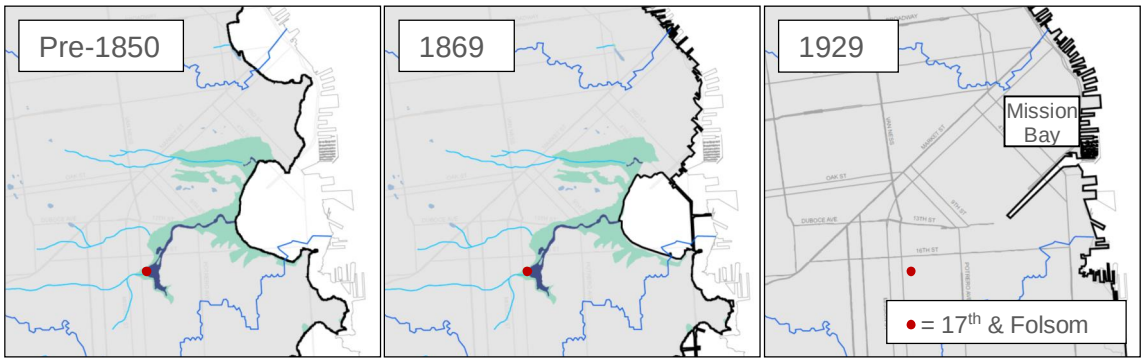
The City and County of San Francisco (City) has a combined sewer system that collects and treats both sanitary sewage and stormwater runoff. The City collects and treats 100% of storm runoff in areas served by combined sewers. Generally, the City's collection system capacity is designed to accommodate the level of service (LOS) storm, a statistically derived storm lasting 3 hours, with a total of 1.3 inches of rainfall and a defined peak rainfall intensity. In certain storms, combined sanitary sewage and stormwater runoff have flooded streets in isolated areas.

The neighborhood surrounding 17th, 18th, and Folsom Streets has been subject to flooding during moderate to heavy storms. Lower-lying areas in the vicinity can experience several feet of accumulated water on the streets and sidewalks during notable rain events, which can potentially lead to health and safety issues, as well as property damage.

1.2 Historical and Recent Flooding in the Vicinity

Flooding is not a new issue to this neighborhood. The area coincides with what had until the mid-1800s been Mission Creek, a navigable waterway surrounded by marshland. As the City grew, this naturally low-lying area was filled in and developed, as shown in Figure 1. Mission Creek is now covered by development and has been incorporated into the sewer system.

Figure 1
1850–1929, Landfill Development in a Historical Marsh



Source: Creek and Watershed Map of San Francisco and SFPUC Urban Watershed Management

Local flooding was first documented in *System of Sewerage for the City and County of San Francisco* by Carl Ewald Grunsky, Marsden Manson, and C. S. Tilton in 1899. Old photographs believed to be taken around 1890 to 1910 show flooding after the marsh area was built out with roads and structures in the neighborhood that is now the Inner Mission, shown in Figure 2.

Figure 2
Old Photographs (c. 1890–1910) Depicting Historical Flooding in Vicinity

Source: SF Public Library Archives

In the last decade, multiple storms have caused flooding to properties, including two separate storms in December of 2014. Although the extent of damage depends on storm magnitude and intensity, the properties experiencing flooding impacts often remain unchanged because water naturally flows toward structures within local topographic low points.

Table 1 lists storms that have caused flooding in the vicinity of 17th and Folsom since the year 2000. This list is based on the knowledge of City staff, and other storms may have also caused unreported damage. For reference, the maximum inches of rainfall in an hour for the LOS storm is 0.72.

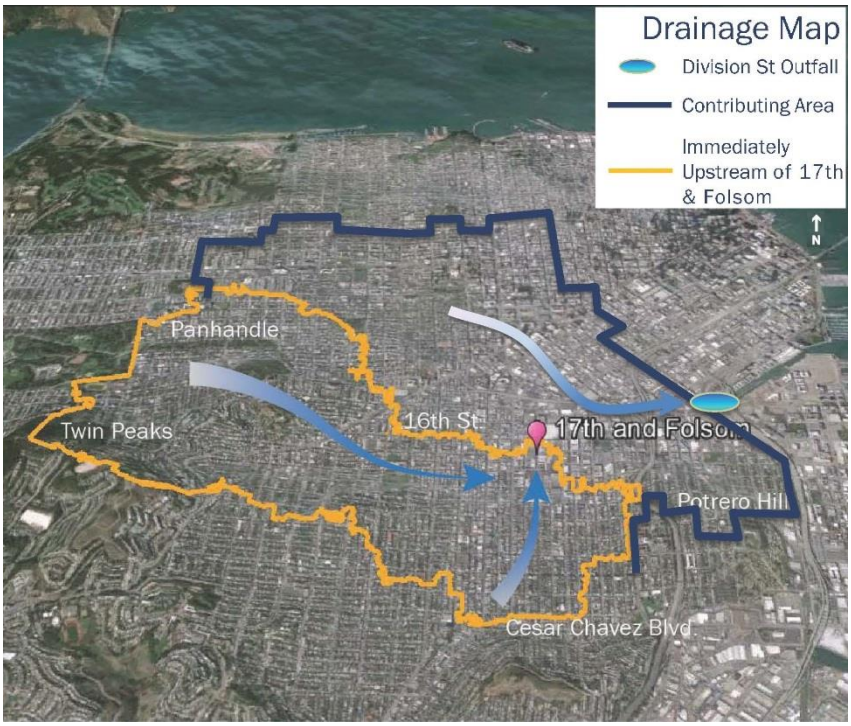
Table 1
17th/Folsom Flooding since Year 2000

Date	Maximum inches of rainfall in an hour
2014 DEC 11	0.8
2014 DEC 3	1.07
2012 DEC 2	0.7
2012 APR 12	0.6
2010 JAN 18	0.55
2009 OCT 19	0.8
2004 FEB 25	1.3
LOS Storm	0.72

1.3 Causes of Flooding

The Inner Mission neighborhood from 18th to 10th Streets is a low-lying area whose combined sewers drain a densely developed area of over 4,000 acres. The drainage area generally extends from near Cesar Chavez Street to the south, the edge of Golden Gate Park to the west, to Pacific Heights at its northern edge, as shown in Figure 3. The highest reaches of the drainage area, just northwest of Twin Peaks, reach some of the highest elevations in the City. The elevation drops approximately 900 feet before flattening out in the vicinity of 17th and Folsom.

Figure 3
Tributary Area of Local Collection System



During rain events, when the collection system reaches a certain flow, most of the flow downstream is diverted through the Division Street box sewer and may flow to the Southeast Water Pollution Control Plant (SEP), to the Bay through the outfall at the current-day Mission Creek, and/or to the North Point Wet Weather Facility (NPF) near Pier 39.

The 17th and Folsom area has been historically prone to flooding. Several hydrologic and hydraulic factors contribute to flood challenges in the area:

- Local topography: 17th and Folsom and vicinity form a naturally low-lying area. As a result, once the collection system reaches its capacity, this neighborhood is where stormwater runoff collects when it is unable to enter the collection system.
- Rainfall/runoff from upstream areas of the drainage basin: The area draining to the vicinity of the flood-prone 17th and Folsom area is steep and highly urbanized. Rainfall on the drainage area becomes runoff almost immediately, enters the combined sewer system, and is conveyed to points downstream. The time for flow to travel from the upper drainage reaches to the 17th and Folsom block is short ï water travels about 3 miles from the uppermost pipes in the drainage area and reaches 17th and Folsom in about 15 minutes. The large drainage basin combined with the steep terrain can lead to significant flow in the collection system in a short period during large storms, including some short storms with high rainfall intensity.
- Conveyance capacity: System flows surpass the combined carrying capacity of the underground sewers and overland streets.
- Land settlement: Because the area is built on a historical creek and landfill, settlement and subsidence of land in this area has potentially resulted in lower property elevations.

2.0 PAST AND PRESENT MEASURES

2.1 Introduction

The City has undertaken numerous analyses that have led to projects to improve the flood protection for this neighborhood. However, while building additional projects will reduce flooding, there is no project that can protect against all flooding, and flooding may still occur in this low-lying area during storms that exceed the LOS storm (such as the storms in December 2014).

2.2 Shotwell Pump Station and Auxiliary Sewer (2006)

Shotwell Street, between 17th and 18th Streets, is one of the lowest points in the vicinity; the block slopes down from each end to form a bowl shape. Because of this topography, property owners here have experienced significant flooding during past storm events.

From 2006 through early 2013, the City installed several upgrades to reduce the flood risk for this low-lying block of Shotwell Street:

- A new isolated sewer pipe and pump station along Shotwell Street to minimize backflow from the collection system
- Related sewer improvements on 17th Street
- Raised crosswalks along 17th and 18th Streets to reduce overland flow contributions from those streets to Shotwell Street
- New upgraded catch basins and culverts to improve drainage on the block only

Community outreach was conducted to engage and inform the neighborhood, and included meetings with the residents and merchants prior to and during the construction project, as well as construction notices and progress updates. The City also held meetings about the project with the Mayorôs Office of Neighborhood Services and former Supervisor Tom Ammianoôs office.

2.3 Storage Tank beneath Park (2014)

In 2013ï 2014, SFPUC evaluated a concept to build additional storage under the existing parking lot at 17th and Folsom to retain overland flows from the immediate vicinity of these streets and reduce related flood damage. Capitalizing on San Francisco Recreation and Park Department plans to convert the space into a new park, the SFPUC considered installing an underground storage basin at that site prior to park construction. The tank would not have relied on the Channel Tunnel (CHTL*) component of the Central Bayside System Improvement Project (CBSIP), but had the potential for performance synergies with the tunnel if constructed in combination with a separate Inner Mission connector tunnel[1]. All three components would have worked together to provide storage and conveyance of stormwater flows.

The 800,000-gallon basin would have been separate from the collection system, remaining empty most of the year. Runoff during storm events would enter the basin, where it would be stored until system capacity was restored, at which time could be

[1] CHTL, CBSIP, and Inner Mission Connector Tunnel discussed in *Channel Tunnel (CHTL) Alignment Alternative Analysis Technical Memorandum* (MWH/URS Joint Venture 2015)

pumped back into the collection system via a new pump station. This would be especially beneficial when combined water from the collection system accumulated on the streets and sidewalks; the basin would divert these overland flows from the low-lying area into the underground storage facility, thereby reducing floodwater intrusion into properties.

Although the project would not have eliminated flooding altogether, it would have completely contained the locally accumulated floodwaters on streets and sidewalks during the storm on December 2, 2012. In all flooding scenarios, it would have provided incremental flood relief for the neighborhood surrounding 17th, 18th, and Folsom Streets.

Outreach activities included maintaining information on websites for the SFPUC, the Planning Department, and the Recreation and Park Department. Materials distributed to the community included a flyer, Frequently Asked Questions document, and postcard. In addition, the SFPUC updated interested stakeholders through email newsletters, reaching over 350 residents, subscribers, and ratepayers.

In the course of evaluating the project and its anticipated performance, SFPUC determined the projectõs local drainage benefits would not justify the disproportionate high costs to San Francisco ratepayers. Despite advancing beyond conceptual design, it was determined upon more detailed analysis that the limited capacity and resulting drainage impacts would not justify the $9 million construction cost (2014 dollars) nor the coordination effort required with the Recreation and Park Department. As a result, this project was cancelled.

2.4 Mayor's Technical Paper/Draft Technical Paper (2015)

In December 2014, flooding resulted from two storms that occurred within a two-week span. The December 3 and December 11 storms each impacted several neighborhoods in the City. As part of the SFPUCõs response to the flooding, City engineers immediately began analyzing the latest floods in the context of previous analysis and capital improvements, including developing revised project proposals. This analysis was consolidated into a set of reports called draft technical papers, including the *17th and Folsom Stormwater Management Technical Paper* (SFPUC 2015), and submitted to the Office of the Mayor. These reports have since been used as the basis for developing the Folsom (i.e. the current project), 15th and Wawona, and Cayuga projects. Subsequent work was performed for the Folsom area; however, there were no summary reports. Results were presented to key stakeholders. The additional work is referred to as the *Folsom Exploration Study* (San Francisco Public Works [SFPW] 2015).

2.5 Temporary Flood Barriers (Current)

To provide interim flood protection during larger rain events while longer-term flood protection projects are being investigated for the area, the SFPUC began deploying plastic barriers along a short alignment at 17th Street/Folsom Street during the 2015-2016 rainy season as part of its routine wet weather operations. These barriers are first of their kind in San Francisco and are deployed along the sidewalk in advance of forecasted large storms and removed when rains have stopped and/or flood risk has subsided.

2.6 Grant Program and Flood Insurance Program (Current)

In addition to its capital investments, the SFPUC has developed an innovative administrative grant program that reimburses property owners Citywide for installing protective measures on their properties. Reimbursable projects include physical barriers and plumbing modifications that minimize floodwater intrusion. Property owners may be reimbursed up to $30,000 per property based on the type of improvements undertaken, and SFPUC has designated an initial allocation of $250,000 for reimbursements. The grant program was announced to the community during a workshop presented by the SFPUC and Supervisor Campos in July 2013.

Moreover, the City joined the National Flood Insurance Program in 2011, including adopting a floodplain management ordinance. This effort made flood insurance available to City property owners, including property owners in the 17th and Folsom area.

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3.0 NEEDS ASSESSMENT AND ALTERNATIVES IDENTIFICATION

3.1 Needs Definition

The primary objective of the Folsom Area Stormwater Improvement Project (Project) is to address the current SSIP LOS. The SSIP/Wastewater Enterprise (WWE) LOS Goals and Strategies are provided in Appendix A. The LOS includes the integration of ñGreenò and ñGreyò infrastructure to manage stormwater and minimize flooding and the control and management of flows from a statistically derived storm lasting 3 hours, with a total of 1.3 inches of rainfall and a defined peak rainfall intensity (5-year 3-hour storm or LOS storm). The existing Folsom Area does not meet the defined SSIP LOS. The design alternatives under consideration will manage stormwater to meet the LOS within the Project study area. The surrounding properties have been subject to stormwater inundation during moderate to heavy storms. Lower-lying areas in the vicinity can experience several feet of flooding during rain events, which could cause potential health and safety issues, as well as property damage.

To analyze alternatives, SFPUC personnel, along with Program Management Consultant (PMC) personnel, utilized a hydraulic and hydrologic simulation computer model (Model) that represents the combined sewer collection system in the City.

To provide meaningful results, the Model requires a base set of assumptions and defined design parameters. The Model simulations provide results that can be analyzed to compare against pre-determined performance metrics to gauge relative and absolute performance in meeting the LOS goal.

3.2 Level of Service Storm and Baseline Flow Analysis

3.2.1 Model

The Cityôs combined sewer system is continuously changing, with existing pipes being replaced or upsized, pump station set points being revised, or new information about the system being gained during field visits and surveys. The Model is intended to reflect the existing system conditions, including the best available information about the system. The latest version of the Model is EHY16_v2, which was used for these analyses.

3.2.2 Model Baseline Elements

The baseline for these analyses includes the existing Model with the addition of planned projects and programs. The most recent comprehensive update to the Model and baseline assumptions was made through the Urban Watershed Assessment (UWA)/Collection System Plan (CSP)[2]. The UWA is the comprehensive watershed-based planning process developed to diagnose challenges and propose prioritized solutions for the surface drainage and collection/conveyance portion of the Cityôs sewer system. The UWA baseline assumptions added to the existing system model include:

1. Stormwater Design Guideline: 0.5% annual redevelopment rate of Ó5,000 square-foot parcels for the 20-year period of the SSIP.

[2] UWA is in the process of transitioning into the Collection System Plan. All further references to the UWA also refer to the CSP.

2. Early Implementation Projects: Baker Beach, Holloway, Sunset, Chinatown, Wiggle, Valencia, Yosemite Creek, and Sunnydale.
3. Sea level rise boundary conditions: Citywide assumption of most likely 2050 condition of 11 inches plus 2-year storm surge.
4. Back flow preventers at all Bayside combined sewer discharge (CSD) outfalls with applicable head-losses.
5. Sea walls to avoid surface bay water inundation are not included. The model simulates surface flows discharging into the bay but will not simulate coastal inundation from tidal conditions.
6. Starting assumption is for downstream sewer facilities to be at dry-weather flow levels.[3]

In addition to the UWA baseline assumptions, future capital improvement projects were included. The set of projects used was developed in a recently completed *Flood Resilience Study* (SFPUC 2016b). Under this study, a range of increasingly sized combined sewer conveyance and storage projects were developed, designed for the 5-year storm up to the 100-year storm. For the current analysis, the 5-year solution set projects were used in the model baseline, with the exception of those projects that fall within the Project study area. Table 2 summarizes model baseline versions used for various related studies.

Table 2
Baseline Model Comparison

Study	Date	Model Baseline	Existing Conditions Version[1]	Assumptions[2]	Flood Resilience Projects
Folsom Area Stormwater Improvement (Current)	October 2016	Flood Resiliency	EHY16_v2	UWA Baseline	Yes
Flood Resilience	April 2016	Flood Resiliency	EHY16_v2	UWA Baseline	No
Folsom Exploration Study	August 2015	Mayor's Baseline	EHY13_v280	UWA Baseline	No
17th and Folsom Stormwater Management Draft Technical Paper	March 2015	Mayor's Baseline	EHY13_v280	UWA Baseline	No

1 Latest Existing Conditions Version when the associated studies were performed
2 UWA Assumptions are presented in the *Flood Resilience Report* (SFPUC 2016a).

[3] Refer to Assumptions and Limitations in Subsection 4.8 on page 81 for additional information.

The initial model simulations of all sub-alternatives were conducted using one-dimensional (1D) modeling. 1D modeling considers only flow in the conveyance facilities (i.e., pipe network). Two-dimensional (2D) modeling, which also considers routing of excess flows on the surface topography, and typical year analysis were then performed on sub-alternatives that remained after initial screening.

3.2.3 Level of Service Storm

The six design rainfall events listed in Table 3 are from the *Flood Resilience Study* (SFPUC 2016b). Event Nos. 1 and 2 are design events derived from an intensity-duration-frequency curve developed in 1941 by the City. Event Nos. 3 through 6 are design events derived from Atlas 14 intensity-duration-frequency curves developed in 2011 by the National Weather Service and the National Oceanic and Atmospheric Administration for California.

Table 3
Flood Resilience Design Rainfall Events

Event No.	Frequency [1]	Recurrence [2]	Duration (Hours)	Volume (Inches)	Maximum 1-hour depth (inches)
1	20%	5-year (LOS)	3	1.28	0.72
2	20%	5-year	24	3.19	0.72
3	10%	10-year	3	1.48	0.87
4	4%	25-year	3	1.78	1.04
5	2%	50-year	3	2.01	1.18
6	1%	100-year	3	2.26	1.32

[1] Probability of occurrence in any given year
[2] Result of long-term average number of years divided by number of occurrences

The LOS storm, derived from the 5-year 3-hour design storm (Event No. 1 in Table 3), is used as the input for all modeling simulations. All project elements will be sized to meet performance metrics according to the results obtained from simulations using this design storm and specified criteria.

3.2.4 Higher Recurrence Interval Storm

The team performed 2D overland flow modeling to explore system performance for higher-recurrence interval design storms (i.e., 10-year, 25-year, 50-year, or 100-year) as a singular event (Events No. 3 through 6 in Table 3). This analysis only determines the performance of the project elements that are being proposed to meet the performance metrics utilizing the LOS storm as a singular event and does not include further refinement of project elements based on the results. However, the analysis could be used to identify additional high-impact, low-cost surface restoration projects (i.e., floodways) that might potentially provide additional flood protection in storm events greater than the LOS storm. This is provided as requested by SFPUC Project Manager.

3.2.5 Typical-Year Simulations

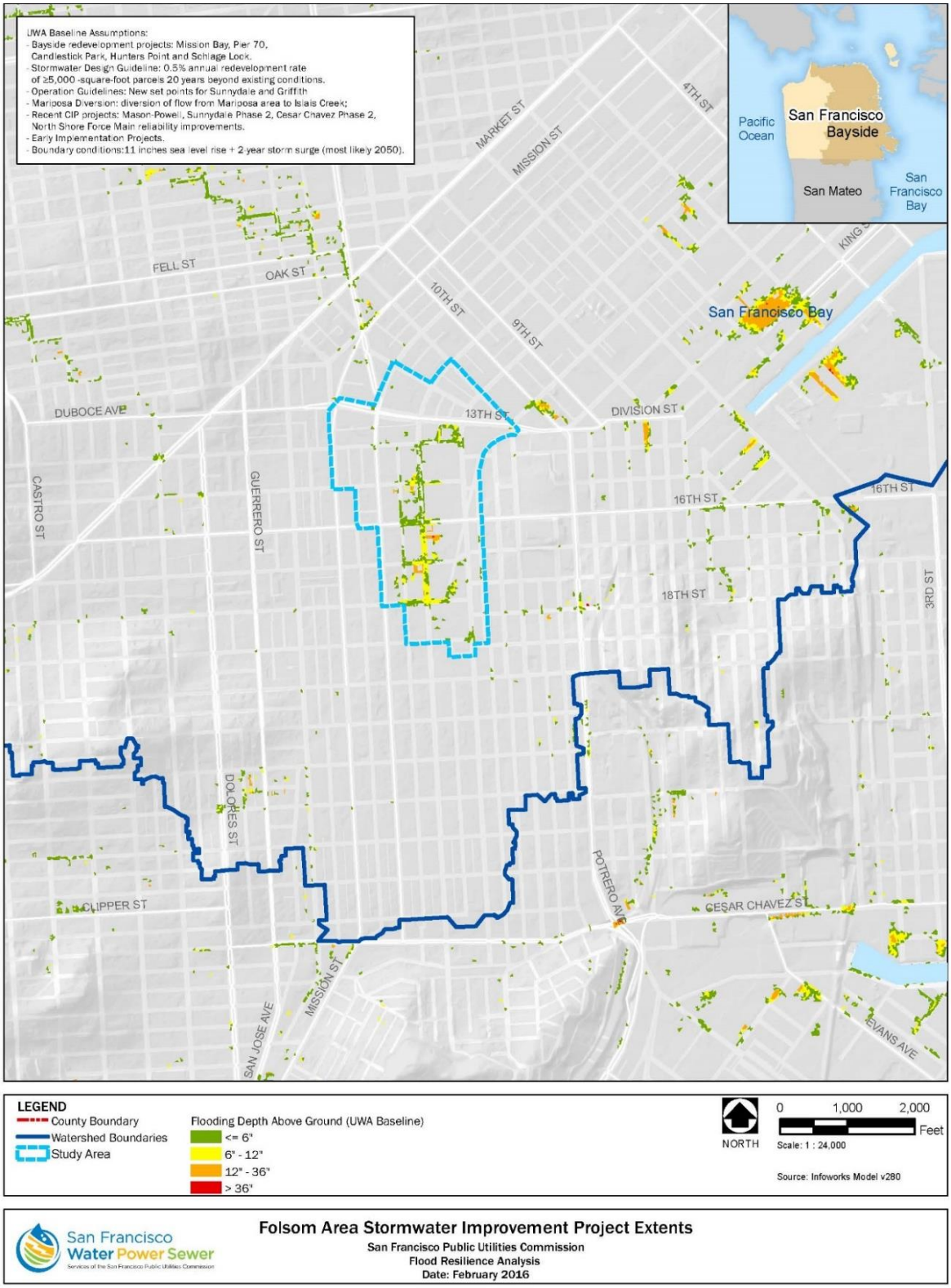
The purpose of the typical-year simulations is to confirm that the alternatives being analyzed are in agreement with the terms of the City's standing National Pollutant Discharge Elimination System (NPDES) permit. In accordance with the United States Environmental Protection Agency Combined Sewer Overflow Policy's Nine Minimum Controls and the SFPUC's Long-Term Control Plan, the permit requires that both treatment and collection system facilities should be fully used as intended prior to any CSDs occurring to prevent unnecessary pollution to the receiving waters of the bay and ocean. Specifically, the simulations are a means of confirming that storage is maximized and any proposed changes do not worsen the CSD count or volume.

3.3 Project Study Area

One of the first steps undertaken in the planning process is to define the project study area. The project study area is the boundary within which the performance metrics, to be described later, are considered. The project study area was intentionally developed to include all surface flooding in the 17th and Folsom neighborhood during the LOS storm. Previous study boundaries were considered from the UWA, *Flood Resilience Study* (SFPUC 2016b), and the *17th and Folsom Stormwater Management Technical Paper* (SFPUC 2015). Of these boundaries, the 15-foot elevation contour, based on the Old City Datum, most accurately encompassed all flooded areas in the LOS storm. Adjustments were made to the 15-foot contour to produce a hybrid boundary aligned with the public right-of-way (ROW) for City streets. This final boundary is shown in Figure 4.

The area within the boundary is considered the project study area. All alternatives analyzed within the project study area are subject to the performance metrics described in this document.

Figure 4
Project Study Area



Modeling results are based on previous version of model. Graphic is only to show study area and not necessarily the flooding depth.

3.4 Performance Metrics

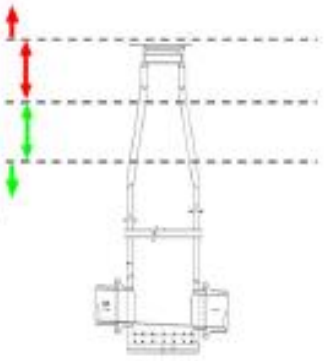
3.4.1 Freeboard Requirements for Conveyance Alternatives

In developing conveyance alternatives, the Project team was directed by the Project Manager to achieve a freeboard of at least two feet at every node or manhole within the project study area for the LOS storm. The Project team also identified multiple outliers that could be ignored if necessary. The performance for each alternative will be defined by totaling the number of nodes within the Project study area under each of the following categories: Negative freeboard (excursion), 0ï 2 feet of freeboard, 2ï 4 feet of freeboard, and >4 feet of freeboard (Figure 5). The sum will be compared to the baseline results.

Additionally, the freeboard at key locations, including 17th and Folsom, 18th and Shotwell, Enterprise Alley, and 14th and Harrison, will be specifically called out to compare across the different options. Enterprise Alley is a known outlier and will likely not meet freeboard for most, if not all, of the alternatives.

Figure 5
Categories for Freeboard Count

	Freeboard	# of Nodes
Freeboard Not Met	Negative	
	0-2 feet	
Freeboard Met	2-4 feet	
	+4 feet	



For areas outside of the Project study area, the project team will adopt a ñdo no worseò approach under the LOS storm event. This metric will be defined by maintaining (or improving) the baseline freeboard at Henry Adams to compare across the different alternatives for the ñdo no worseòapproach.

3.4.2 Freeboard Requirements for Storage Alternative

Storage alternatives are required to achieve hydraulic grade below surface elevation; no freeboard is required. Conveyance elements required to deliver flow to storage elements must meet the two feet freeboard requirement. Freeboard performance will be evaluated similarly to the conveyance alternatives.

3.5 Alternatives Identification

The planning process will consider three conveyance alternatives and one storage alternative to meet the LOS as defined in Section 3.2.3:

Conveyance

Alternative A: Wet-weather connector tunnel to the future Central Bayside System Improvement Project main tunnel
Alternative B: Wet-weather tunnel to other location
Alternative C: Division Street box sewer expansion

Storage

Alternative D: Storage facility

These four alternatives are expanded into sub-alternatives with multiple viable options. Each sub-alternative will be compared first against others within the same family of alternatives. The best sub-alternative of each family of alternatives will then be carried into alternatives analysis for analysis against each other. The following subsections describe each sub-alternative, and Table 4 summarizes the sub-alternatives.

3.5.1 A-Alternative – Connector Tunnel to Future Central Bayside System Improvement Project Storage Tunnel (Inner Mission Connector Tunnel)

Alternative A (Figure 6) would connect to the larger CBSIP storage tunnel (CHTL). The primary purpose of CBSIP is to provide redundancy to the existing 66-inch Channel Force Main, which conveys all dry-weather flows from North Shore and Channel watersheds to the SEP. The project would consist of a large diameter storage tunnel tentatively named the CHTL, a deep dewatering pump station, and optional connector tunnels to the Mariposa and Inner Mission areas. Alternative A would connect to the CHTL as an indirect means to connect to the Division Outfall, and does not impact the sizing of the CHTL.

The CHTL considered three main alignment alternatives, which were narrowed down to two in the projectôs Alternatives Analysis Report phase. Of these, a deep eastern alignment (Figure 6) has been used for UWA studies as a proxy alignment for hydraulic analyses, and is also the basis for this Project.

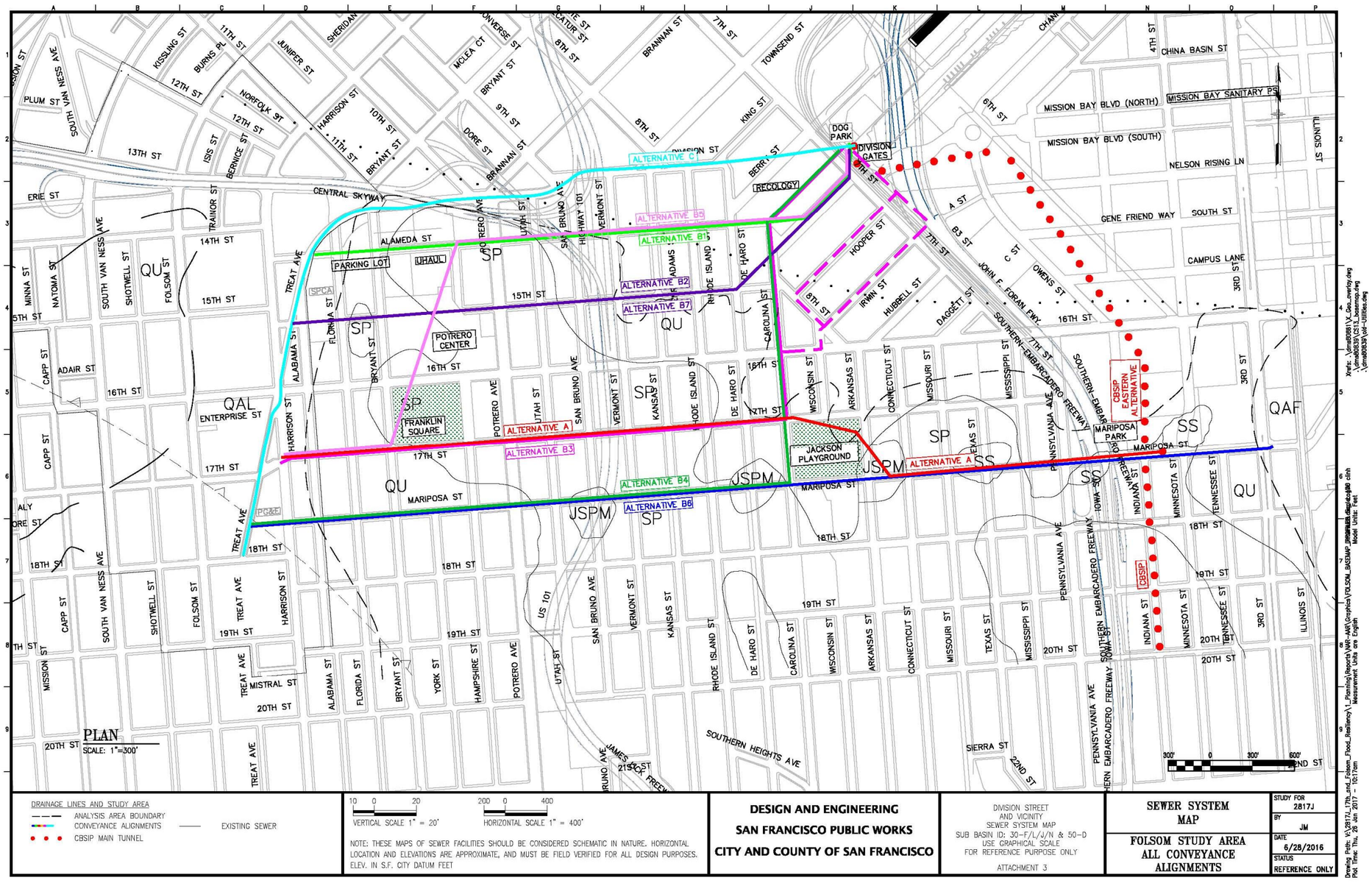
A previous CBSIP Task 8.5 Technical Memorandum called for the Inner Mission Connector Tunnel to be a 17-foot-diameter wet-weather connector tunnel constructed from a 35-foot launching shaft in the street near Jackson Playground that would continue to an intermediate shaft in the Inner Mission. The revised baseline assumptions used for this project analysis indicate a 9.5-foot inside-diameter tunnel would suffice for the connector tunnel. Dry weather flow would not be changed from its existing course to the Division Street Sewer system. The connector tunnel alignment would follow the Mariposa Street ROW to Jackson Playground, turn and cross under Jackson Playground to 17th Street, and continue to a 20-foot-by-40-foot retrieval shaft at 17th Street at Treat Avenue. The Treat Avenue retrieval shaft would be expanded to incorporate structures that would divert stormwater into the Inner Mission Connector Tunnel from the existing sewers in 17th Street and Treat Avenue. This shaft would also be used to launch a 9-foot-diameter tunnel beneath 17th Street from Treat Avenue to a retrieval shaft at South Van Ness Avenue. The South Van Ness shaft would be converted into a drop structure for connection of future combined sewer system improvements identified in the UWA. The tunnel machine retrieved from Treat Avenue would be returned to the launching shaft near Jackson Playground. The Inner Mission Connector Tunnel would be extended east to connect to the CHTL on Indiana Street at a junction and drop structure shaft.

Table 4
Initial Alternatives

Alternative Category		Notes
Sub-Alternative	**Length (LF)**	
A. Connector Tunnel to Future Central Bayside System Improvement Project Storage Tunnel		
A ï CBSIP Connector	6,450	Mostly developed under CBSIP studies. Size of connector tunnel to be reevaluated.
B. Connector Tunnel without CBSIP		
B1 ï Alameda	4,200	Connects to downstream end of Division Street sewer.
B2 ï 15th (Channel Northside)	4,600	Connects to Channel ñC1ò Transport/ Storage Box.
B3 ï 17th-Carolina	6,020	Connects to downstream end of Division Street sewer.
B4 ï Mariposa-Carolina	6,470	Connects to downstream end of Division Street sewer.
B5 ï 17th-Alameda	5,920	Connects to downstream end of Division Street sewer.
B6 ï Mariposa-Outfall	7,300	Connects to Mariposa Transport/Storage Box.
B7 ï 15th (Channel Southside)	4,560	Connects to Channel ñC4ò Transport/ Storage Box.
C. Division Street Sewer Expansion		
C1 ï Expand one compartment	5,070	Expansion of southernmost compartment.
C2 ï Expand two compartments	5,070	Expansion of two southernmost compartments (to a single compartment).
C4 ï Expand four compartments	5,070	Expansion of all (two or four) compartments.
D. Storage Facility	**Volume (MG)**	
D1 ï Centralized Storage	12.8	Single detention tank location.
D2 ï Centralized Storage with Minor Components	12.8	Single detention tank location with conveyance components.
D3 ï Distributed Storage	2.3 3.0	Multiple detention tank locations.
D4 ï Distributed Storage with Minor Components	2.3 3.0	Multiple detention tank locations with conveyance components.

CBSIP = Central Bayside System Improvement Project; ID = inside diameter; LF = linear feet; MG = million gallons

Figure 6
A, B, and C Alternatives



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Because the alignment has already been developed in some detail by the CBSIP project, it is carried forward in this study without considering alternative alignments. However, the sizing of the Inner Mission Connector Tunnel will be refined to be consistent with the baseline assumptions of the other alternatives under consideration. This refined option will be carried forward for alternatives analysis.

3.5.2 B-Alternatives – Connector Tunnel without CBSIP

The B-alternatives (Figure 6) consider a tunnel conveyance option without the need to connect to the CHTL. The B-alternatives would include a 12-foot inside-diameter tunnel beginning at some point along Treat Avenue and ending at either the Channel or Mariposa Transport/Storage box. The B-alternatives are also referred to as ñconnector tunnelsò because they link the combined sewer in the Inner Mission to a location at one of the existing downstream CSD facilities. These downstream CSD facilities consolidate flow prior to treatment and CSDs.

Of the seven sub-alternatives detailed below, the best option will be selected to represent the B-alternative for alternatives analysis.

Alternative B1 – Alameda

Tunnel alignment would mainly follow Alameda Street, starting at the intersection of Treat and Alameda Streets, and connecting to Channel Transport/Storage Box near 7th and Berry Streets.

Alternative B2 – 15th Street

Tunnel alignment would run mainly along 15th Street, starting at the intersection of Treat and 15th Streets, travelling eastward toward the intersection of 15th and De Haro Streets, and connecting to Channel Transport/Storage Box near Berry and 7th Streets.

Alternative B3 – 17th and Carolina Streets

Tunnel alignment would run mainly along 17th and Carolina Streets, starting near the intersection of Treat and 17th Streets, travelling eastward toward the intersection of 17th and Carolina Streets, continuing northward toward the intersection of Carolina and 8th Streets, and finally connecting to the downstream end of the Division Street Sewer near 7th and Berry Streets. This alternative would overlap a portion of one of the CBSIP alignments.

Alternative B4 – Mariposa and Carolina Streets

Tunnel alignment would mainly follow Mariposa and Carolina Streets, starting near the intersection of Treat and Mariposa Streets, travelling eastward toward the intersection of Mariposa and Carolina Streets, continuing northward toward the intersection of Carolina and 8th Streets, and finally connecting to the downstream end of the Division Street Sewer near 7th and Berry Streets. This alternative would overlap a portion of one of the CBSIP alignments.

Alternative B5 – 17th and Alameda Streets

Tunnel alignment would run mainly along 17th and Alameda Streets, starting near the intersection of Treat and 17th Street, travelling eastward toward the intersection of 17th and Bryant Streets, then travelling northeasterly toward the intersection of Alameda and

Hampshire Streets, then travelling eastward and connecting to the downstream end of the Division Street Sewer near 7th and Berry Streets.

Alternative B6 – Mariposa Street

Tunnel alignments would run entirely along Mariposa Street, starting at the intersection of Treat and Mariposa Streets, travelling eastward, and connecting to the Mariposa Transport/Storage Box at the intersection of Mariposa and 3rd Streets.

Alternative B7 – 15th Street

Tunnel alignment would run mainly along 15th Street, starting at the intersection of Treat and 15th Streets, travelling eastward toward the intersection of 15th and De Haro Streets, and connecting to Channel Transport/Storage Box near Channel and 7th Streets.

3.5.3 C-Alternatives– Division Street Sewer Expansion[4]

The C-alternatives consider the expansion of the Division Street Sewer (Figure 1). The existing Division Street sewer consists of two to four parallel compartments, each 9.5 feet wide by 8.25 feet high. Originally constructed in the early 1900s and later expanded in the 1960s, the box sewer runs from the intersection of Treat and 16th Streets, along Division Street, and ends at the Channel Transport/Storage Box near the intersection of 7th and Berry Streets. The Division Street Sewer has two compartments from 16th Street to 10th Streets, and four compartments from 10th Street to the outfall near 7th and Berry Streets.

Of the three sub-alternatives detailed below and shown in Figure 7, the best option will be selected to represent the C-alternative for alternatives analysis.

Alternative C1 – Expand One Compartment

This sub-alternative considers the expansion of the southernmost compartment.

Alternative C2 – Expand Two Compartments

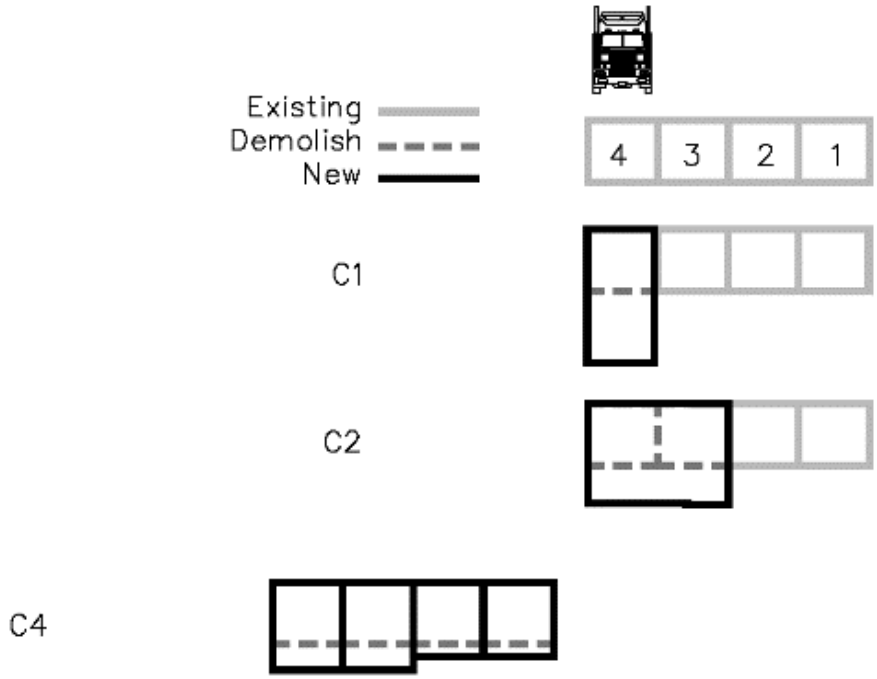
This sub-alternative considers the expansion of the two southernmost compartments.

Alternative C4 – Expand All Compartments

This sub-alternative considers the expansion of all (two or four) of the compartments.

[4] Whereas the sub-alternatives are numbered sequentially for other alternatives, the C sub-alternatives are numbered corresponding to the number of compartments that will be expanded. There is no C3 sub-alternative.

Figure 7
Division Street Sewer Expansion Sub-alternatives



3.5.4 D-Alternatives – Storage Facility

The D-alternatives consider a storage facility to manage storm and sanitary flow.

All detention tanks considered in this study were configured as off-line storage and are on private property. The possibility of in-line storage was eliminated because the relevant pipes would not offer the hydraulic constriction necessary to detain the peak flow. In addition, the expected detention volume required would exceed the physical dimensions of many in-line storage locations.

Centralized storage sub-alternatives were sited near 17th and Folsom Streets. Distributed storage sub-alternatives also included locations near 14th and Folsom in addition to locations near 17th and Folsom. These locations were shown to have the most impact in reducing flooding. Figure 8 shows the two general areas under consideration for detention, highlighting possible parcels. Locations are further refined in Subsection 3.6.5.

Of the four sub-alternatives detailed below, the best option will be selected to represent the D-alternative for alternatives analysis.

Alternative D1 – Centralized Storage

A single detention tank would be used to manage most flooding within the project area.

Alternative D2 – Centralized Storage with Minor Components

The single detention tank would be supplemented with the minor components set to manage all flooding within the project area.

Alternative D3 – Distributed Storage

As a comparison to a single detention tank, multiple tanks distributed across the study area was also configured and analyzed. This is based on an expected reduction in overall detention volume required by capturing flows before they reach the flooding area.

Alternative D4 – Distributed Storage with Minor Components

The multiple detention tanks will be supplemented with the minor components set to manage all flooding in the project area.

3.5.5 Minor Components

Integral to all conveyance alternatives and some of the storage alternatives are the minor components. The minor components are mostly sewer pipe upsizing or re-routing that will ensure that the necessary flows will reach the new facilities. Minor components were also evaluated so that the ñlow-hanging fruitò would be incorporated into the alternatives to help reduce the demands on the new infrastructure.

The list of possible minor components resulted from a combination of previous studies and brainstorming sessions. Hydraulic analyses were performed to determine the highest-performing set of minor components, which will be included in the analyses for each of the alternatives. The minor components modeling work is summarized in Appendix B. The minor components are further discussed in Subsection 4.3 on page 60.

Figure 8
General Site Area for Detention

3.6 Screening of Alternatives

Prior to the alternatives comparison, each of the four alternatives was screened for viability. In the case of Alternative A, much analysis had already been completed as part of CBSIP. Therefore, only one sub-alternative was screened. For the remaining alternatives, the set of initial sub-alternatives was reviewed to identify the highest-performing option to carry forward.

3.6.1 Screening of A-Alternative – Connector Tunnel to Future Central Bayside System Improvement Project Storage Tunnel (Inner Mission Connector Tunnel)

The proposed alignment and related geologic information for A-Alternative are shown in Figure 9. Ratings were assigned as follows: 3 = best rating, 2 = moderate rating, and 1 = poor rating. In addition to the rating, an importance factor was assigned to each category (3 = more important, 2 = neutral, 1 = less important). All importance factors have been set at neutral for the screening of A-Alternative.

Shaft Locations

The preferred direction for tunneling would be uphill (east to west) due to more effective removal of water and cuttings from the tunnel face and better tunnel drive shaft access in terms of traffic and major arterial routes. In general, all tunneling will require a mixed- or hybrid-type Tunnel Boring Machine (TBM). The TBM must be capable of tunneling in saturated soils using pressurized face mode (slurry or earth pressure balance machine) as well as be capable of tunneling through weak to strong rock and squeezing ground through the Franciscan complex, as shown in Figure 1.

The main drive shaft, between Indiana and Minnesota Streets or in Mariposa Park, will have the same issues as sub-alternative B6, described in further detail on page 43. The reception shaft will have the same issues as sub-alternative B3 in the vicinity of 17th Street between Harrison Street and Treat Avenue, described in further detail on page 37.

Geology, Constructability, Maintenance, Environmental Impact, Community Impacts, Site Availability

As shown in Figure 9, the alignment is deep and long through difficult geology. The Franciscan rock complex is subject to squeezing ground. Consequently, the ratings, shown in Table 6, with respect to depth and length and geology are the worst (1). Because of the depth, maintenance is rated (1) as well. Environmental impacts are rated as neutral (2), whereas community impacts are rated as (1) because of the UCSF Childrenôs Hospital and the business district between Harrison Street and Treat Avenue. Site availability is seen as neutral because the alignment is mainly through the public ROW; however, the shaft locations in the Pacific Gas and Electric (PG&E) parking lot and Mariposa Park may be relatively easier acquisitions.

In the area of Jackson Park, Alternative A can make a northward S-curve from Mariposa to 17th Streets. The proposed shaft on 17th Street between Carolina and De Haro Streets could serve as an intermediate shaft for Alternative A. The proposed shaft could also serve as an angle point and eliminate the S-curve. (This shaft could also serve as a launching shaft for Alternative B3.)

If a driveshaft can be located within Jackson Park, it could serve as a drive shaft toward the west and east directions. In that case, the S-curve may be avoided, but the disadvantage is that it is relatively deep.

Tie-in

The tie-in to the Treat Avenue sewers on the upstream end and to the CBSIP CHTL on the downstream end may be done underground and is therefore relatively straightforward; consequently, it receives a (3), the best rating for this category.

Cost and Schedule

The costs are the highest and the schedule the longest for tunneling activities, and therefore rates the worst among all alternatives.

Detailed analysis of shaft locations (Appendix C), tunneling conditions (Appendix D), and construction costs (Appendix E) are provided in the listed appendices. Additional plan views are provided in Appendix F.

Preliminary alternative-specific scorecards, developed to compare hydraulic modeling results, are provided in Appendix G.1. Updated scorecards, developed to further refine the alternatives brought forward to alternatives analysis, are provided in Appendix G.2.

Because there is only one A-alternative, this alternative will be carried forward to alternatives analysis.

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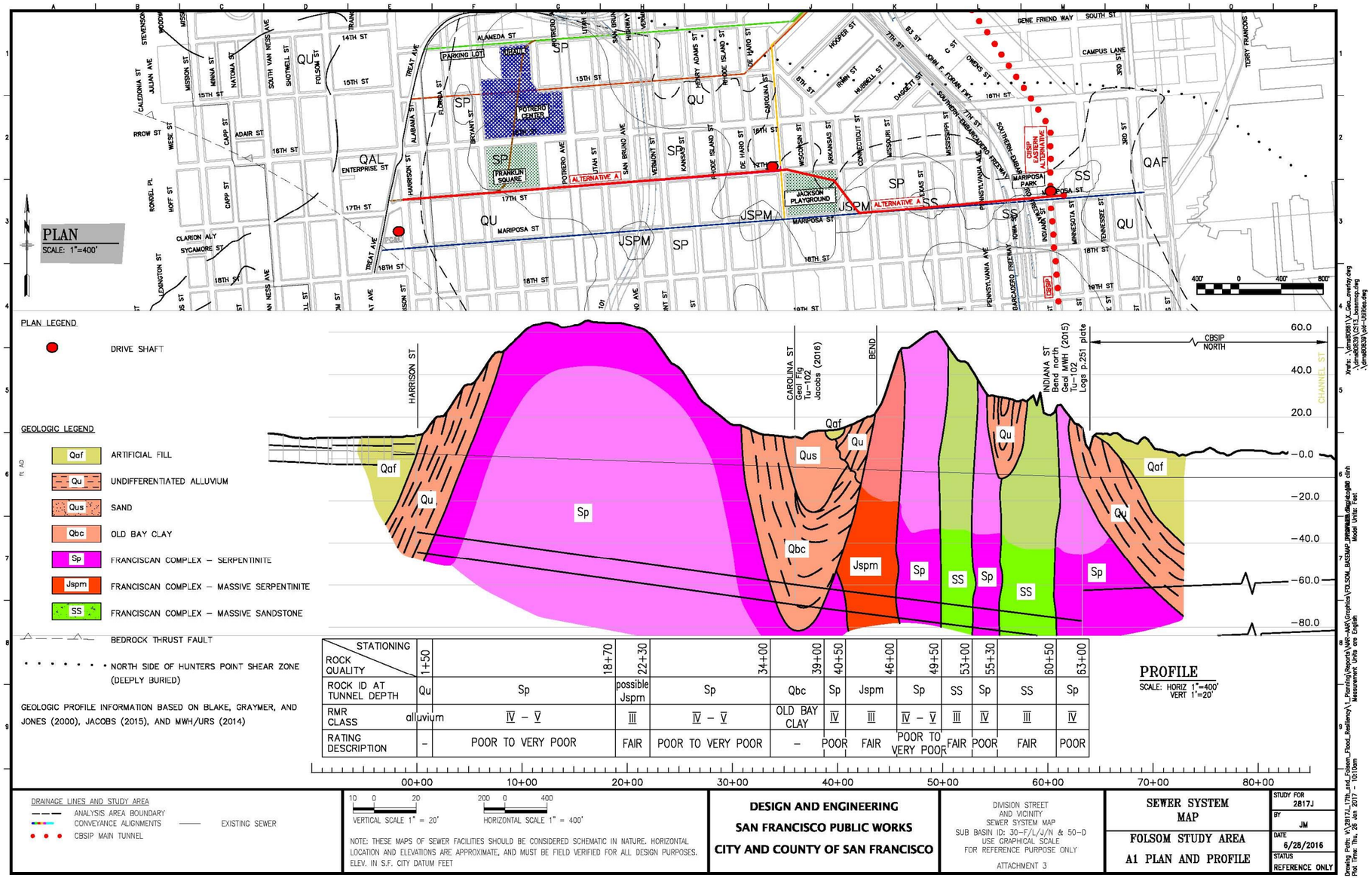
Figure 9
Alternative A Geologic Plan and Profile



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3.6.2 Screening of B-Alternatives – Connector Tunnel without CBSIP (Initial)

The project team conducted an initial screening of the B-alternatives, which considers a tunnel conveyance option independent of the CHTL, to eliminate certain sub-alternatives based on a variety of reasons.

The first two sub-alternatives to be eliminated were sub-alternatives B4 and B5. In addition to being substantially similar to sub-alternative B3, B4 would require greater tunneling length and an additional easement between Treat Avenue and Mariposa Street, while providing no additional benefits over sub-alternative B3. Sub-alternative B5 required three large easements through Potrero Center, Franklin Square, and a UHAUL property. Due to constructability concerns related to these significant site availability requirements, these two sub-alternatives were eliminated.

Each of the remaining sub-alternatives, B1, B2, B3, B6, and B7, were then preliminarily sized to all provide consistent hydraulic performance within the study area. Due to the similarities, tunnel size was not a major factor in ranking the remaining sub-alternatives; constructability was the primary differentiating metric used to narrow sub-alternatives down for further consideration. Table 5 presents some of the layout and constructability issues associated with each sub-alternative.

The next two sub-alternatives eliminated, based on the constructability concerns presented in Table 5, were sub-alternatives B2 and B7. The primary alignment for both these sub-alternatives followed 15th Street, requiring large easements through the San Francisco Society for the Prevention of Cruelty to Animals (SPCA) building at 201 Alabama Street and the Potrero Center at 2300 16th Street; these two properties are highlighted with red text in Table 5. Due to constructability concerns related to site availability of these easements, these two sub-alternatives were eliminated.

Table 5
Preliminary Constructability Concerns for Initial B- Alternatives

Category	Consideration	B1	B2	B3	B6	B7
Geometry	Approximate Length (Linear Feet)	4,200	4,500	5,800	7,300	4,500
	Requires Outfall Expansion				X	
Crossings	Caltrain Railway	X	X	X	X	X
	Highway 101	X	X	X	X	X
	Interstate 280				X	
Easements	Recology (Parking Lot)	X				
	Recology (Paper Street)	X	X	X		X
	Potrero Center (Shopping Complex)		**X**			**X**
	Harrison St and Mariposa St (Building)				X	
	SPCA (Building)		**X**			**X**
	15th St Vacated ROW (Parking Lot)	X				
	15th & Carolina (Building)		X			X
Bends	Major 90 Degree Bends			X		
	Major 45 Degree Bend or Less	X	X	X		X
	Total Number of Issues	6	7	5	5	7

Note: Sub-alternative B4 was eliminated because it is substantially similar to B3, requiring greater tunneling distance and an additional easement. Sub-alternative B5 was eliminated due to requiring three additional easements.

3.6.3 Screening of B-Alternatives Alternatives – Connector Tunnel without CBSIP (Detailed)

The remaining B sub-alternatives, B1, B3, and B6, were further carried forward for analysis in the Alternatives Analysis phase because they had fewer issues. The information to narrow the sub-alternatives down to one single B-alternative to carry forward is presented below.

The preferred direction for tunneling would be uphill (east to west) due to more effective removal of water and cuttings from the tunnel face and better tunnel drive shaft access in terms of traffic and major arterial routes. In general, all tunneling will require a mixed or hybrid type TBM. The TBM must be capable of tunneling in saturated soils using pressurized face mode (slurry or earth pressure balance machine) as well as be capable of tunneling through weak to strong rock and squeezing ground through the Franciscan complex. The shaft locations for sub-alternative B6 would allow the tunnel to start in rock.

Detailed analysis of shaft locations (Appendix C), tunneling conditions (Appendix D) and capital construction costs (Appendix E) is provided in the listed appendices. In general, where shafts are in soil for the upper portion or for the entire depth, the support system will require a secure watertight system such as secant pile walls or slurry walls. In contrast, within the Franciscan rock complex, conventional shoring such as ribs and shotcrete lagging may be employed. Shoring for the shafts is discussed in Appendix C for each shaft location. Additional plan views are also provided in Appendix F.

To further narrow the number of B-Alternatives, combinations of alternative alignments and construction methods were comparatively rated according to eight categories: environmental, community, operation and maintenance, site availability, tie-in complexity, geotechnical and constructability (consisting of depth, length, and geology), costs, and schedule, as listed in Table 6. That table includes a variant of Alternative B1, named B1a, which assumes that ROW for tunneling under the Recology property and tunneling from the dog park area is not feasible due to traffic congestion and community commitments. Ratings were assigned as follows: 3 = Best, 2 = Neutral, and 1 = Worst. In addition to the rating, an importance factor was assigned to each category: 3 = more important, 2 = neutral, 1 = less important. All importance factors have been set at neutral for the screening of B-alternatives. For reference, the A-alternative is also included in Table 6.

Table 6
B-Alternatives Rating and Ranking Matrix

Alternative	Attribute / Alternative Description	Tunnel Length (ft)	Box or Multi-Pipes Jacking (ft)	Cut-and-cover Length (ft)	Importance Factor (IF) [1]										Total IF x Rating	Rank
					2	2	2	2	2	0.67	0.67	0.67	2	2		
					Rating											
					Environmental	Community	Operation and Maintenance	Site Availability	Tie-in Complexity	Geotechnical and Constructability			Cost	Schedule		
										Depth	Length	Geology				
A	Tunnel ï 17th Street to Mariposa	6,300			2.00	1.00	1.00	2.00	3.00	1.00	1.00	1.00	1.50	1.00	**25.0**	N/A
B1	Tunnel ï Alameda Street	4,200			2.00	2.00	2.50	1.00	1.00	3.00	2.75	2.00	3.00	2.50	**33.2**	1
B1a	Tunnel & Cut-and-Cover ï Alameda - Carolina	3,200	300	1,600	1.50	1.50	2.75	1.00	1.00	2.50	3.00	2.50	2.50	2.75	**31.3**	2
B3	Tunnel & Cut-and-Cover ï 17th to Carolina	3,600	300	1,900	1.25	1.50	2.75	2.00	1.00	1.50	3.00	2.50	2.50	2.00	**30.7**	3
B6	Tunnel ï Mariposa	7,300			2.00	1.00	1.00	3.00	2.00	1.00	1.00	1.00	1.00	1.00	**24.0**	4

Importance Factor: 3 ï More Important
2 ï Neutral
1 ï Less Important

Rating System: 3 ï Best
2 ï Neutral
1 ï Worst

[1] All importance factors are set at (2), which is neutral. Geotechnical and Constructability category is further divided into three sub-categories, with each sub-category accounting for one-third of the importance factor. м * 2 = 0.67.

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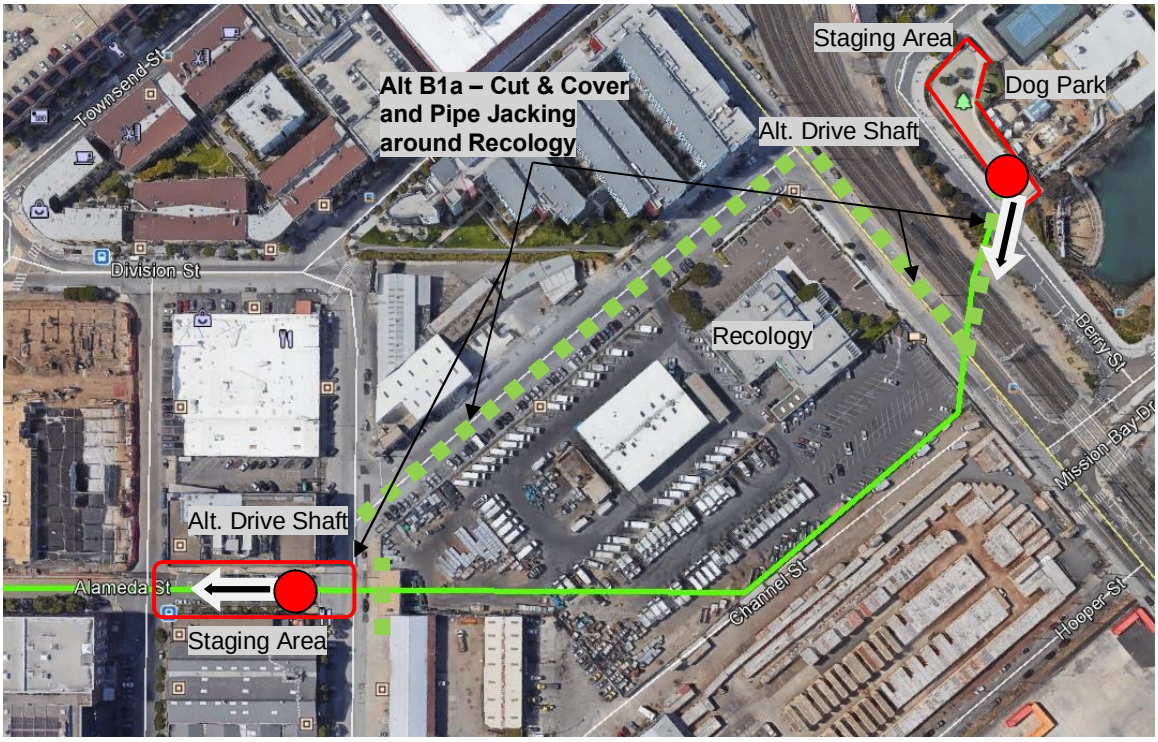
Sub-alternatives B1/B1a

Shaft Locations

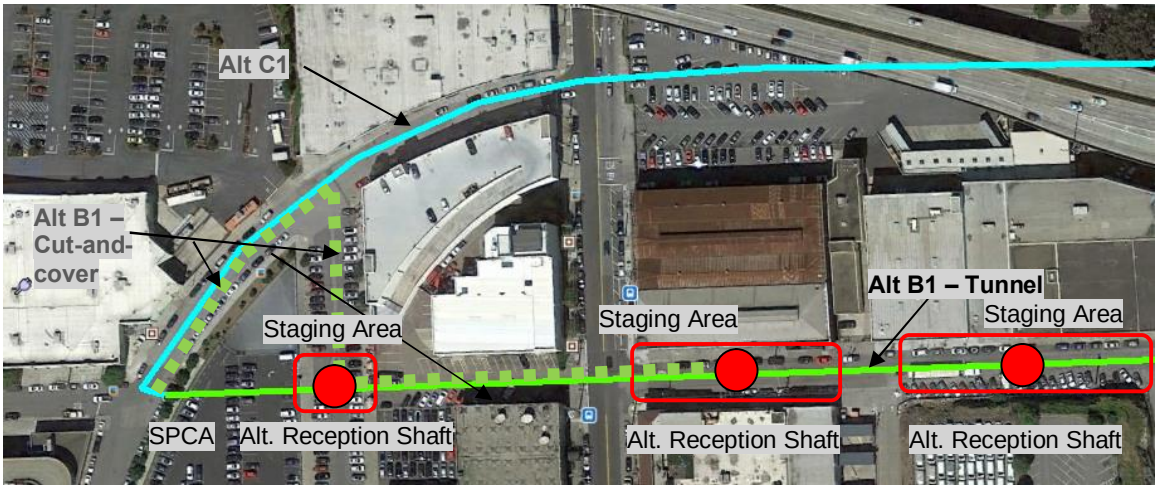
Sub-alternative B1 assumes tunneling under the Recology property from a shaft somewhere in the dog park near the tie-in to Division Street sewer, as shown in Figure 10. Sub-alternative B1a is a variation of B1 and assumes that ROW for tunneling under the Recology property and tunneling from the dog park area is not feasible due to traffic congestion and community commitments; this will require further confirmation. B1a assumes cut-and-cover from the dog park area to the main drive shaft on Alameda Street between De Haro and Rhode Island Streets. B1a would route around to the north of the Recology property on De Haro, Berry, and 7th Streets, then pass under the railroad by cut-and-cover box construction or (multiple) pipe jacking.

Figure 10
Sub-alternative B1/B1a Drive Shaft, Staging Areas, and Adjacent Structures



The reception shaft could be at one of a few locations, depending on ROW issues, staging area availability, utilities, and traffic routing feasibility. The reception shaft would be about 3,200 feet to 4,200 feet from the main drive shaft to the west on Alameda Street, between Potrero and Treat Avenues, as shown in Figure 11. The alignment could pass under the SPCA parking lot or be routed by cut-and-cover to tie in to the Treat Avenue sewer.

Figure 11
Sub-alternative B1/B1a Reception Shaft, Staging Areas, and Adjacent Structures



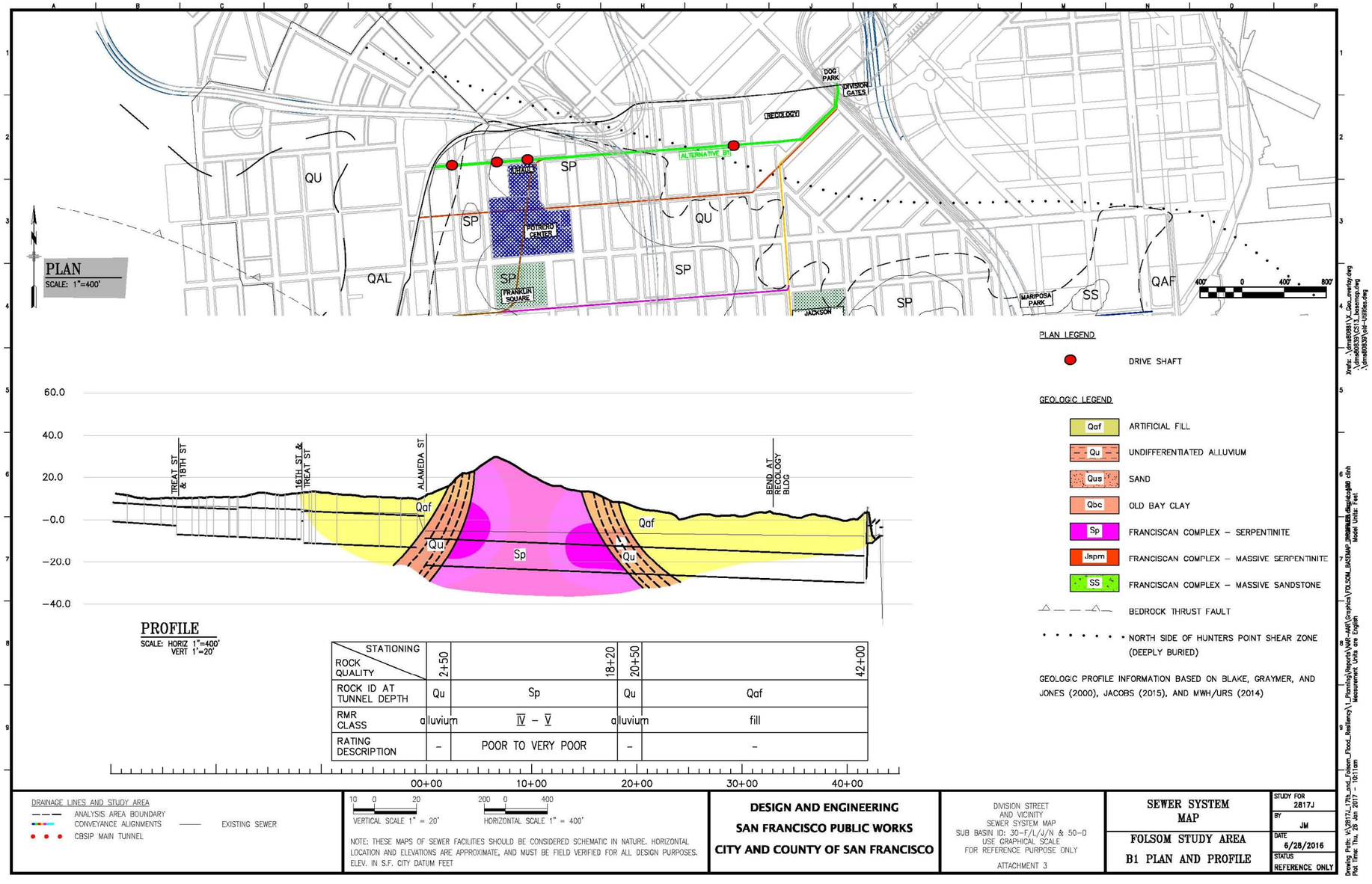
The available shaft locations for sub-alternative B1 would require compound staging areas because of the limited available open space unless use of the SPCA parking lot could be obtained. The proposed shaft staging areas, as shown on the figures, are very small and would require street closure and traffic re-routing. There are also warehouses in the area that may be flexible to relocate.

Sub-alternatives B1 and B1a have several possible upstream shaft locations, all in the congested industrial area and the SPCA area. The main drive shaft location is problematic, located either in a congested industrial and commercial area between Rhode Island and De Haro Streets or in the dog park near the Division Street Gate structures. Depending on the shaft locations and whether tunneling under the Recology property (Alt. B1) or cut-and-cover construction around it (Alt. B1a) is chosen, the tunnel length, mainly under Alameda Street, will vary between about 3,200 and 4,200 feet.

Geology, Constructability, Maintenance

As shown in Figure 12, the B1 and B1a alignments are relatively shallow compared to other alternatives, and the tunneling conditions are in soil on the flanks at the shaft locations and through the Franciscan serpentinite rock at the core. Consequently, the geotechnical and constructability ratings are relatively favorable and receive ratings that average higher than 2.5. The depth is also relatively favorable for operation and maintenance considerations and receives a (3) for B1 and (2.5) for B1a.

Figure 12
Sub-alternative B1 Geologic Plan and Profile



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Community, Site Availability, Environmental and Tie-In

Community and environmental impacts receive neutral ratings of (2) given the semi-industrial nature of the possible shaft locations. Site availability is unfavorable because of the complexity in routing through or around the Recology property and the SPCA lands and receives a (1). This also makes tie-ins complex and unfavorable, and this category also receives a (1).

Capital Construction Cost and Schedule

Costs are relatively favorable because of the shallower depth and possible cut-and-cover construction alternatives, and so this category receives a (3) for B1 and a (2.5) for B1a. Cut-and-cover construction also allows for more flexible construction by allowing access to work areas on multiple fronts/locations and receives a (2.5) for B1 and (2.75) for B1a.

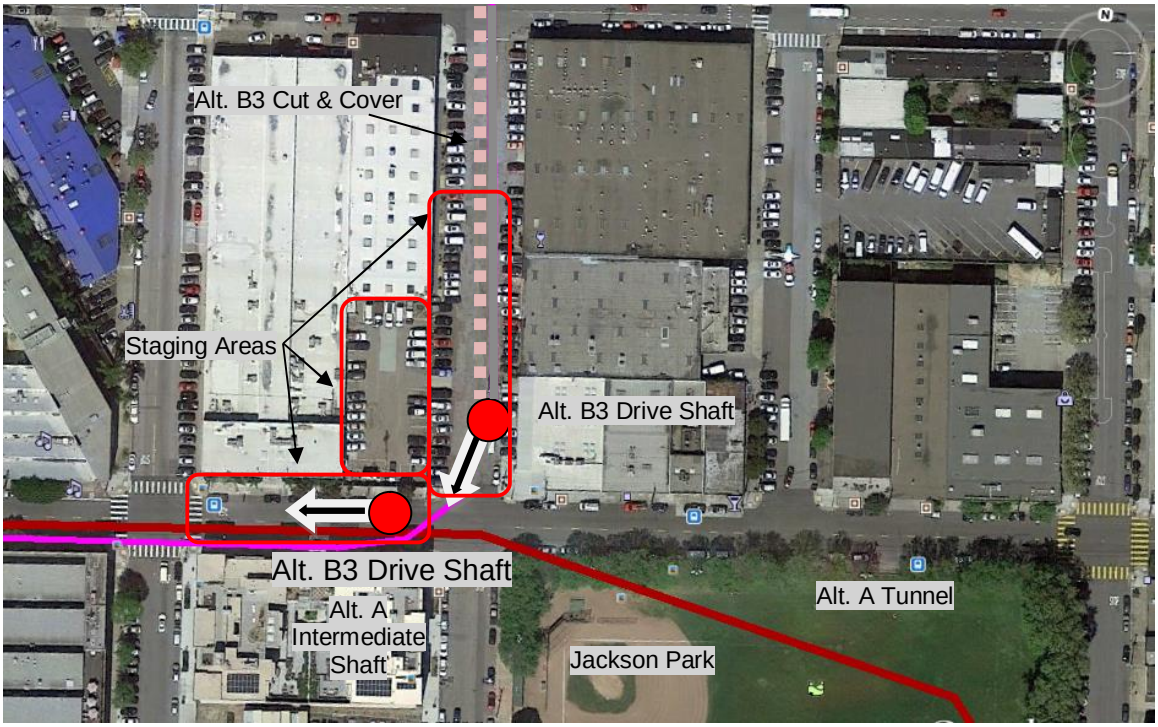
Sub-alternatives B1 and B1a rank first and second, respectively, with all importance factors set at neutral for the screening of B-alternatives, and were carried forward for alternatives analysis.

Sub-alternative B3

Shaft Location

Sub-alternative B3 assumes tunneling from a shaft in the vicinity of 17th and Carolina, as shown in Figure 13. The open space at Jackson Park, which is bounded by Arkansas, Carolina, 17th, and Mariposa Streets, is not available due to commitments to the community. The proposed main drive shaft would be centered either at Carolina Street between 16th and 17th Streets or at 17th Street between Carolina and De Haro Streets. (The shaft on 17th Street could serve as an intermediate shaft for Alternative A and help to accommodate curves and minimize encroachment under private ROW). The proposed shaft staging areas, as shown in Figure 13, are very small and would require compound staging, street closure, and traffic re-routing.

Figure 13
Sub-alternative B3 Drive Shaft, Staging Area, and Adjacent Structures



As shown in Figure 14, the reception shaft would be located in the vicinity of 17th Street between Harrison Street and Treat Avenue. The intersection is a major arterial for guided SFMTA bus traffic and leads to the SFMTA bus maintenance facility. Budgetary prices for relocation of overhead wires range between $5 million and $10 million per route mile). This area is an extremely busy commercial district; however, the tunnel could curve into a PG&E parking lot at about a 600- to 800-foot radius. The PG&E parking lot covers about one acre, which could accommodate shaft construction and TBM retrieval activities with relative ease.

The cut-and-cover construction would proceed north on Carolina and be constructed through or around the Recology property or to the south on Hooper or Irwin Streets, and then under the railroad to the Division Street Gates.

The B3 alternative has a favorable upstream shaft location, as shown in Figure 14, if the PG&E parking lot can be acquired. Consideration may be given to using the upstream shaft as the main drive shaft, but it is centered on a busy San Francisco Municipal Transportation Agency bus line and a commercial district. The downstream main drive shaft would be located either between Carolina and De Haro Streets or between 16th and 17th Streets if a curve is negotiable. The area is congested, being in a semi-industrial area.

Figure 14
Sub-alternative B3 Reception Shaft, Staging Areas, and Adjacent Structures

Geology, Constructability, Maintenance

As shown in Figure 15, sub-alternative B3 is moderately deep compared to sub-alternatives B1/B1a (shallower) and B6 (deeper). Tunneling conditions are in soil on the flanks at the shaft locations and through the Franciscan serpentinite rock at the core. Consequently, geotechnical and constructability scores land between sub-alternatives B1/B1a and B6 and average about a 2. The depth is also rated in between for operation and maintenance considerations and receives a rating of (2.75).

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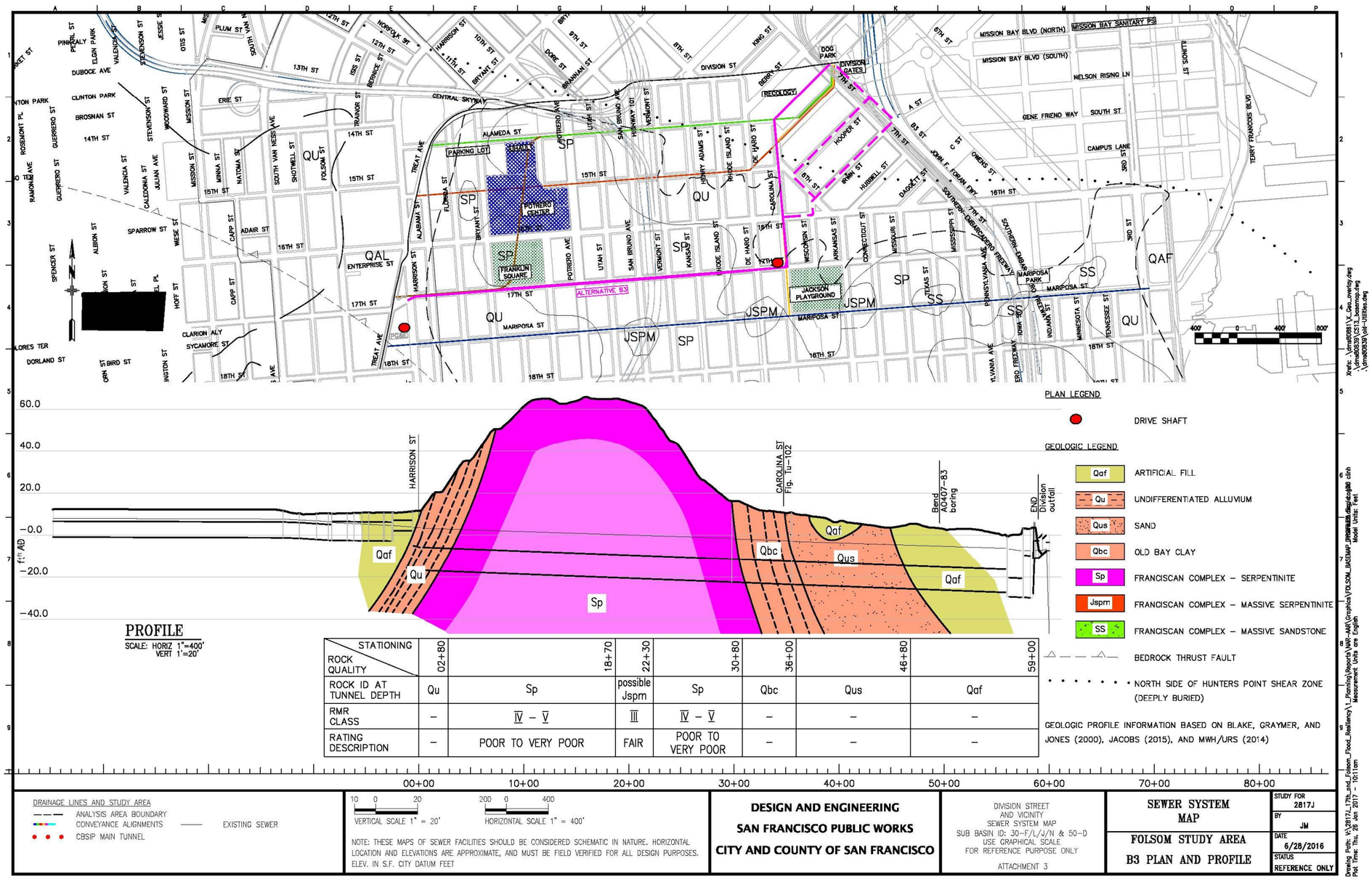
Figure 15
Sub-alternative B3 Geologic Plan and Profile



STATIONING / ROCK QUALITY	02+80	18+70	22+30	30+80	36+00	46+80	59+00
ROCK ID AT TUNNEL DEPTH	Qu	Sp	possible Jspm	Sp	Qbc	Qus	Qaf
RMR CLASS	–	V – V	III	V – V	–	–	–
RATING DESCRIPTION	–	POOR TO VERY POOR	FAIR	POOR TO VERY POOR	–	–	–

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Capital Construction Cost and Schedule

Cost is rated similar to B1/B1a because of the combination of cut-and-cover work required to go around the Recology property and receives a rating of (2.5). Cut-and-cover construction also allows for more flexible construction by allowing access to work areas on multiple fronts/locations and receives a rating of (2).

Sub-alternative B3 ranks third, with all importance factors set at neutral for the screening of B-alternatives, and is eliminated.

Sub-alternative B6

Shaft Locations

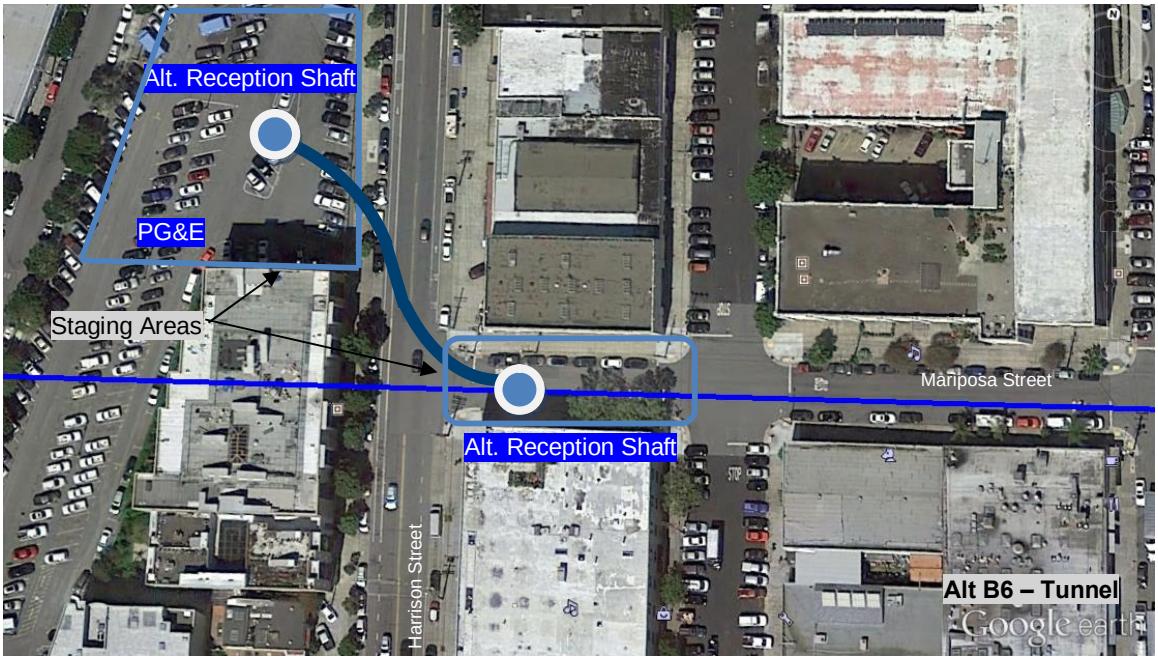
The main drive shaft for sub-alternative B6 is next to Mariposa Park, between Indiana and Minnesota Streets. If the shaft could be located in the park, the alignment would curve on a 600- to 800- foot radius until it met the alignment on Mariposa Street. Even if the park is available, the proposed shaft staging areas, as shown in Figure 16, are in a congested area and would require street closure and traffic re-routing. If the park were not available, the staging areas would be very small, requiring compound staging and plating. Plating of the street and working under a road deck could improve construction flexibility and help to minimize street closure issues.

Figure 16
Sub-alternative B6 Drive Shaft, Staging Area, and Adjacent Structures

The alignment proceeds westward under Mariposa Street to Treat Avenue. Alternative reception shafts may be on Mariposa Street between Harrison and Alabama Streets or in the PG&E parking lot, as shown on Figure 17. Locating the shaft in the street ROW, which is a congested area, would require a very tight staging area for the receiving shaft, street closure, traffic re-routing, and compound staging operations. However, the PG&E parking lot has about one acre, which could accommodate shaft construction and TBM retrieval activities with relative ease (especially compared to the main drive shaft if Mariposa Park is not available for Alternatives A and B6). Tight turning radii would be

required, including a likely S-curve to avoid ROW issues, as shown in Figure 17. For either location, this area is an extremely busy commercial district, and traffic management will be of prime importance.

Figure 17
Sub-alternative B6 Reception Shaft, Staging Area, and Adjacent Structures

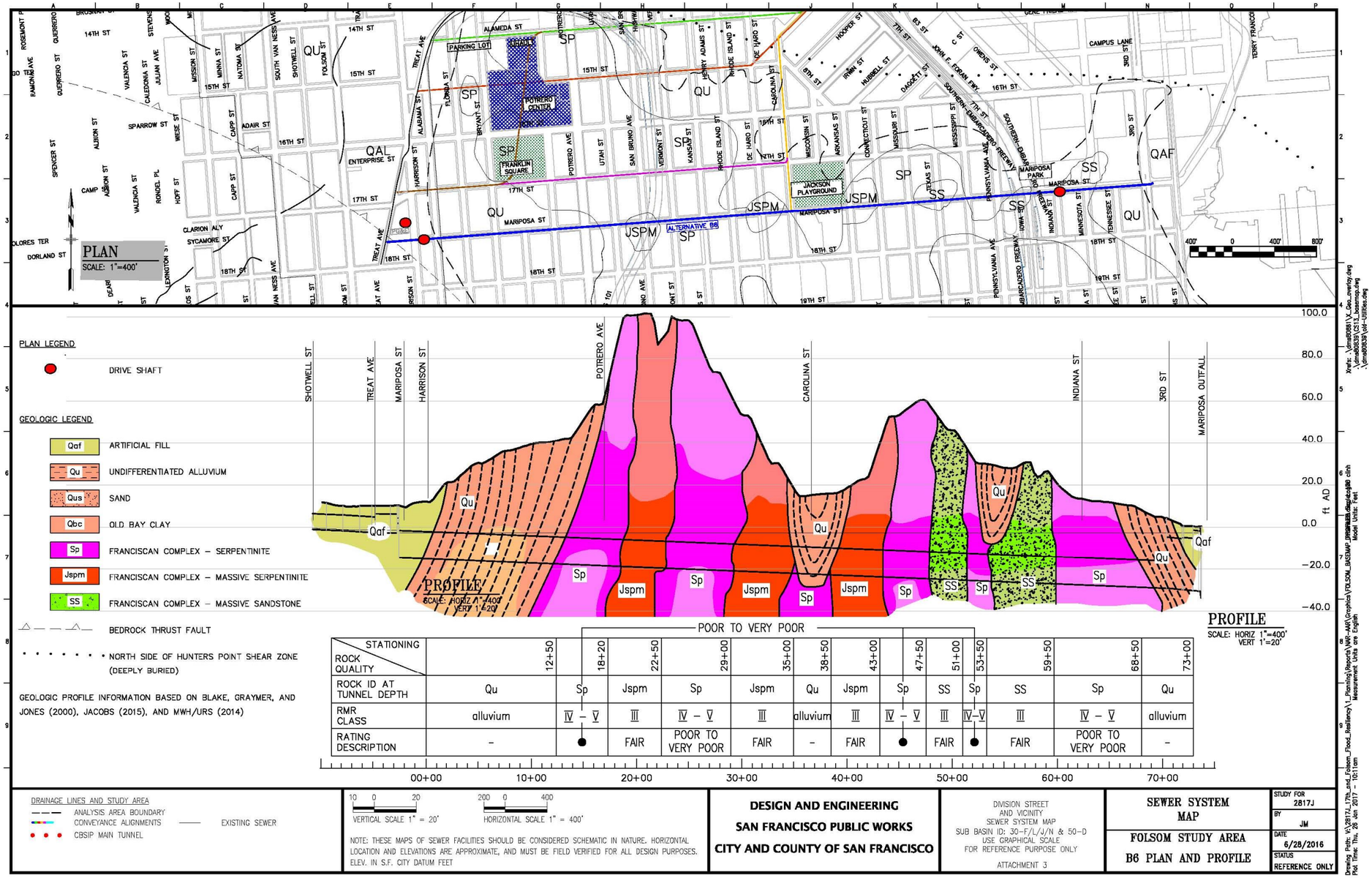


The main drive shaft for B6 would be between Indiana and Minnesota Streets or in Mariposa Park, while the reception shaft would be either on Mariposa Street between Harrison and Alabama Streets or finish in the PG&E parking lot, which may require an S-curve, depending upon foundation and adjacent structure issues. The connection between the main drive shaft to the Mariposa Transport Storage Box would likely be cut-and-cover construction.

Geology, Constructability, Maintenance, Environmental, Community, Site Availability

As shown in Figure 18, the B6 alignment is deep and long through difficult geology. The Franciscan rock complex is subject to squeezing ground. Consequently, depth, length and geology receive the lowest rating. Also due to the depth, maintenance is rated (1) as well. Environmental impacts are rated as neutral (2). Community impacts are rated as (1) because of the UCSF Childrenŝ Hospital and the business district between Harrison Street and Treat Avenue, although potentially not as problematic as 17th Street. Site availability is considered neutral because the alignment is mainly through the public ROW; however, the shaft locations in the PG&E parking lot and Mariposa Park may be a relatively easier acquisition. The alignment is straight, so ROW issues are of less concern compared to other sub-alternatives, but the disadvantage is that it is relatively deep.

Figure 18
Sub-alternative B6 Geologic Plan and Profile



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Tie-in

The tie-in complexity to the Treat Avenue sewers is complicated by the sewers if the shaft ends in the ROW on Mariposa Street. However, if the shaft ends in the PG&E parking lot, the tie-ins should be more favorable. On the downstream end, tie-ins should be relatively straightforward but will require traffic control. This alternative receives a rating of (2) for tie-ins.

Capital Construction Cost and Schedule

The costs are the highest and the schedule the longest for tunneling activities, and consequently they receive the lowest rating of (1) for both.

Sub-alternative B6 ranks fourth, with all importance factors set at neutral for the screening of B-alternatives, and is eliminated.

Table 7 shows the B sub-alternatives that are eliminated, with a brief summary of supporting rationale.

Table 7
Eliminated B Sub-Alternatives

Sub-alternative	Length (LF)	Reason for Elimination
B2 ï 15th (Channel Northside)	4,500	Right-of-way issues
B3 ï 17th-Carolina	5,800	Ranked lower than Alternative B1/B1a
B4 ï Mariposa-Carolina	6,470	Similarity to B3, but greater tunnel length and additional easement needs
B5 ï 17th-Alameda	5,920	Right-of-way issues
B6 ï Mariposa	7,300	Highest cost and constructability concerns
B7 ï 15th (Channel Southside)	4,560	Right-of-way issues

LF = linear feet

Preliminary alternative-specific scorecards, developed to compare hydraulic modeling results, are provided in Appendix G.1. Updated scorecards, developed to further refine the alternatives brought forward to alternatives analysis, are provided in Appendix G.2. Cost estimates for the tunneling alternatives are provided in Appendix E.

Sub-alternative B1/B1a, Alameda Street alignment, was carried forward to alternatives analysis, as discussed in Section 4.0.

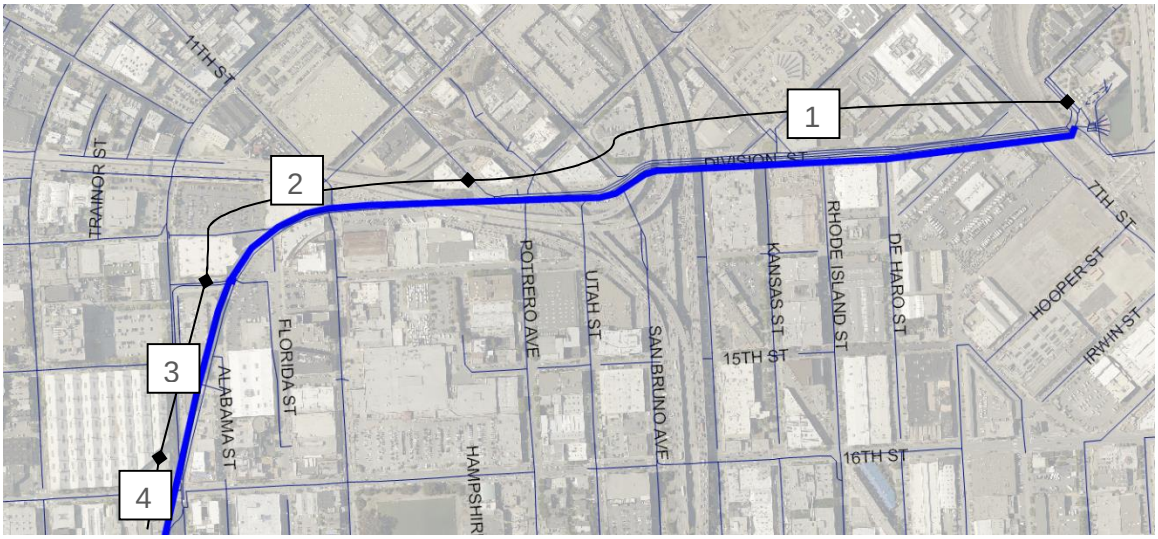
3.6.4 Screening of C-Alternatives – Division Street Sewer Expansion [5]

For the purposes of this analysis, the alignment of the existing Division Street sewer was divided into four segments, which were sized individually to account for incoming flows along the length of the sewer (Figure 19). In the previous *Folsom Exploration Study*

[5] Whereas other sub-alternatives are numbered sequentially, the C sub-alternatives are numbered corresponding to the number of compartments that will be expanded. There is no C3 sub-alternative.

(SFPW 2015), segments were sized assuming all four compartments would be uniformly lowered. The cost estimating for this configuration revealed that the number of compartments being reconstructed was a significant driver for total cost.

Figure 19
Alternative C Segments



Because the downstream transport/storage box is deep enough to allow the use of a narrower section with increased depths, there is an opportunity to optimize the cross section. For the current study, several options for cross sections were considered to determine the optimal section. The options include the aforementioned sub-alternatives C1, C2, and C4.

Based on calculated hydraulic capacity, assuming the cross sections are flowing full, and using Manningôs flow factor, each sub-alternative was configured to have a similar hydraulic capacity as summarized in Table 8. Rough preliminary costs were developed for a single representative segment, Segment 1, of each of the sub-alternatives, taking into account the varying box sewer dimensions, and are shown in Table 9.

Table 8
Segment 1 Options – Manning's Flow Factor $A*R_h^{2/3}$

Sub Alt.	Size	Compartment				
		4	3	2	1	Total
Existing	4 @ 9.5ôx 8.25ô	133	133	133	133	532
C1	1 @ 10ôx 18ô 3 @ 9.5ôx 8.25ô	392	133	133	133	791
C2	1 @ 14ôx 16ô 2 @ 9.25ôx 8.25ô	539		133	133	805
C4	2 @ 9.5ôx 10ô 2 @ 9.5ôx 12ô	172	172	218	218	781

A = Area, ft^2
R_h= Hydraulic Radius, ft

Table 9
Segment 1 Preliminary Cost

Sub Alternative	Construction Cost $M	Percent Increase %
Existing	ï	ï
C1	$28	ï
C2	$31	11
C4	$49	75

This rough preliminary cost exercise shows that, of the C sub-alternatives, the expansion of a single compartment of the Division Street sewer is very comparable to the expansion of two compartments. In contrast, sub-alternative C4 was eliminated based on cost. Sub-alternatives C1 and C2 are similar enough to be considered the same for the purposes of alternatives analysis. From this point on, any reference to sub-alternative C1 will also apply to sub-alternative C2. Further differentiation between these two sub-alternatives is outside the scope of this report and will be covered in the Conceptual Engineering phase, should this sub-alternative emerge as the highest ranked alternative.

Table 10 shows the eliminated C sub-alternative, with a brief summary of supporting rationale.

Table 10
Eliminated C Sub-Alternative

Alternative Category		Reason for Elimination
Sub-Alternative	Length (LF)	
C. Division Street Sewer Expansion		
C4 ï Expand four compartments	5,070	Least cost effective, costing an additional $21 M (75%) more than sub-alternative C1 to achieve an equivalent hydraulic capacity. Construction footprint is also greater than C1.

LF = linear feet

Preliminary alternative-specific scorecards, developed to compare hydraulic modeling results, are provided in Appendix G.1. Updated scorecards, developed to further refine the alternatives brought forward to alternatives analysis, are provided in Appendix G.2. Basis of cost estimate for the box expansion alternatives are provided in Appendix H.

Sub-alternative C1, Expand One Compartment, will be carried forward to alternatives analysis. Note that Sub-alternative C2 is considered similar enough to Sub-alternative C1 that both can be carried forward; however, the text will only refer to Sub-alternative C1 from this point on. Figure 20 shows the geologic plan and profile for Sub-alternative C1.

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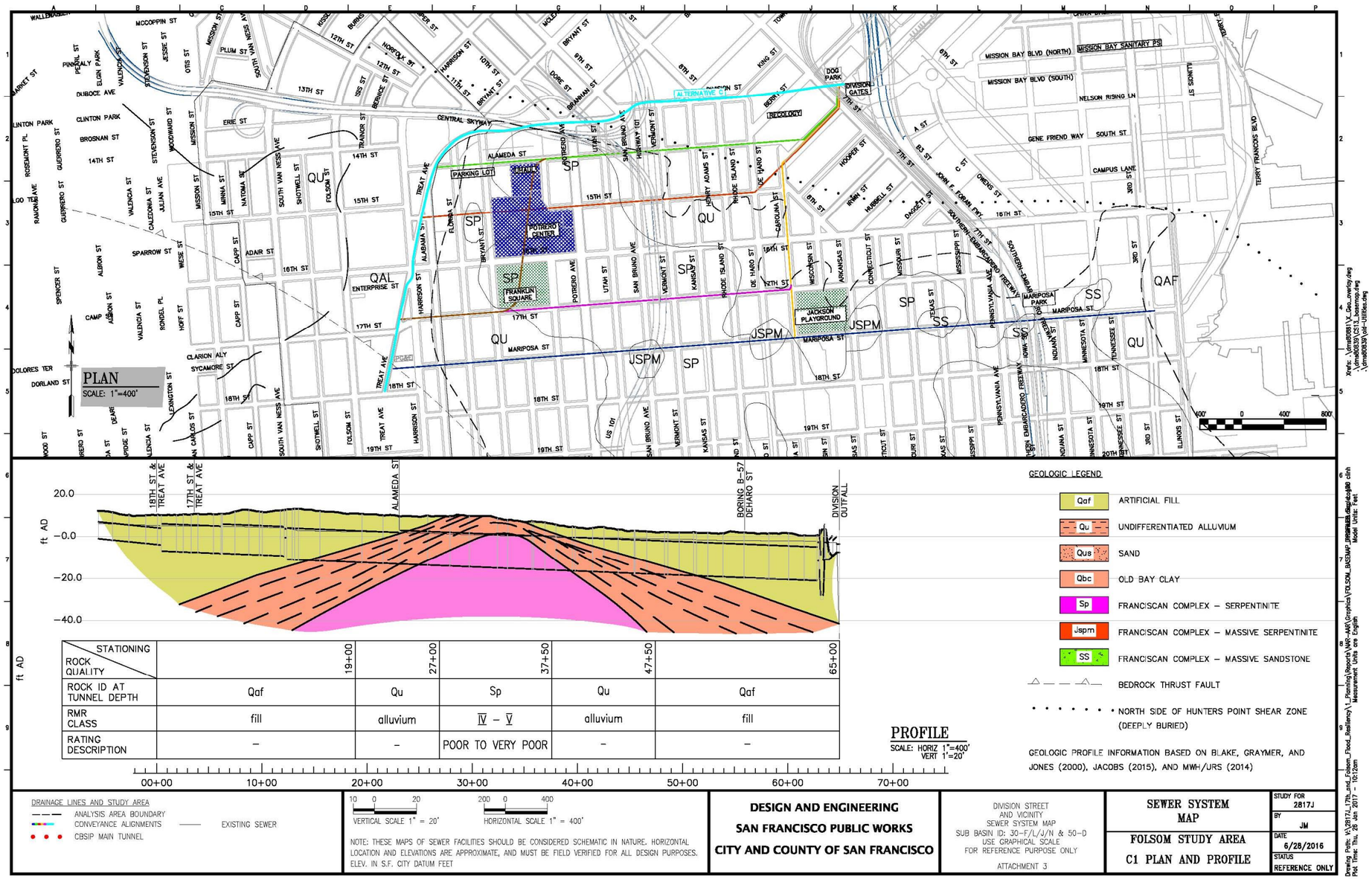
Figure 20
Sub-alternative C1 Geologic Plan and Profile



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3.6.5 Screening of D-Alternatives – Storage Facility [6]

The project team conducted screening of the D-alternatives, considering storage options to meet the performance criteria. The information to narrow the sub-alternatives down to one single D alternative to carry forward is presented here.

Based on preliminary hydraulic modeling, Table 11 presents the optimal size of the detention tanks required to most closely achieve the stated freeboard requirements in the study area. Not all sub-alternatives were able to meet the freeboard requirements. Detention tank(s) are preliminarily located near 14th/Folsom Streets and 17th/Folsom Streets. The possible detention locations shown on Figure 8 were narrowed down to five locations based on field reconnaissance to determine feasibility. These locations are shown in Figure 21, which includes the parking lots belonging to Best Buy, Comcast, Foods Co, OfficeMax, and PG&E. Further real estate acquisition analysis is needed to determine site feasibility, and will be completed should a detention tank alternative emerge as the highest ranked alternative.

The incoming pipe to the detention tank has been designed to act as both a weir and a conveyance structure. All detention tanks were designed to drain using pumping because gravity drainage was not feasible due to the small change in grade throughout the study area. The pumping system has been designed to empty the detention tank in 24 hours. Pumped flow would reenter the combined sewer system through proposed connecting pipes.

Table 11
Hydraulic Performance of D Sub-Alternatives

Detention Sub-Alternative	Detention Tank Location	Tank Volume (MG)	# of Nodes Not Meeting Freeboard
Baseline	ï	ï	138
D1 ï Centralized Storage	17th and Folsom	12.8	25
D2 ï Centralized Storage with Minor Components	17th and Folsom	12.8	0
D3 ï Distributed Storage	17th and Folsom, 14th and Folsom	2.3 3.0	39
D4 ï Distributed Storage with Minor Components	17th and Folsom, 14th and Folsom	2.3 3.0	0

Sub-alternatives were initially filtered based on the minimum freeboard requirement for nodes within the study area. As a result, D1 and D3 were eliminated because freeboard was not met for 25 nodes and 39 nodes, respectively, within the project area (Table 11).

Sub-alternative D2 is eliminated due to the large size that would be required for the detention tank. A 12.8 million gallon detention tank near 17th and Folsom Streets would require roughly half of a City block, approximately 300 feet x 300 feet, at a depth of more than 30 feet. The project team deemed it highly unlikely that such a detention tank could

[6] Although D-alternatives are storage options, analyses were performed to gauge effectiveness of storage solutions along with additional conveyance components (the minor components).

be sited and constructed within the 17th and Folsom Street area, which is densely populated and only has small open spaces available for construction.

The eliminated D sub-alternatives are shown in Table 12 with a brief summary of supporting rationale.

Table 12
Eliminated D Sub-Alternatives

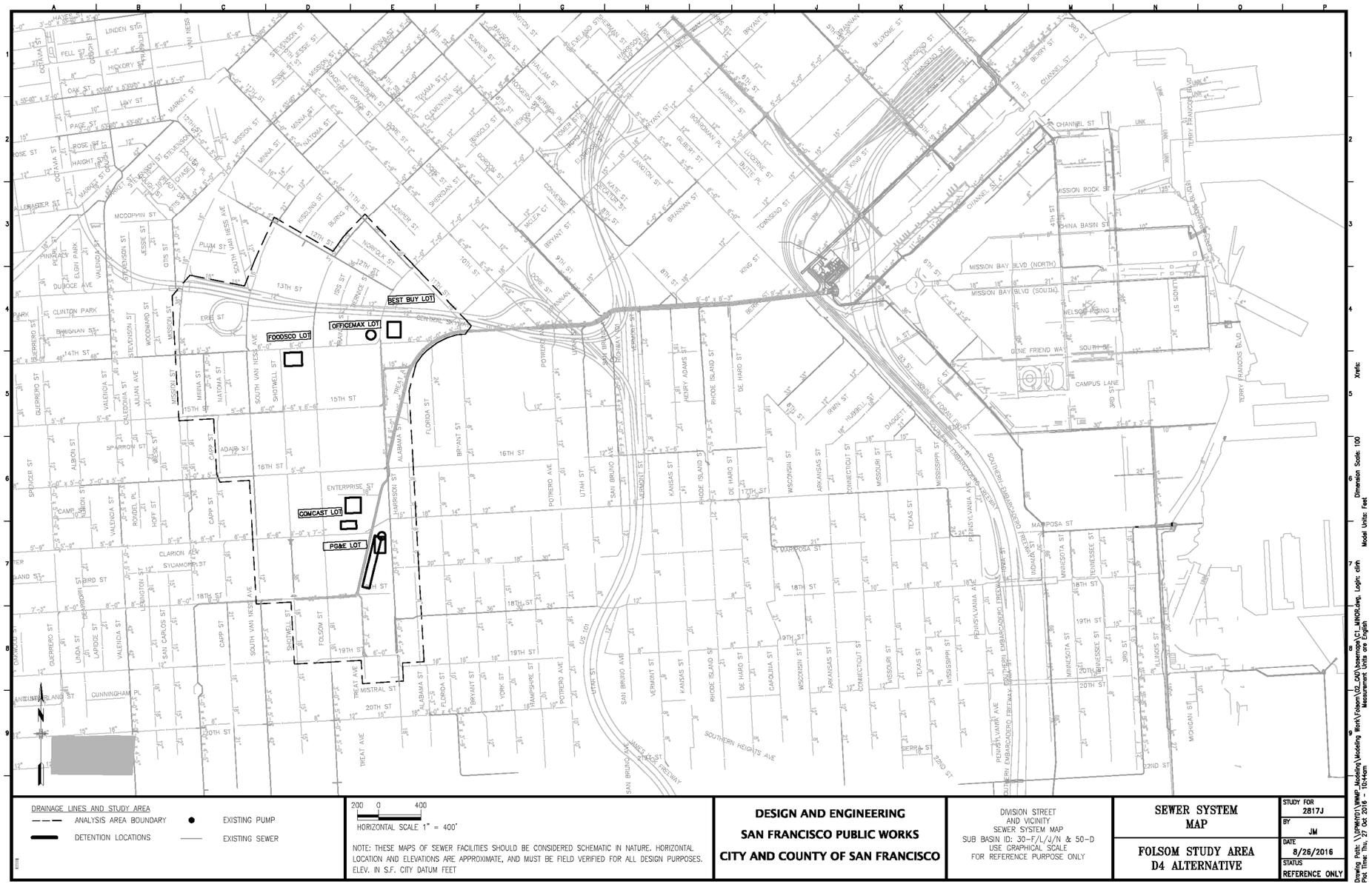
Alternative Category	Reason for Elimination
Sub-Alternative	
D. Storage Facility	
D1 ï Centralized Storage	12.8 million gallon tank is too large for any site. Does not meet the freeboard performance objective.
D2 ï Centralized Storage with Minor Components	12.8 million gallon tank is too large for any site.
D3 ï Distributed Storage	Does not meet the freeboard performance objective.

Sub-alternative D4, distributed storage, supplemented with the minor components, was able to manage the majority of flooding in the 17th and Folsom study area. A 2.3 million gallon tank would be located between Folsom Street and Shotwell Street south of 17th Street to detain the peak flow before entering the Treat Avenue sewer. In addition, a second 3.0 million gallon tank south of 14th Street between Folsom Street and Shotwell Street at the Foods Co parking lot would relieve the trunk lines at 14th Street and 15th Street that are overwhelmed in the LOS storm.

Preliminary alternative-specific scorecards, developed to compare hydraulic modeling results, are provided in Appendix G.1. Updated scorecards, developed to further refine the alternatives brought forward to alternatives analysis, are provided in Appendix G.2. Cost estimates for the storage alternatives are provided in Appendix I.

Sub-alternative D4, Distributed Storage with Minor Components, will be carried forward to alternatives analysis.

Figure 21
Possible Detention Locations



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3.7 Remaining Alternatives

Alternatives being carried forward to alternatives analysis (one from each category) are shown in Table 13.

Table 13
Alternatives for Analysis

Alternative	Size
A ï CBSIP Connector Tunnel	9.5-foot ID 6,450 LF
B1/B1a ï Alameda Street Tunnel	12-foot ID 4,200 to 5,100 LF
C1 ï Expand One Compartment of Division Street Box Sewer	20-foot depth 5,070 LF
D4 ï Distributed Storage with Minor Components	2.3 MG and 3.0 MG

ID = inside diameter; LF = linear feet; MG = million gallons

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4.0 ALTERNATIVE ANALYSIS

4.1 Introduction

The remaining alternatives, one from each family of sub-alternatives, were further analyzed against each other to compare relative advantages and limitations.

4.2 Alternatives for Analysis

The following is a brief recap of the alternatives brought forward for alternatives analysis.

4.2.1 Alternative A – Connector Tunnel with CHTL

The connector tunnel alignment would follow the Mariposa Street ROW to Jackson Playground, turn and cross under Jackson Playground to 17th Street, and continue to 17th Street at Treat Avenue. It would connect to the CHTL on Indiana Street at a junction and drop structure shaft.

Alternative	Size
A ï CBSIP Connector Tunnel	9.5-foot ID 6,450 LF

ID = inside diameter; LF = linear feet

4.2.2 Alternative B1/B1a – Tunnel without CHTL

Tunnel alignment runs mainly along Alameda Street, starting at the intersection of Treat and Alameda Streets, and connecting to the downstream end of the Division Street Sewer near 7th and Berry Streets. The final portion of sewer infrastructure may be constructed via cut-and-cover if site availability issues arise.

Alternative	Size
B1/B1a ï Alameda Street Tunnel	12-foot ID 4,200 LF to 5,100 LF

ID = inside diameter; LF = linear feet

4.2.3 Alternative C1 – Division Street Sewer Expansion, Expand One Compartment

The existing box sewer would be expanded from the intersection of Treat and Alameda Streets, along Division Street, to the Channel Transport/Storage Box near the intersection of 7th and Berry Streets. The Division Street Sewer has two compartments between 15th/Alameda Streets and 10th/Division Streets, and four compartments between 10th/Division Streets and the outfall near 7th/Berry Streets.

Alternative	Size
C1 ï Expand One Compartment of Division Street Box Sewer	20-foot height 5,070 LF

LF = linear feet

4.2.4 Alternative D4 – Storage Facility, Distributed Storage with Minor Components

Distributed storage supplemented with the minor components was able to manage the majority of flooding in the 17th and Folsom study area. One tank was located between Folsom Street and Shotwell Street south of 17th Street. This tank at 2.3 million gallons detains the peak flow before entering the Treat Avenue Sewer. The second tank is placed south of 14th Street between Folsom Street and Shotwell Street at the Foods Co parking lot. This tank, sized at 3.0 million gallons, relieves the trunk line at 14th Street and 15th Street that is overwhelmed in the LOS storm.

Alternative	Size
D4 ï Distributed Storage with Minor Components	2.3 MG and 3.0 MG

MG = million gallons

4.3 Minor Components

The minor components integral to each of the alternatives for alternatives analysis are detailed below, summarized in Table 14, and shown in Figure 22.

Treat Avenue

Required as a minor component for Alternative B1/B1a, and is already encompassed in the major component of Alternative C1. Deepens existing box sewer on Treat Avenue from 16th Street to Alameda Street from 8.25ôhigh to 12ôhigh. This minor component improves conveyance from the 17th and Folsom area to the Division Street sewers.

15th Street

Integral to Alternatives A, B1/B1a, and C1. Upsizes approximately 1,000 linear feet (LF) of existing sewer on 15th Street from Shotwell Street to Mission Street from 66 inches and 72 inches to 72 inches and 78 inches. This minor component addresses flooding locations in the northern portion of the analysis area by improving conveyance to Harrison Street along 15th Street.

Harrison Street

Integral to all alternatives. Upsizes approximately 1,200 LF of existing 3-foot 0-inch x 5-foot 0-inch sewer on Harrison Street from 16th Street to 19th Street.

Alternative A replaces the existing sewer with a 54-inch circular sewer. Alternatives B1/B1a, C1, and D4 replaces the existing sewer with a box sewer having a width of 108 inches and a height that varies from 6 feet to 8 feet. This minor component provides relief to the Treat Avenue sewer and improves conveyance from the 17th and Folsom area to the Division Street sewers.

18th Street

Integral to all alternatives. Upsize, to various sizes, approximately 900 LF to 1,200 LF of the 90-inch sewer and 60-inch auxiliary sewer on 18th Street from Harrison Street to Shotwell Street. This minor component addresses flooding in the analysis area by improving conveyance on 18th Street to the Harrison Street sewer.

17th Street

Integral to all alternatives. Specific upgrade requirements vary by alternative. Alternative A requires modifying or upsizing 650 LF of existing sewer on 17th Street from Folsom Street to South Van Ness Avenue to various sizes. Alternatives B1/B1a and C1 requires constructing 220 LF of new 90-inch sewer between the intersection of 17th and Harrison Streets and 17th Street and Treat Avenue. Alternative D4 requires constructing 220 LF of new 84-inch sewer between the intersection of 17th and Harrison Streets and 17th Street and Treat Avenue. This minor component improves conveyance and provides relief to the Treat Avenue sewer.

14th Street

Integral to all alternatives. Upsizes approximately 1,200 LF of existing sewers on 14th Street from Harrison to Folsom Streets and approximately 600 LF of existing sewers on 14th Street from South Van Ness Avenue to Valencia Street. Upsizes the existing 75-inch sewer to an 84-inch sewer and the existing 3-foot 6-inch x 5-foot 3-inch brick sewer to a 66-inch sewer. Also adds an additional weir at Harrison and 14th Streets. This minor component improves conveyance to the Division Street dual-compartment sewer.

12th Street Reroute

Integral to all alternatives. Constructs 1,050 LF of new 48-inch sewer to convey flow from the intersection of 12th and Folsom Streets to the intersection of 11th and Harrison Streets.

This minor component addresses flooding in the analysis area by diverting flows from the intersection of 12th and Folsom Streets to the North Point Main at Harrison and 11th Streets, where the 11th Street reroute project can provide additional conveyance onto the Division Street sewer.

11th Street Reroute

Integral to all alternatives. Constructs 850 LF of new 75-inch sewer to convey flow from the intersection of Harrison and 11th Streets to the Division Street Sewer east of the intersection of Bryant and Division Streets. This minor component improves conveyance by diverting flow from the North Point Main at Harrison and 11th Streets onto the Division Street sewers

General Upsizing

Integral to all alternatives. Upsizes various sewers throughout the analysis area smaller than 30 inches to address localized areas not meeting LOS.

Secondary

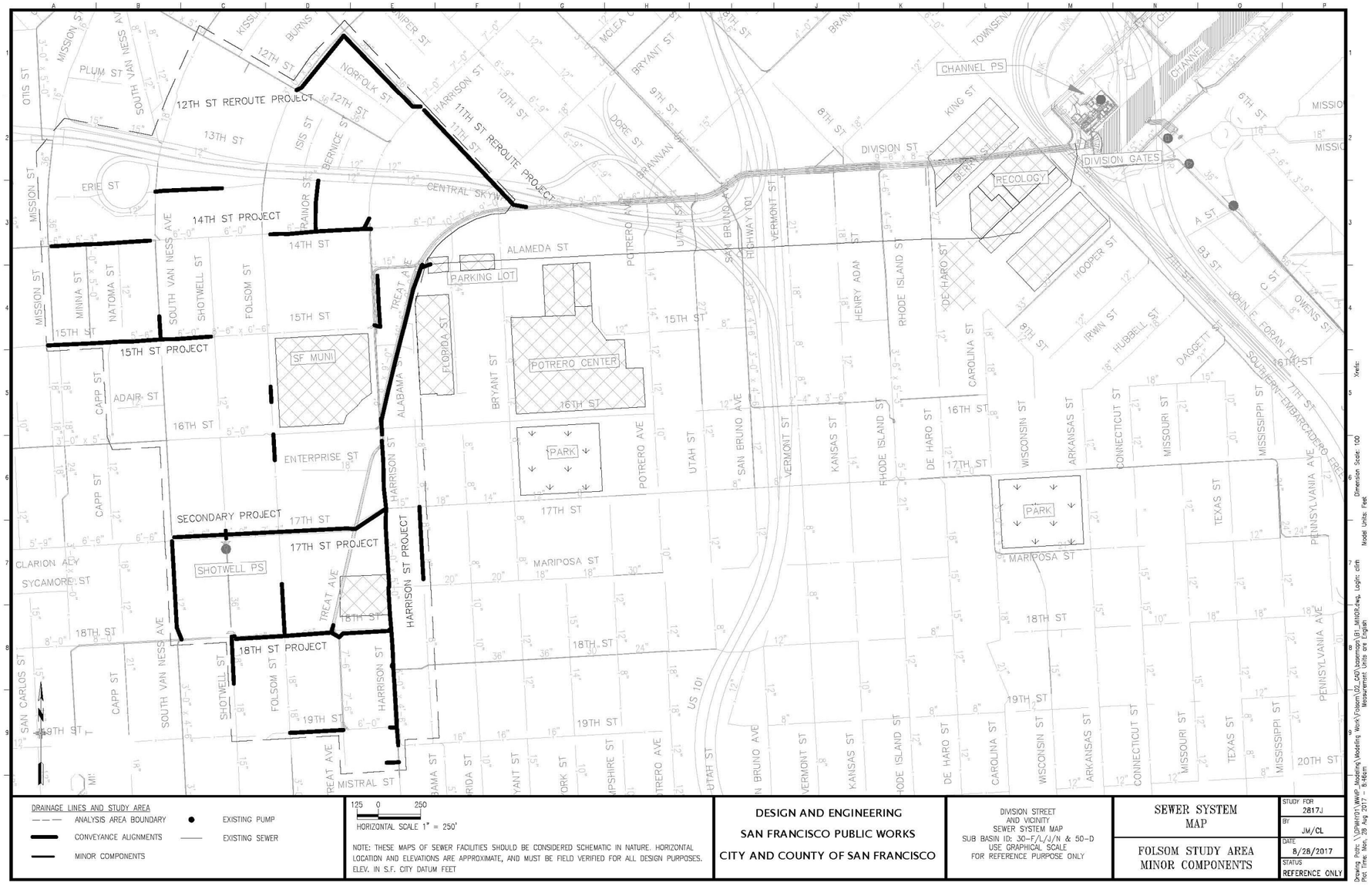
Integral to Alternatives A, B1/B1a, and C1. Specific upgrade requirements vary by alternative. Alternative A requires constructing 1,260 LF of 78-inch auxiliary sewer on 17th Street from Treat Avenue to South Van Ness Avenue. Alternative B1/B1a requires constructing 1,100 LF of 102-inch auxiliary sewer on 17th Street from Treat Avenue to South Van Ness Avenue. Alternative C1 requires constructing 1,100 LF of 72-inch auxiliary sewer on 17th Street from Treat Avenue to South Van Ness Avenue. All conveyance alternatives require upsizing the 15-inch headend sewer on South Van Ness Avenue from 17th Street to 18th Street to 42 inches and requires a new 36-inch sewer to divert flows from 18th Street at the South Van Ness intersection. This minor

component distributes flow between 17th Street and 18th Street and improves conveyance to the respective alternatives main project element.

Table 14
Minor Components

Minor Component	A	B1/B1a	C1	D4
Treat Avenue		X		
15th Street	X	X	X	
Harrison Street	X	X	X	X
18th Street	X	X	X	X
17th Street	X	X	X	X
14th Street	X	X	X	X
12th Street Reroute	X	X	X	X
11th Street Reroute	X	X	X	X
General Upsizing	X	X	X	X
Secondary	X	X	X	

Figure 22
Minor Components



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4.4 Evaluation Criteria

Expanding on the previous screening process, alternatives are analyzed, evaluated, and a highest-ranking alternative is selected based on the following criteria:

- **Present Ownership**: This assessment considers current ownership, identifying the party that would need to be contacted for easement and property needs. This criterion is assigned an importance factor[7] of 1, representing lower importance, based on discussions with management.
    - A (+1) rating indicates that land needed for construction and/or final layout of facilities is completely within the City ROW.
    - A (0) rating indicates that land needed for construction and/or final layout of facilities is completely within the City ROW but is under the jurisdiction of a non-SFPW, non-SFPUC agency, and may require an encroachment permit.
    - A (-1) rating indicates that land needed for construction and/or final layout of facilities is within private property and requires negotiations with third parties.
- **Site Availability/Acquisition**: This assessment considers the easement and property rights considerations for construction of the alternative. This criterion is assigned an importance factor of 1, representing lower importance, based on discussions with management.
    - A (+1) rating indicates that only temporary land acquisition is needed and/or that availability is not expected to be an issue.
    - A (0) rating indicates that temporary and permanent land acquisition is required and that availability is not expected to be an issue.
    - A (-1) rating indicates that permanent land acquisition is required and/or that availability is expected to be a significant issue.
- **Potential Utility Concerns**: This assessment considers the extent of utilities and underground infrastructure that would be encountered for each alternative. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
    - A (+2) rating indicates that minor underground utility or infrastructure are present that do not adversely affect the alternative selection or are easily mitigated.
    - A (0) rating indicates that major underground utility or infrastructure are present and will need to be mitigated.
    - A (-2) rating indicates that major underground infrastructure is present and either will be challenging to mitigate or cannot be mitigated.
- **Preliminary Geological Conditions**: This assessment considers site soil conditions as they pertain to excavation and shoring, such as groundwater level,

[7] Importance factor - 3 = more important, 2 = neutral, 1 = less important

soil stability, and liquefaction potential. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.

- A (+2) rating indicates a significantly better geological condition relative to the other alternatives.
- A (0) rating indicates no significant differences in geological conditions relative to the other alternatives.
- A (-2) rating indicates a significantly worse geological condition relative to the other alternatives.

- **Future Impact**: This assessment considers potential impact on future development of the area. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates that there are no impacts to the future development of the area.
  - A (0) rating indicates that there will be mitigable impacts to the future development of the area.
  - A (-2) rating indicates that there will be significant, non-mitigable, impacts to the future development of the area.
- **Traffic Impact**: This assessment considers how construction of an alternative may temporarily affect traffic in the vicinity. Traffic considerations include vehicular traffic, public transportation (MUNI buses), and local access to driveways and sidewalks. This criterion is assigned an importance factor of 3, representing higher importance, based on discussions with management.
  - A (+3) rating indicates minor impacts on traffic.
  - A (0) rating indicates major, but mitigable, impacts on traffic.
  - A (-3) rating indicates major, and non-mitigable, impacts on traffic.
- **Potential Environmental Impact**: This assessment considers hazardous materials that may be encountered during the construction of each alternative. This criterion is assigned an importance factor of 3, representing higher importance, based on discussions with management.
  - A (+3) rating indicates relatively low amount of hazardous materials expected during construction.
  - A (0) rating indicates an average amount of hazardous materials expected during construction.
  - A (-3) rating indicates a relatively high amount of hazardous materials expected during construction.
- **Hydraulic Performance – Flooding, LOS Storm**: This assessment confirms whether the alternative meets the performance criteria of two feet of freeboard in a LOS storm within the project area for a conveyance option, or zero feet of freeboard in a LOS storm within the project area for a storage option, excluding

outliers. This criterion is given an importance factor of 3, representing higher importance, based on discussions with management.

- A (+3) rating indicates that the alternative meets the performance criteria, excluding outliers.
- A (-3) rating indicates that the alternative does not meet the performance criteria.

- **Hydraulic Performance – Flooding, Higher Recurrence Interval Storms:** This assessment considers the performance of the alternative in a series of higher recurrence interval storms indicated by the Annualized Flood Volume Index[8]. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates that the alternative performs considerably better than the average of all alternatives.
  - A (0) rating indicates that the alternative performs on par with the average of all alternatives.
  - A (-2) rating indicates that the alternative performs considerably worse than the average of all alternatives.
- **Hydraulic Performance – CSDs:** This assessment considers the impacts of the alternative on CSD performance during a typical-year analysis as described in Subsection 3.2.5. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates that CSD performance is positively impacted.
  - A (0) rating indicates that the alternative has negligible impact on CSD performance.
  - A (-2) rating indicates that CSD performance is negatively impacted.
- **Maintenance**: This assessment considers potential issues with accessing, inspecting, and maintaining the newly constructed facilities in the future. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates that there are no additional maintenance needs relative to current practices.
  - A (0) rating indicates that there are additional maintenance needs but no significant differences in access or maintenance relative to current practices.
  - A (-2) rating indicates significantly more maintenance needs and includes more difficult access or more complex maintenance relative to current practices.
- **Constructability**: This assessment considers the feasibility and difficulty of construction for each alternative, including footprint and staging needs. This

[8] Annualized Flood Volume Index is described further in Subsection 4.5.9 on page 74.

criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.

- A (+2) rating indicates a significantly simpler construction relative to other alternatives.
- A (0) rating indicates no significant differences in constructability relative to other alternatives.
- A (-2) rating indicates a significantly more difficult construction relative to other alternatives.

- **Construction Cost**: This assessment highlights the potential difference in costs between alternatives. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates an estimated construction cost that is less than 70% of the average cost of the alternatives.
  - A (0) rating indicates an estimated construction cost that is between 70% and 130% of the average cost of the alternatives.
  - A (-2) rating indicates an estimated construction cost that is greater than 130% of the average cost of the alternatives.
- **Construction Duration:** This assessment highlights the potential construction duration of the alternatives. This criterion is assigned an importance factor of 2, representing neutral importance, based on discussions with management.
  - A (+2) rating indicates an estimated construction duration that is less than 70% of the average duration of the alternatives.
  - A (0) rating indicates an estimated construction duration that is between 70% and 130% of the average duration of the alternatives.
  - A (-2) rating indicates an estimated construction duration that is greater than 130% of the average duration of the alternatives.
- **Synergistic Opportunities:** This criteria considers the synergistic opportunities of the alternative with other upcoming SFPUC and non-SFPUC efforts. This criterion is assigned an importance factor of 1, representing lower importance, based on discussions with management.
  - A (+1) rating indicates synergistic opportunities are available with other upcoming efforts.
  - A (0) rating indicates minimal synergistic opportunities with other upcoming efforts.
  - A (-1) rating indicates that the alternative relies on the implementation of a separate project to be fully functional.

4.5 Evaluation Approach and Alternatives Analysis

Table 15 serves as the basis for determining the highest ranked alternative. This table presents a qualitative evaluation of the main components of each alternative (excluding the minor components) against each of the screening criteria discussed in

Subsection 4.4. The summary section, located at the end of Table 15, highlights key aspects of each criterion, providing qualitative ratings of (+1), (0), and (-1) to indicate whether the alternative is advantageous, neutral, or disadvantageous, respectively, compared to the other alternatives for that criterion. Net ratings are summed based on an importance factor, where each criterion is adjusted based on a factor, prior to summing the individual ratings. The importance factor of each criterion is based on feedback from management at various meetings.

The following subsections in this chapter provide additional analysis beyond what is contained in Table 15.

4.5.1 Present Ownership

Alternative A: Most of the tunnel alignment runs in the public ROW. The only permanent easement required is through Jackson Playground which is under the Recreation and Park Departmentôs jurisdiction. Construction easements for staging would be required under private ownership. This alternative receives a (0) rating for this criterion.

Alternative B1/B1a: Most of the tunnel alignment runs in the public ROW. A permanent easement is required because the alignment passes beneath the parking lots of two private properties near Alameda and Bryant Streets. Construction easements for staging will be required and are under private ownership. This alternative receives a (-1) rating for this criterion.

Alternative C1: Entirety of box sewer alignment is within the public ROW and existing sewer easements. This alternative receives a (+1) rating for this criterion.

Alternative D4: Entirety of possible detention tank locations is under private ownership. This alternative receives a (-1) rating for this criterion.

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Table 15
Evaluation Matrix

	Alternative A: **Connector Tunnel with CBSIP**	**Alternative B1/B1a:** **Connector Tunnel w/o CBSIP**	**Alternative C1/C2:** **Division Box Sewer Expansion**	**Alternative D4:** **Distributed Storage with Minor Components**
PROJECT SCOPE	9.5' inside diameter tunnel 6,450 LF Launching shaft Receiving shaft	4,200 LF of 12' inside diameter tunnel or 3,500 LF of 12' inside diameter tunnel and 1,600 LF cut-cover Launching shaft Receiving shaft Junction structure	Expand 5,070 linear feet of one or two compartment(s) of Division Street Sewer	Construct 2.3 MG detention tank Construct 3.0 MG detention tank Construct 2.3 MGD pump station Construct 3.0 MGD pump station
Method of Construction	Tunnel	Tunnel or Tunnel and Cut-and-cover installation	Cut and cover installation	Cut and cover installation
SCREENING CRITERIA				
Present Ownership (Importance Factor = 1)	Mostly public right-of-way; one easement location (Jackson Playground) owned by City agency. Private ownership of specific staging areas. (0)	Mostly public right-of-way; however, tunnel alignment does pass through private property. Private ownership of specific staging areas. (-1)	Public right-of-way. (+1)	Private property. (-1)
Site Availability / Acquisition (Importance Factor = 1)	Construction and Permanent Easement acquisition is needed at Jackson Playground (City property); temporary construction easement for staging expected. However, previous discussions with Recreation and Park Department regarding Jackson Playground were not successful. (-1)	Construction and Permanent Easement acquisition is needed in private property, however, current land is used as parking facility. (0)	Since existing infrastructure is in public right-of-way, no acquisition is expected. (+1)	Sited at two of various parking lots; one near 14th/Folsom and one near 17th/Folsom. Site acquisition for construction and permanent easements will be required and essential; availability and cost will be determined by real estate analysis but is expected to be difficult and costly. (-1)
Potential Utility Concerns (Importance Factor = 2)	Excavation and utility concerns only at launching and receiving shafts; no utilities expected at tunnel depth. (+2)	Excavation and utility concerns only at launching and receiving shafts; no utilities expected at tunnel depth. (+2)	Largest excavation footprint leading to higher chance of utility conflicts. However, work is mostly within footprint of existing infrastructure so utility facilities should not be of major concern. (0)	Majority of construction within private property; least utility concerns (+2)
Preliminary Geological Conditions (Importance Factor = 2)	The alignment is deep and long through difficult geology. The Franciscan rock complex is subject to squeezing ground. (-2)	Alignment is relatively shallow compared to other tunneling alternatives, and the tunneling conditions are in soil on the flanks at the shaft locations and through the Franciscan serpentinite rock at the core. (0)	Geologic condition is not a concern due to expansion of existing facility that is already on piles, and relatively shallower depth of excavation. (+2)	Possible locations for the storage tanks are in or near fill areas. (0)
Future Impact (Importance Factor = 2)	Limited impact to development at easement locations; however, connection point near 7th and Berry Streets will be highly congested with the current DTX project (aboveground) and the future HSR project (subsurface). (0)	Limited impact to development at easement locations; however, connection point near 7th and Berry Streets will be highly congested with the current DTX project (aboveground) and the future HSR project (subsurface). (0)	No future impacts expected. (+2)	Future development of sites will be impacted, and will likely precluded certain types of development. (-2)
Traffic Impact (Importance Factor = 3)	Traffic impacts expected only at shaft locations. (+3)	Traffic impacts expected only at shaft locations and possible cut-and-cover locations. (0)	Largest excavation footprint; most traffic impact. (-3)	Majority of construction within private property; minimal traffic impact. (+3)

	Alternative A: **Connector Tunnel with CBSIP**	**Alternative B1/B1a:** **Connector Tunnel w/o CBSIP**	**Alternative C1:** **Division Box Sewer Expansion**	**Alternative D4:** **Distributed Storage with Minor Components**
Potential Environmental Impact (Importance Factor = 3)	California Class I Non-RCRA hazardous soil expected; mitigation measures necessary for dust, run off, and noise. Relatively small excavation footprint at shafts only. (+3)	California Class I Non-RCRA hazardous soil expected; mitigation measures necessary for dust, run off, and noise. Relatively small excavation footprint at shafts only. (+3)	California Class I Non-RCRA hazardous soil expected; mitigation measures necessary for dust, run off, and noise. Largest excavation footprint; potential to disturb largest amount of soil. (-3)	California Class I Non-RCRA hazardous soil expected; mitigation measures necessary for dust, run off, and noise. Smallest excavation footprint; potential to disturb smallest amount of soil. (+3)
Hydraulic Performance - Flooding, LOS Storm (Importance Factor = 3)	Meets stated goals of two feet of freeboard within study area, and "do no worse" outside of study area. (+3)	Meets stated goals of two feet of freeboard within study area, and "do no worse" outside of study area. (+3)	Meets stated goals of two feet of freeboard within study area, and "do no worse" outside of study area. (+3)	Meets stated goals of zero feet of freeboard for storage components and two feet of freeboard for conveyance components. (+3)
Hydraulic Performance - Flooding, Higher Recurrence Interval Storms (Importance Factor = 2)	Sensitivity to 10, 25, 50 and 100 year storms expressed as the Annualized Flood Volume Index. Flood Index of 1.64 is on par with the average of all alternatives. (0)	Sensitivity to 10, 25, 50 and 100 year storms expressed as the Annualized Flood Volume Index. Flood Index of 1.03 is better than the average of all alternatives. (+2)	Sensitivity to 10, 25, 50 and 100 year storms expressed as the Annualized Flood Volume Index. Flood Index of 1.29 is on par with the average of all alternatives, however, synergistic opportunities can improve this. (+2)	Sensitivity to 10, 25, 50 and 100 year storms expressed as the Annualized Flood Volume Index. Flood Index of 3.50 is worse than the average of all alternatives. (-2)
Hydraulic Performance – CSDs (Importance Factor = 2)	Alternative shows a 22.7% reduction in CSD volumes and a reduction of two CSD activation counts; however this improvement is likely due to the CHTL*. (+2)	Alternative shows a 3.2% reduction in CSD volumes. (+2)	Alternative shows a 2.4% reduction in CSD volumes. (+2)	Alternative shows negligible impact to CSD volumes. (0)
Maintenance (Importance Factor = 2)	New tunnel facility; maintenance is required and needs to be accounted for. Downstream end of tunnel is significantly deeper than other alternatives. (-2)	New tunnel facility; maintenance is required and needs to be accounted for. (0)	Expansion of existing facility; no change to existing maintenance processes. (+2)	Flushing and maintenance of pump station necessary. (-2)
Constructability (Importance Factor = 2)	Longer and deeper tunnel, tie-in to CBSIP will be deep shaft (-2)	Shorter tunnel, relatively shallow tie-in. Downstream tie-in may be difficult due to existing and upcoming facilities, including HSR, DTX, and CBSIP. (0)	Expansion of existing box sewer will be undertaken via cut-and-cover operations at a relatively shallow depth. Construction work will have to occur below the freeway, but this has been done in other areas of the City. (+2)	Detention tank depths range from 10' to 75'. However, since construction is limited to two properties, the issues that could arise are also limited. (+2)
Construction Cost[9] (Importance Factor = 2)	$97.3 M (0)	$132.2 M (0)	$124.4 M (0)	$64.0 M (+2)
Construction Duration (Importance Factor = 3)	26 months (0)	23 months (0)	45 months (-3)	33 months (includes 9 month easement acquisition) (0)
Synergistic Opportunities (Importance Factor = 1)	Alternative relies on the construction and activation of CBSIP tunnel and pump station elements before it can be activated. (-1)	No known synergistic opportunities. (0)	Synergistic with floodway construction and Unity Boulevard vision. Floodway construction could reduce the Flood Index (performance in higher-recurrence-interval storms). (+1)	No known synergistic opportunities. (0)

CBSIP = Central Bayside System Improvement Project; CSD = combined sewer discharge; DTX = Downtown Extension; HSR = High-Speed Rail; LF = linear feet; LOS = level of service; MG =million gallons; MGD = million gallons per day; RCRA = Resource Conservation and Recovery Act

[9] Excludes property acquisition

	Importance Factor	**Alternative A: Connector Tunnel with CBSIP**	**Alternative B1/B1a: Connector Tunnel w/o CBSIP**	**Alternative C1: Division Box Sewer Expansion**	**Alternative D4: Distributed Storage with Minor Components**
Commentary	1	Present Ownership (0)	Present Ownership (-1)	Present Ownership (+1)	Present Ownership (-1)
	1	Site Availability/Acquisition (-1)	Site Availability/Acquisition (0)	Site Availability/Acquisition (+1)	Site Availability/Acquisition (-1)
	2	Potential Utility Concerns (+2)	Potential Utility Concerns (+2)	Potential Utility Concerns (0)	Potential Utility Concerns (+2)
	2	Preliminary Geologic Conditions (-2)	Preliminary Geologic Conditions (0)	Preliminary Geologic Conditions (+2)	Preliminary Geologic Conditions (0)
	2	Future Impact (0)	Future Impact (0)	Future Impact (+2)	Future Impact (-2)
	3	Traffic Impact (+3)	Traffic Impact (0)	Traffic Impact (-3)	Traffic Impact (+3)
	3	Potential Environmental Impact (+3)	Potential Environmental Impact (+3)	Potential Environmental Impact (-3)	Potential Environmental Impact (+3)
	3	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)	Hydraulic Performance - Flooding, LOS Storm (+3)
	2	Hydraulic Performance - Flooding, Sensitivity (0)	Hydraulic Performance - Flooding, Sensitivity (+2)	Hydraulic Performance - Flooding, Sensitivity (+2)	Hydraulic Performance - Flooding, Sensitivity (-2)
	2	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (+2)	Hydraulic Performance - CSDs (0)
	2	Maintenance (-2)	Maintenance (0)	Maintenance (+2)	Maintenance (-2)
	2	Constructability (-2)	Constructability (0)	Constructability (+2)	Constructability (+2)
	2	Construction Cost (0)	Construction Cost (0)	Construction Cost (0)	Construction Cost (+2)
	3	Construction Duration (0)	Construction Duration (0)	Construction Duration (-3)	Construction Duration (0)
	1	Synergistic Opportunities (-1)	Synergistic Opportunities (0)	Synergistic Opportunities (+1)	Synergistic Opportunities (0)
Weighted Rating (IF)		**Net Rating: +5**	**Net Rating: +11**	**Net Rating: +9**	**Net Rating: +7**

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4.5.2 Site Availability/Acquisition

Alternative A: Construction and permanent easements are required for this alignment. Tunnel alignment runs through Jackson Playground, where previous discussions regarding the use of the playground for the CBSIP project proved unsuccessful. This alternative receives a (-1) rating for this criterion.

Alternative B1/B1a: Construction and permanent easements are required for this alignment. Tunnel alignment runs through the parking lots of two private properties. Due to the current land use and relatively small size of subsurface easement, permanent easement discussions are not expected to be a significant issue. This alternative receives a (0) rating for this criterion.

Alternative C1: No property acquisition is required for this alternative. This alternative receives a (+1) rating for this criterion.

Alternative D4: Property acquisition is required and essential for this project and is likely a significant hurdle to this alternative. This alternative receives a (-1) rating for this criterion.

4.5.3 Potential Utility Concerns

Alternative A: The only areas with utility concerns are at the shaft locations because utilities are not expected at the depth of the tunnel profile. With proper planning and communications, utility issues can be mitigated. This alternative receives a (+2) rating for this criterion.

Alternative B1/B1a: The only areas with utility concerns are at the shaft locations because utilities are not expected at the depth of the tunnel profile. With proper planning and communications, utility issues are mitigable. However, B1a, which includes a portion of cut-and-cover work, would require more utility coordination. This alternative receives a (+2) rating for this criterion.

Alternative C1: Entire alignment consists of cut-and-cover work, leading to more potential for utility conflicts. Because work is mostly within the footprint of existing infrastructure, potential utility conflicts are not as big of a concern as they could be if an all-new alignment was being considered. This alternative receives a (0) rating for this criterion.

Alternative D4: Most construction is within private property, presenting the least utility concerns. This alternative receives a (+2) rating for this criterion.

4.5.4 Preliminary Geological Conditions

Alternative A: Tunnel alignment is deep and long through difficult geology. The Franciscan rock complex is subject to squeezing ground. This alternative receives a (-2) rating for this criterion.

Alternative B1/B1a: Alignment is relatively shallow compared to other tunneling alternatives, and the tunneling conditions are in soil on the flanks at the shaft locations and through the Franciscan serpentinite rock at the core. This alternative receives a (0) rating for this criterion.

Alternative C1: Geologic condition is not a concern due to expansion of an existing facility that is already on piles. Work also requires relatively shallower depth of excavation. This alternative receives a (+2) rating for this criterion.

Alternative D4: Possible locations for the detention tanks are in or near fill areas, which could lead to shoring issues. This alternative receives a (0) rating for this criterion.

4.5.5 Future Impact

Alternative A: This alternative may have minor impacts to future development at the Jackson Playground easement location. This alternative receives a (0) rating for this criterion.

Alternative B1/B1a: This alternative may have impacts to future development at the SPCA and Recology easement locations. Downstream tie-in location, near 7th and Berry Streets, will be highly congested due to future projects that are in planning phases being slated for the corridor. These projects include the aforementioned CBSIP, Downtown Rail Extension transportation project, and High Speed Rail transportation project. This alternative does not necessarily preclude the construction of any of the aforementioned but may require additional planning and design work-arounds to successfully execute. This alternative receives a (0) rating for this criterion.

Alternative C1: Since the only change is to the depth of an existing facility, no future impact is expected. This alternative receives a (+2) rating for this criterion.

Alternative D4: This alternative covers a relatively large footprint of the potential locations and, coupled with the relatively shallow depth of cover over the detention tanks, could limit the future development of the parcels. This alternative receives a (-2) rating for this criterion.

4.5.6 Traffic Impact

Alternative A: Traffic impacts from this alternative are limited to the shaft locations. This alternative receives a (+3) rating for this criterion.

Alternative B1/B1a: Traffic impacts from this alternative are limited to the shaft locations and possibly at the tie-in location should cut-and-cover prove to be more feasible than complete tunneling. This alternative receives a (0) rating for this criterion.

Alternative C1: This alternative impacts traffic for the entire length of the alignment, which follows a high volume corridor essential for freeway access. This alternative receives a (-3) rating for this criterion.

Alternative D4: Because the majority of construction work is within private property, there should be minimal traffic impacts. This alternative receives a (+3) rating for this criterion.

4.5.7 Potential Environmental Impact

Alternative A: Soils in the area are generally considered California Class I Non-Resource Conservation and Recovery Act (RCRA) hazardous soils and will require special handling and disposal. Mitigation measures will be required for dust, surface runoff, and noise. This alternative has a relatively small excavation footprint, only at the shaft locations, so potential impact will be minimal. This alternative receives a (+3) rating for this criterion.

Alternative B1/B1a: Soils in the area are generally considered California Class I Non-RCRA hazardous soils and will require special handling and disposal. Mitigation measures will be required for dust, surface runoff, and noise. This alternative has a relatively small excavation footprint, at the shaft locations and possibly at the tie-in

location, so potential impact is still less than a cut-and-cover-only alternative. This alternative receives a (+3) rating for this criterion.

Alternative C1: Soils in the area are generally considered California Class I Non-RCRA hazardous soils and will require special handling and disposal. Mitigation measures will be required for dust, surface runoff, and noise. This alternative has the largest excavation footprint spanning the entire alignment, so potential impact will be the greatest. This alternative receives a (-3) rating for this criterion.

Alternative D4: Soils in the area are generally considered California Class I Non-RCRA hazardous soils and will require special handling and disposal. Mitigation measures will be required for dust, surface runoff, and noise. This alternative has a relatively small excavation footprint within the potential detention locations outside the public ROW, so potential impact will be minimal. This alternative receives a (+3) rating for this criterion.

4.5.8 Hydraulic Performance – Flooding, LOS Storm

A summary of the freeboard node counts within the study area using 1D simulations is provided in Table 16. The number of nodes differs between the baseline and alternatives due to differences in Minor Components.

Table 16
Freeboard Node Counts (within Study Area)

Alternative	Negative Freeboard (# of Nodes)	0 to 2 Feet Freeboard (# of Nodes)	>2 Feet Freeboard (# of Nodes)
Base	138	63	96
A	0	4	292
B1	0	16	280
C1	0	21	275
D4	0	78	220

A representative location outside of the study area, located at Henry Adams and Division Street, was used to ensure ñdo no worseò The freeboard for this location is provided in Table 17.

Table 17
Freeboard at Henry Adams (Outside Study Area)

Alternative	Freeboard (ft)
Base	0.0
A	2.9
B1	1.0
C1	0.8
D4	0.5

Additional information is provided in Appendix G.2.

Alternative A: This alternative meets the stated goals of two feet of freeboard within the study area and ñdo no worseò outside of the study area, excluding outliers. This alternative receives a (+3) rating for this criterion.

Alternative B1/B1a: This alternative meets the stated goals of two feet of freeboard within the study area and ñdo no worseò outside of the study area, excluding outliers. This alternative receives a (+3) rating for this criterion.

Alternative C1: This alternative meets the stated goals of two feet of freeboard within the study area and ñdo no worseò outside of the study area, excluding outliers. This alternative receives a (+3) rating for this criterion.

Alternative D4: This alternative meets the stated goals of zero feet of freeboard for storage components and two feet of freeboard for conveyance components, excluding outliers. This alternative receives a (+3) rating for this criterion.

4.5.9 Hydraulic Performance – Flooding, Higher Recurrence Interval Storms

To better compare the performance of each alternative, an index value was generated per analysis area. The three analysis areas are the Folsom Study Area, 13ï Mission, and 14ï Design District, as shown in Figure 23, and their corresponding index values are shown in Table 18. The latter two areas are taken from the Flood Resilience Study (SFPUC 2016b), and are summed to provide an indication of hydraulic performance under higher recurrence level storms. The Mission analysis area primarily encompasses the Folsom Study Area but covers a larger area, defined not by any specific contours but rather City neighborhood delineation. The Design District analysis area is adjacent to and downstream of (on a basin-wide scale) the Mission analysis area. Low index values correspond to superior hydraulic performance. The 2D overland flow modeling results are shown in Table 18 and Figure 24.

The index value is calculated as follows:

$$\text{Index} = \sum_{i} \left(\text{Flooded Volume}_{i} \times \text{Flooded Area}_{i} \right)$$

where i is the return period for events ranging from the LOS storm, 10-year, 25-year, 50-year, and 100-year design storm, as described in Subsection 3.2.4.

Figure 23
Flood Index Analysis Area

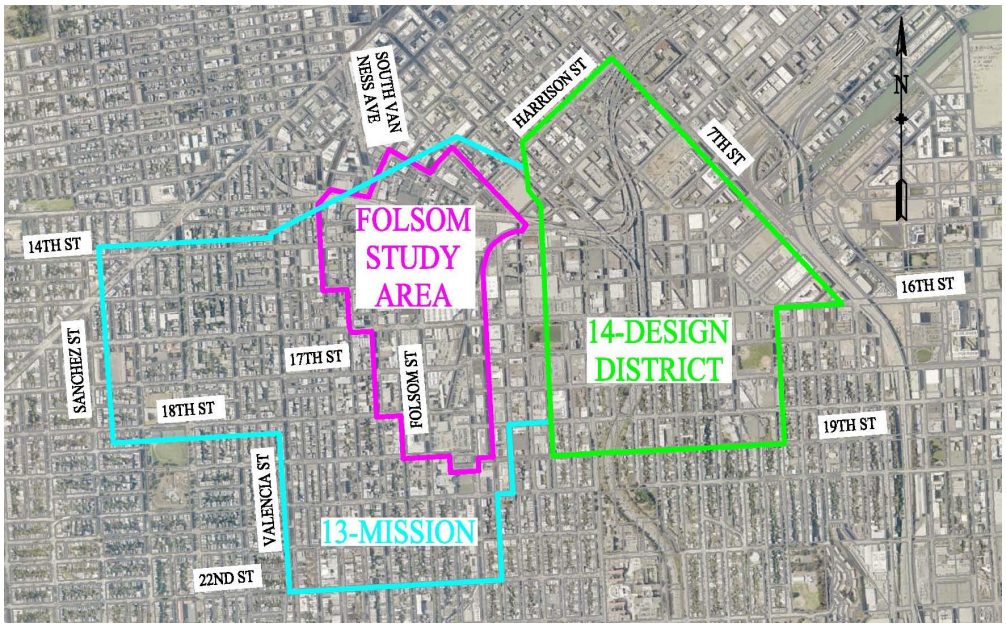
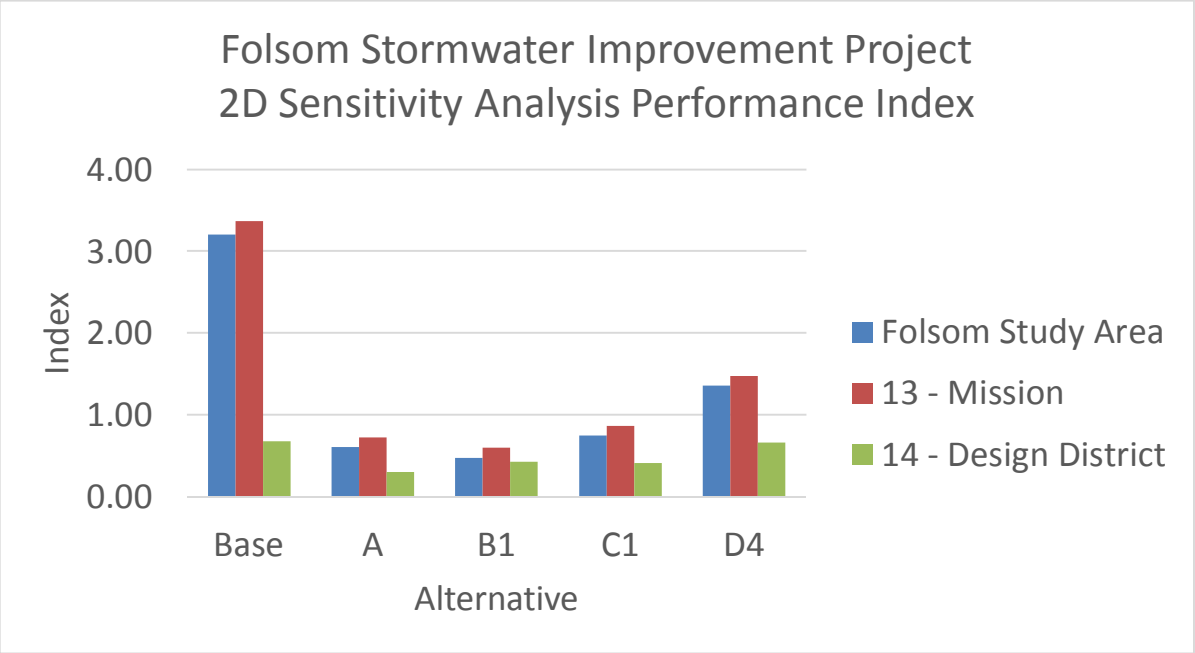


Table 18
Expected 2D Performance Index Values

Alternative	Folsom Study Area	13 – Mission	14 – Design District	Total of Mission and Design District
Base	3.20	3.37	0.68	4.05
A	0.61	0.73	0.30	1.64
B1	0.48	0.60	0.43	1.03
C1	0.75	0.87	0.42	1.29
D4	1.36	1.48	0.66	2.14

Figure 24
Expected 2D Performance Index Values



The impact of floodways, areas of the roadway that are designed to be flooded during large rainfall events that exceed the LOS storm, was not included in this comparison, but may be taken into consideration in the remaining planning and design phases.

Alternative A: This alternative has a flood index of 1.64, which is on par with the average of all alternatives. Refer to Subsection 4.5.9 on page 78 for more discussion on performance under higher recurrence interval storms. This alternative receives a (0) rating for this criterion.

Alternative B1/B1a: This alternative performed best, with a flood index of 1.03, which is better than the average of all alternatives. Refer to Subsection 4.5.9 on page 78 for more discussion on performance under higher recurrence interval storms. This alternative receives a (+2) rating for this criterion.

Alternative C1/C2: This alternative has a flood index of 1.29, which is on par with the average of all alternatives. Refer to Subsection 4.5.9 on page 78 for more discussion on performance under higher recurrence interval storms. This alternative receives a (+2) rating for this criterion.

Alternative D4: This alternative has a flood index of 2.14, which is worse than the average of all alternatives. Refer to Subsection 4.5.9 on page 78 for more discussion on performance under higher recurrence interval storms. This alternative receives a (-2) rating for this criterion.

4.5.10 Hydraulic Performance – CSDs

Typical-year analyses were performed to gauge CSD performance for each of the four alternatives. Results of the analyses are provided in Table 19.

Alternative A: This alternative shows a 22.7% reduction in overall Bayside CSD volumes and a reduction of two CSD activation counts in the Islais Creek area. However, the CSD performance improvement is likely due to the CHTL. This alternative receives a (+2) rating.

Alternative B1/B1a: This alternative shows a 3.2% reduction in overall Bayside CSD volumes, a 7.8% reduction in Mission Creek CSD volumes, and no change to CSD activation counts. This alternative receives a (+2) rating.

Alternative C1: This alternative shows a 2.4% reduction in overall Bayside CSD volumes, a 6.4% reduction in Mission Creek CSD volumes, and no change to CSD activation counts. This alternative receives a (+2) rating.

Alternative D4: This alternative shows a negligible reduction in CSD volumes and no change to CSD activation counts. This alternative receives a (0) rating.

4.5.11 Maintenance

Alternative A: This alternative has a relatively deeper tie-in point to the CHTL. Maintenance for this deeper tunnel alternative will pose more issues than other alternatives. This alternative receives a (-2) rating for this criterion.

Alternative B1/B1a: This alternative has a relatively shallower tie-in point. New maintenance procedures are required for this alternative, although it is not expected to be significantly different from other existing facilities. This alternative receives a (0) rating for this criterion.

Alternative C1: The expansion of this existing facility does not require any significant change in maintenance access or procedures. This alternative receives a (+2) rating for this criterion.

Alternative D4: This new facility will likely require routine maintenance and flushing after each time its use is required, leading to additional labor demands. This alternative receives a (-2) rating for this criterion.

4.5.12 Constructability

Alternative A: Tunneling, by its nature, has inherent risks, which are exacerbated by length and depth. This tunneling alternative is both longer and deeper than other alternatives. The tie-in to the CHTL is also much deeper than other tie-ins. This alternative receives a (-2) rating for this criterion.

Alternative B1/B1a: This tunneling alternative is shorter than Alternative A and has a relatively shallow tie-in. Downstream tie-in may be an issue with the 7th Street corridor, slated to have DTX, HSR, and CBSIP facilities. If the corridor does become too dense, the downstream portion can be converted to cut-and-cover, which is inherently less risky, to avoid some of the issues. This alternative receives a (0) rating for this criterion.

Alternative C1: The entire alignment will be constructed via cut-and-cover at a relatively shallow depth. The overhead freeway, US-101, which runs along portions of the alignment, may require some work-arounds; however, similar types of cut-and-cover work has been previously undertaken successfully within San Francisco. This alternative receives a (+2) rating for this criterion.

Alternative D4: Construction is limited to mostly within the boundaries of private property. Detention tanks can range from large-footprint/shallow-depths to small-footprint/deeper-depths, thus allowing a trade-off dependent on site conditions. Because construction will be undertaken in a prescribed area, the issues that could arise are limited. This alternative receives a (+2) rating for this criterion.

Table 19
Typical-Year Analyses Results

Full TY	Treatment Volume (MG)							Activations by Permitted Area				Activations by Reported Area							Discharge Volume (MG)						
Scenario	NPF primary effluent flow	SEP second effluent	SEP primary effluent	OSP effluent	WSPS primary effluent	Total CSD	Total outflow	Oceanside	North Basin	Central Basin	South Basin	Oceanside	North Shore	Mission Creek	Mariposa, 20th & 22nd	Islais Creek	Evans, Hudson & Yosemite	Sunnydale	Oceanside	North Shore	Mission Creek	Mariposa, 20th & 22nd	Islais Creek	Evans, Hudson & Yosemite	Sunnydale
Base	1,251	10,256	1,631	0	0	1,226	14,364	0	3	12	2	0	3	8	12	11	2	0	0.00	29.76	515	3	678	0.90	0.00
A	1,251	10,518	1,666	0	0	946	14,381	0	3	12	1	0	3	8	12	9	1	0	0.00	29.61	392	3	520	0.90	0.00
B1	1,240	10,295	1,633	0	0	1,186	14,354	0	3	12	2	0	3	8	12	11	2	0	0.00	29.38	475	3	678	0.90	0.00
C1	1,275	10,266	1,633	0	0	1,195	14,369	0	3	12	2	0	3	8	12	11	2	0	0.00	31.05	482	3	678	0.89	0.00
D4	1,251	10,259	1,630	0	0	1,222	14,362	0	3	12	2	0	3	8	12	11	2	0	0.0	29.7	510	3	678	0.90	0.0

MG =million gallons; NPF = North Point Wet Weather Facility; OSP = Oceanside Water Pollution Control Plant; SEP = Southeast Water Pollution Control Plant; WSPS = Westside Pump Station

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4.5.13 Construction Cost

Alternative A: Total construction cost is estimated to be $97.3 million, which is within 70% to 130% of the average cost of the alternatives. Associated land acquisition costs are not included in this analysis. This alternative receives a (0) rating for this criterion.

Alternative B1/B1a: Total construction cost is estimated to be $132.2 million, which is within 70% to 130% of the average cost of the alternatives. Associated land acquisition costs are not included in this analysis. This alternative receives a (0) rating for this criterion.

Alternative C1: Total construction cost is estimated to be $124.4 million, which is within 70% to 130% of the average cost of the alternatives. This alternative receives a (0) rating for this criterion.

Alternative D4: Total construction cost is estimated to be $64.0 million, which is less than 70% of the average cost of the alternatives. Associated land acquisition costs are not included in this analysis. This alternative receives a (+2) rating for this criterion.

Construction costs are summarized in Table 20.

4.5.14 Construction Duration

Alternative A: Construction duration is expected to be approximately 26 months. This alternative receives a (0) rating for this criterion.

Alternative B1/B1a: Construction duration is expected to be approximately 23 months. This alternative receives a (0) rating for this criterion.

Alternative C1: Construction duration is expected to be approximately 45 months. Multiple headings can reduce the total duration, but that is not accounted for in this duration. This alternative receives a (-3) rating for this criterion.

Alternative D4: Construction duration is expected to be approximately 24 months. Work does not need to be sequential, and both detention tanks can be constructed simultaneously. This duration accounts for simultaneous construction. This alternative receives a (0) rating for this criterion.

4.5.15 Synergistic Opportunities

Alternative A: This alternative relies on CBSIP to be fully activated before it can be put in operation. This alternative receives a (-1) rating for this criterion.

Alternative B1/B1a: This alternative has no known synergistic opportunities with other projects. This alternative receives a (0) rating for this criterion.

Alternative C1: If floodways are considered in the future, there could be synergistic opportunities with this alternative. If coupled, the cost to construct the floodways would be reduced due to overlap of demolition and restoration work. Floodways would also improve the flood index, discussed in Subsection 4.5.9, for this alternative. Further into the future, there may also be synergies with the SFMTA Unity Boulevard/Division Street vision. This alternative receives a (+1) rating for this criterion.

Alternative D4: This alternative has no known synergistic opportunities with other projects. This alternative receives a (0) rating for this criterion.

Table 20
Construction Cost Summary

	Alternative A [1]	Alternative B1 [2]	Alternative B1a [3]	Alternative C1 [4]	Alternative D4 [5]
Direct Construction Cost [6]	$53,504,223	$58,285,225	$61,139,999	$57,970,000	$ 25,611,032
Contractor Markups [7]	---	---	---	$11,637,000	$ 5,142,376
Estimating Contingency (30%)	$16,051,267	$17,485,568	$18,342,000	$20,880,000	$ 9,226,022
Base Construction Cost	$69,555,490	$75,770,793	$81,242,630	$90,487,000	$ 39,979,430
Construction Contingency (10%)	$6,955,549	$7,577,079	$8,124,263	$9,050,000	$ 3,997,943
Total Major Construction Cost	$76,511,039	$83,347,872	$89,366,893	$99,537,000	$ 43,977,373
Total Minor Component Construction Cost	$20,800,000	$42,800,000	$42,800,000	$24,900,000	$ 20,000,000
Total Construction Cost	**$97,311,039**	**$126,147,872**	**$132,166,893**	**$124,437,000**	**$ 63,980,000**
Project Soft Cost (48.15%)	$46,855,265	$60,740,200	$63,638,359	$59,916,416	$ 30,806,370
Total Capital Project Cost	**$144,170,000**	**$186,890,000**	**$195,810,000**	**$184,360,000**	**$ 94,790,000**

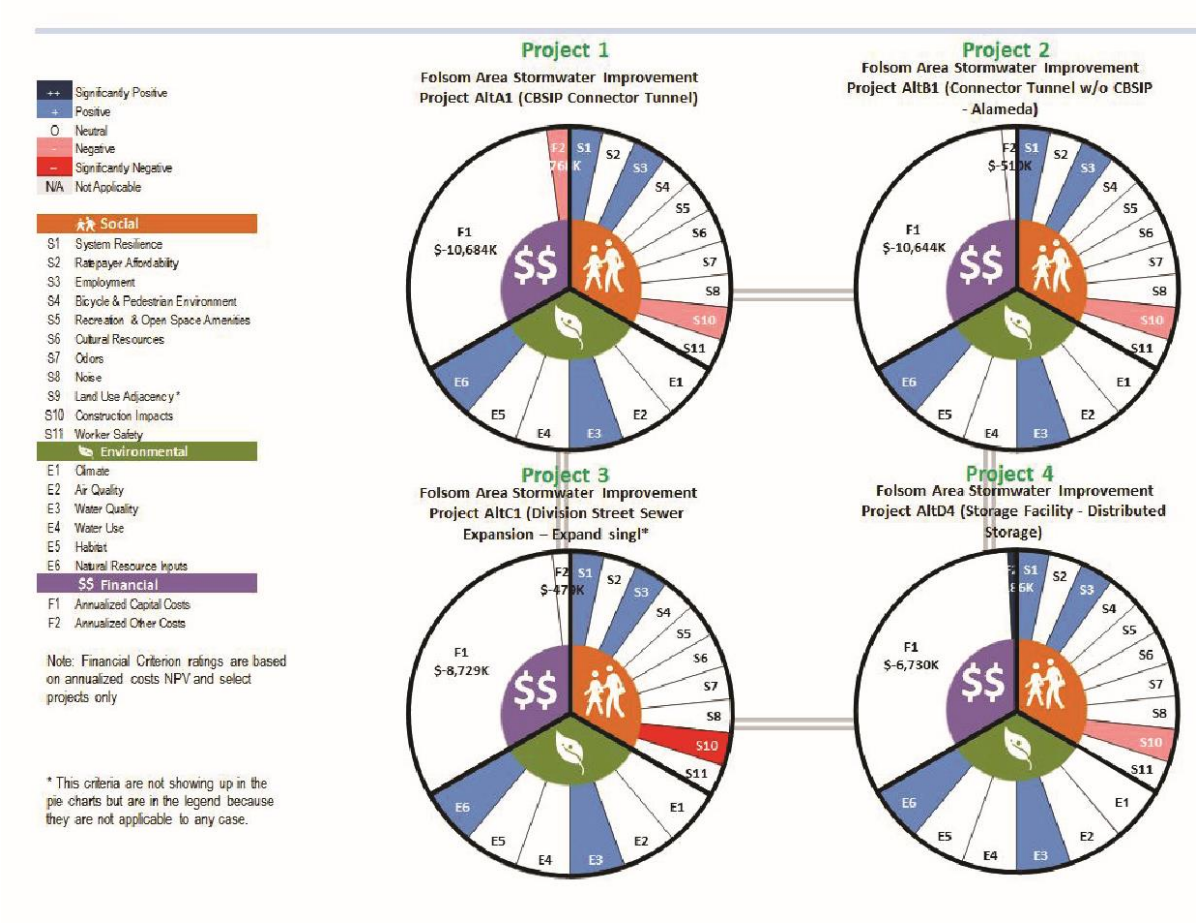
[1] Refer to Appendix E for breakdown
[2] Refer to Appendix E for breakdown
[3] Refer to Appendix E for breakdown
[4] Refer to Appendix H for breakdown
[5] Refer to Appendix I for breakdown
[6] Direct construction cost for Alternatives A and B include contractor markups
[7] Contractor markups include general conditions and requirements, overhead and profit, and bonding and insurance

4.6 Triple Bottom Line Analysis

The triple bottom line (TBL) tool compares preliminary conceptual alternatives across financial, social, and environmental categories. Each category is made up of multiple criteria, which are in turn built on measurable indicators.

The complete TBL analysis, including a breakdown of the various criteria, is presented in Appendix J. The following text and Figure 25 is the conclusion from the TBL analysis.

Figure 25
TBL Summary



Project 1 ï Alternative A Project 2 ï Alternative B1 Project 3 ï Alternative C1 Project 4 ï Alternative D4

For the financial category, all four of the proposed alternatives, A1, B1, C1 and D4 are comparable in Capital Costs – all alternatives received a neutral ranking– but they are not in Other Costs – alternative A1 is negative, alternatives B1 and C1 are neutral, and alternative D4 is significantly positive. For the social category, the alternatives performed the same in all criteria with the exception of the Construction Impact criterion, for which alternative C1 received a significantly negative ranking and the others a negative ranking. Finally, for the environmental category, all four alternatives scored the same relative to one another.

Given the differences between projects are limited to only two criteria, from a TBL perspective the preferred alternatives are D4 and B1 in order of preference. However, these two alternatives only differ in the Other Costs criterion, which represents a relatively small share of the project. Furthermore, alternative D4 would entail very high acquisition challenges and would preclude any future development of the land. Moreover, because conveyance projects are designed to have more freeboard than storage projects, Alternative B1 has the benefit of better performance under higher recurrence-interval storms and higher reduction in combined sewer discharge volume.

For these reasons, B1/B1a remains the highest ranked alternative.

4.7 Highest Ranked Alternative

The highest ranked alternative was determined using selected criteria that exhibited noteworthy distinctions between alternatives. The highest ranked alternative, based on the evaluation criteria identified in Table 15, and feedback from management, is Alternative B1/B1a. This alternative emerges with the highest weighted rating, which includes advantageous criteria of Potential Utility Concerns, Potential Environmental Impact, Hydraulic Performance ï Flooding LOS Storm, Hydraulic Performance ï Flooding Sensitivity, and Hydraulic Performance ï CSDs. The highest ranked alternative was (-) disadvantageous for only one criterion, Present Ownership. Figure 26 maps the elements of the highest ranked alternative.

4.8 Assumptions and Limitations

The following are assumptions and limitations of this report:

- **Scope of evaluation:** The sizing of the elements in this report are based on the SFPUC SSIP WWE defined LOS design storm, a statistically derived storm lasting 3 hours, with a total of 1.3 inches of rainfall and a defined peak rainfall intensity. Sensitivity analyses were conducted using the typical-year and 10-, 25-, 50-, and 100-year design storms at the direction of the Project Manager. Alternatives are also sized based on the assumption that the downstream sewer system facilities begin at a dry-weather flow level. Should a LOS storm peak intensity occur at any time other than during dry-weather flow level within the sewer system, which is a typical wet-weather occurrence, the full capacity of the sewer system facilities will not be available to handle the stormwater from the storm event. This project will rely on the availability of the downstream sewer system facilities for storage, which is an optimistic and improbable downstream scenario, based on numerous documented wet-weather system performances. Separate analysis is needed to assess sizing during typical and realistic wet-weather downstream scenarios, which can be supported by documented observations, but the process will not be undertaken unless prescribed by the Project Manager.
- **TBL:** The TBL tool compares preliminary conceptual alternatives across financial, environmental, and social categories. Each category is made up of multiple criteria, which are in turn built on measurable indicators. Generally, the TBL tool is not expected to sway the analysis, but can potentially supplement the alternatives evaluation with additional metrics.

- **Design and General Seismic Requirements:** Design and general seismic requirements are anticipated to be addressed with the Design Criteria Report, which coincides with the Conceptual Engineering Report, and is not used in the determination of the highest ranked alternative.
- **Environmental Review:** California Environmental Quality Act and environmental review will begin concurrently in the following phases of work. All of these issues will be discussed further in the Conceptual Engineering phase.
- **LID/LEED:** The hydraulic analyses described have not included low-impact development (LID) and LEED (Leadership in Energy and Environmental Design) concepts. LID/LEED concepts will be further defined in the Conceptual Engineering phase.
- **Cost and Schedule:** All preliminary costs and schedules for this project are planning level estimates as of produced between 2016 and 2017 and are subject to change in the subsequent phases of planning and design.
- **Available Information:** The information gathered and summarized is based on available project information at the time of preparation of this report. This information may be updated as necessary if/when additional information is available.

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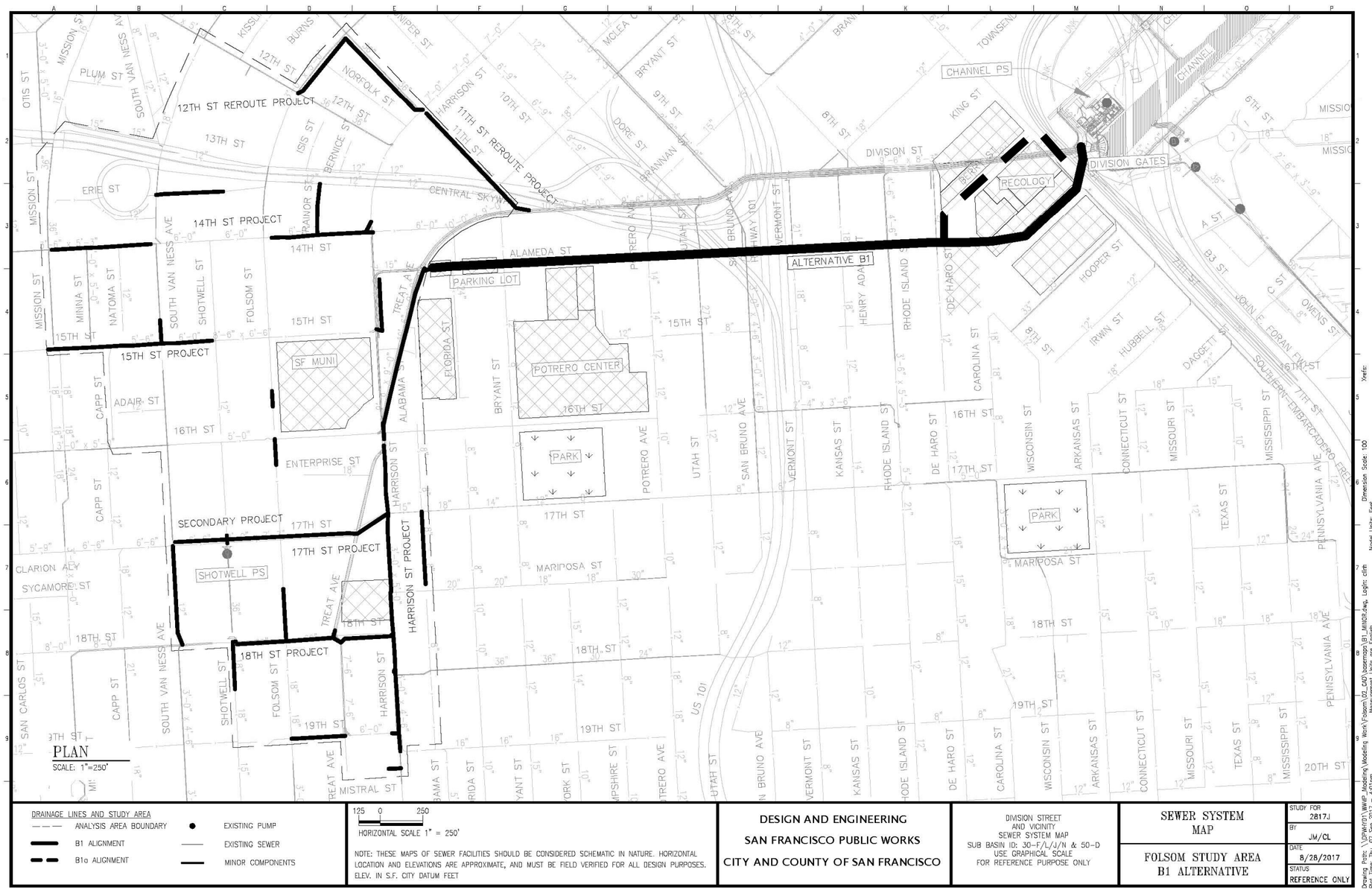
Figure 26
Highest Ranked Alternative



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5.0 CONCLUSIONS

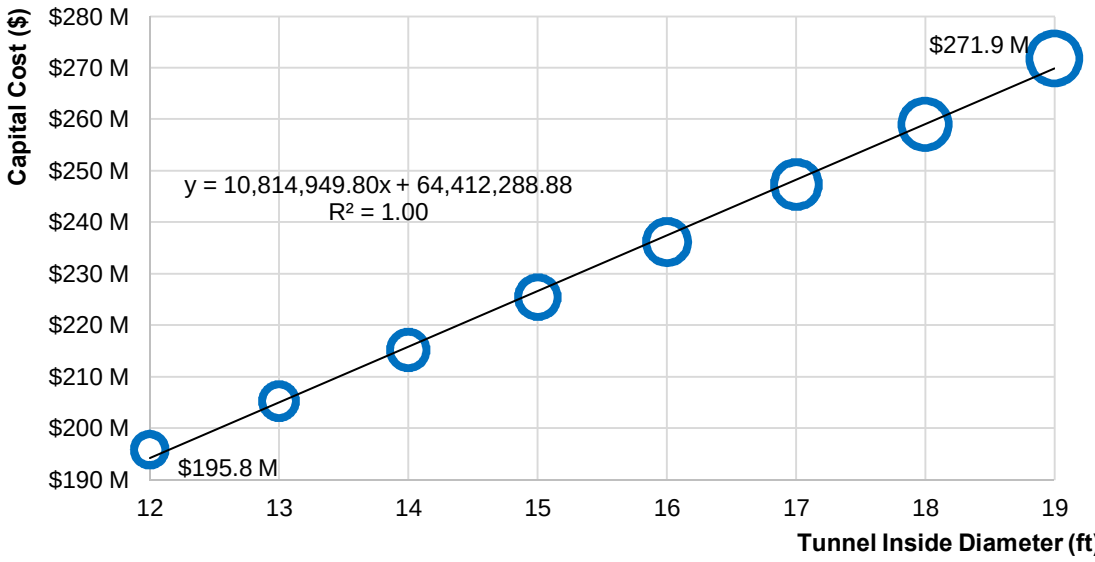
5.1 Highest Ranked Alternative

In summary, the highest ranked alternative was determined based on criteria identified in Table 15.

5.1.1 Tunnel Size

From a hydraulic perspective, a 12ôinside diameter tunnel will provide the flood relief benefits to manage the LOS storm. During presentation of the four alternatives, including Alternative B1/B1a with 12ôinside diameter tunnel, SFPUC management was interested in understanding the incremental flood reduction benefits of a larger sized tunnel for a marginal increase in cost. The project team was tasked with performing this cost analysis to determine if there may be a ñknee-of-the-curveò for tunnel diameter versus cost. The cost analysis results for varying tunnel diameters are provided in Figure 27.

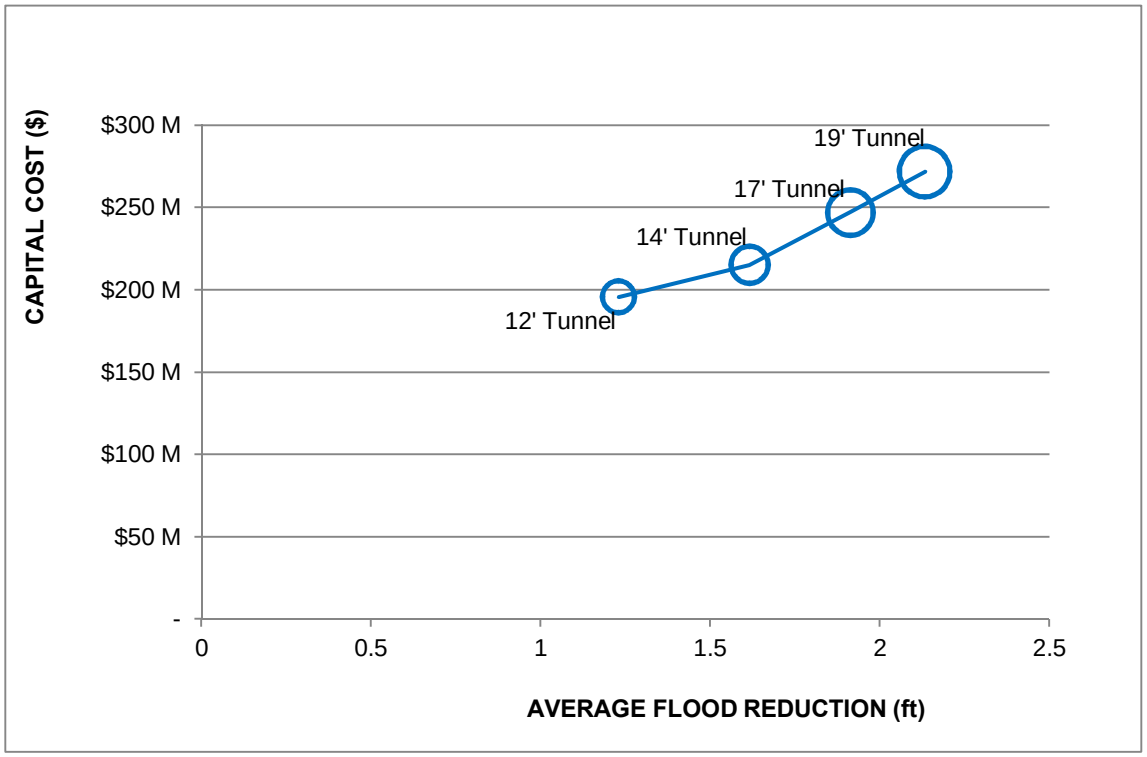
Figure 27: Tunnel Inside Diameter vs Capital Cost



The results indicate that there is no ñknee-of-the-curveò for a tunnel inside diameter range of 12 feet through 19 feet[10], exhibiting a nearly linear trend line. The breakdown is provided in Appendix E.

[10] The largest feasible tunnel size was determined to be 19ôinside diameter based on minimum depth of cover required of one-half diameter and to meet downstream connection elevation of -35ô

Figure 28: Average Flood Depth Reduction vs Capital Cost



Flood reduction performance was also assessed for incremental tunnel sizes to determine whether additional benefits could be achieved by a larger tunnel for a marginal increase in cost. Figure 28 compares project capital cost and average flood depth reduction based on 12-feet, 14-feet, 17-feet, and 19-feet diameter tunnels. Results indicate that increasing tunnel inside diameter from 12 feet ($195.8 million; 1.2 feet average flood reduction) to 14 feet ($215.2 million; 1.6 feet average flood reduction) would cost an additional $19.4 million, achieving a 0.4 feet improvement in performance. Based on these results, SFPUC management determined that the minor additional benefits of an incrementally larger tunnel did not warrant the relative high increase in cost. Therefore, the project team will proceed with a 12ôinside diameter tunnel as the major component of Alternative B1/B1a.

5.1.3 Scope of Work

The major scope of work includes:

- Construction of 4,200 linear feet of 12ôinside diameter tunnel (or 3,500 linear feet of 12ô inside diameter tunnel and 1,600 linear feet open-cut box sewer), from approximately the intersection of Alameda Street and Treat Avenue connecting to the Channel Transport/Storage Box near the intersection of 7th Street and Berry Street.

Minor Components include:

- Deepening approximately 1,100 LF of existing box sewer on Treat Avenue from Alameda Street to 16th Street from 8.25ôhigh to 12ôhigh.
- Upsize approximately 1,000 LF of existing sewer on 15th Street from Shotwell Street to Mission Street from 66 inches and 72 inches to 72 inches and 78 inches.
- Upsize approximately 1,200 LF of existing 3-foot 0-inch x 5-foot 0-inch sewer on Harrison Street to a box sewer having a width of 108 inches and a height that varies from 6 feet to 8 feet.
- Upsize approximately 900 LF to 1,200 LF of the 90-inch sewer and 60-inch auxiliary on 18th Street from Treat Avenue to Shotwell Street.
- Construct 220 LF of new 90-inch sewer between the intersection of 17th and Harrison Streets and 17th Street and Treat Avenue.
- Upsize approximately 1,200 LF of existing sewers on 14th Street from Harrison to Folsom Streets and on 14th Street from South Van Ness Avenue to Valencia Street. Upsize existing 75-inch sewer to 84-inch sewer and from existing 3'-6-inch x 5'-3-inch brick sewer to 66-inch sewer. Construct an additional weir at Harrison and 14th Streets.
- Construct 1050 LF of new 48" sewer to convey flow from the intersection of 12th and Folsom Streets to the intersection of 11th and Harrison Streets.
- Construct 850 LF of new 75-inch sewer to convey flow from the intersection of Harrison and 11th Streets to the Division Street Sewer east of the intersection of Bryant and Division Streets.
- Construct 1100 LF of 72-inch auxiliary sewer on 17th Street from Treat Avenue to South Van Ness Avenue. Upsize the 15-inch headend sewer on South Van Ness Avenue from 17th Street to 18th Street to 42 inches and a new 36-inch sewer to divert flows from 18th Street at the South Van Ness intersection.
- Other general upsizing

5.1.4 Project Team

The project team consists of the staff from SFPUC, SFPW, and professional services consultants. The current and expected project team consists of the personnel listed in Table 21.

Table 21
Project Team

Role	Department	Name
Project Manager	SFPUC Project Management Bureau	Amy Kam
Program Management Support	SSIP Program Management Consultants	Bryce Wilson
Project Controls	SFPUC Project Management Bureau	Chris Saidon
Project Engineer	SFPW Design and Engineering	Chung Linh
Operations, Engineering, and Maintenance Representative	SFPUC Wastewater Engineering	Ed Ho

This project is led by SFPUC, with multiple entities providing engineering and technical support:

- SFPW staff will provide engineering support for all phases of this project, including, but not limited to, support from the following SFPW Divisions:
  - Hydraulics (Project Lead)
  - Geotechnical
  - Structural
- SFPUCõs Operations, Engineering, and Maintenance staff will review and support the project development process to ensure that the infrastructure meets their needs.
- SFPUC staff will provide other project support, including communications and outreach, real estate services, and environmental review services.

5.1.5 Construction Cost

The construction cost of the main components of this alternative is estimated to be $89.4 million; construction cost of the minor components of this alternative is estimated to be $42.8 million. Total construction cost is estimated to be $132.2 million. Total project cost is estimated to be $195.8 million.

5.1.6 Project Schedule

The planning phase is expected to be completed by spring 2018, with the design phase to follow. A complete schedule will be provided with the Conceptual Engineering phase.

5.2 Next Steps

The findings of this report have been presented to the SFPUC Management Oversight Committee for decision and approval. The project team has been directed to further develop the selected alternative, Alternative B1/B1a, including all associated project components and design criteria definition, in the Conceptual Engineering phase.

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6.0 REFERENCES

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Appendix A

SSIP Goals, LOS, and Strategies

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Sewer System Improvement Program (SSIP)
Goals, Levels of Service (LOS), Program and Phase 1 Strategies (Endorsed March 22, 2016)

Wastewater Enterprise Goals	Wastewater Enterprise Levels of Service	Sewer System Improvement Program Strategies ($6.9B)	Phase 1 Strategies ($2.9B)
1. Provide a Compliant, Reliable, Resilient, and Flexible System that can Respond to Catastrophic Events			
	1.1. Full compliance with State and Federal regulatory requirements applicable to the treatment and disposal of sewage and stormwater.	a. Reduce the annual long-term average of Combined Sewer Discharge (CSD) occurrences within the Central drainage basin (Channel and Islais Creek urban watersheds) by 2 (from 12 to 10), consistent with the NPDES permit.	Complete Planning and Environmental Review of the Central Bayside System Improvement Project, for Channel Force Main redundancy, to achieve a maximum long-term average of 10 CSD occurrences, consistent with the NPDES permit.
		b. Comply with Liquid and Biosolids wastewater treatment plant permit requirements.	Construct Liquid and Biosolids projects at SEP, OSP, and NPF for permit compliance (SEP: Headworks, Disinfection, Primary and Secondary Clarification, Oxygen Generation Plant, Biosolids, and Existing Digesters; OSP: Digester Gas Upgrades, Westside Pump Station; NPF: Outfall Rehabilitation, North Shore Pump Station). Rehabilitate, or replace, critical sewers based on condition assessment and prioritization within the budgeted amount.
		c. Improve combined sewer discharge (CSD) structures to increase floatables control, consistent with the NPDES permit.	Rehabilitate CSD structures (Beach St., Sansome St., Fifth St., Sixth St.-North, and Division St.) to increase floatables control, consistent with the NPDES permit.
	1.2. Critical functions are built with redundant infrastructure.	a. Construct redundancy of Channel, North Shore, and Westside Force Mains.	Complete Planning and Environmental Review of Central Bayside System Improvement Project, for Channel Force Main redundancy. Rehabilitate the remaining section of North Shore Force Main near The Embarcadero and Jackson Street.
		b. Ensure electrical redundancy to treatment facilities.	Provide redundant electrical feeds to SEP, OSP, and NPF.
		c. Rehabilitate and add redundant pumps, as necessary, at major pump stations.	Upgrade Westside, Bruce Flynn, and North Shore Pump Stations with the ability to pump peak flow with the largest pump out of service, and rehabilitate other pump stations (Griffith, Mariposa, and Hudson), as identified by condition assessment.
	1.3. Dry weather primary treatment, with disinfection, must be on-line within 72 hours of a major earthquake.	a. Design critical and new treatment facilities to withstand the following seismic events: Magnitude 7.8 earthquake on the San Andreas fault; and, Magnitude 7.1 earthquake on the Hayward fault.	Design new facilities at SEP (Headworks, Biosolids, Disinfection, Oxygen Generation Plant, Power Switchgear Building) to withstand 7.8 earthquake on the San Andreas fault and 7.1 earthquake on the Hayward fault.
			Provide seismic retrofits to SEP Building 042, to provide primary treatment of dry weather flows.
2. Integrate Green and Grey Infrastructure to Manage Stormwater and Minimize Flooding			
	2.1. Control and manage flows from a storm of a three hour duration that delivers 1.3 inches of rain (Level of Service storm).	a. Maximize protection of the City during the Level of Service storm.	Assess flood risk citywide and prioritize infrastructure needs. Implement projects in neighborhoods including: Kansas/Marin Streets, Cayuga Ave./Rousseau St., Wawona St./15th Ave., Victoria St./Urbano Dr., Joost Ave./Foerster St., and 17th St. /Folsom St. (Planning and Design only). Implement additional measures to reduce flood risk beyond the capacity of the collection system.
		b. Develop projects using an urban watershed approach which employs the Triple Bottom Line.	Complete the Urban Watershed Assessment plan. Apply Triple Bottom Line to applicable projects during the Alternatives Analysis phase.
		c. Identify, evaluate, and develop projects to reduce combined sewer discharge (CSD) occurrences on public beaches.	Complete Urban Watershed Assessment plan.
		d. Develop Design Standards for Green Infrastructure that are informed by the performance of the Early Implementation Projects (EIPs).	Construct EIPs and monitor performance.
3. Provide Benefits to Impacted Communities			
	3.1. Limit plant odors to within the treatment facility s fence lines.	a. Construct effective odor control systems at SEP, OSP, and NPF.	Design and construct the new Headworks and Biosolids facilities at SEP to meet 5 dilutions/threshold (D/T) odor criteria at the fence line.
		b. Use operational controls and infrastructure modifications to minimize odors from the Collection System (sewers).	Develop a Collection System Odor Model to identify potential areas of significant odor. Implement Cargo Way Flushing Line and repair of Westside Flushing Line to minimize odors.
	3.2. All projects will adhere to the Environmental Justice and Community Benefits policies.	c. Incorporate visual improvements into projects at the treatment plants and pump stations, where feasible and appropriate.	Incorporate visual and architectural improvements in the design and construction of the new Headworks and Biosolids projects at SEP.
		d. Provide community benefits including job creation, workforce development, contracting opportunities, and greening.	Provide green infrastructure contractor training and coordinate all jobs through the Contractors Assistance Center.
		e. Work with other City and County agencies on capital projects they have initiated to protect the value and function of wastewater facilities, maximize economic development, and minimize construction impacts and costs.	Coordinate and implement interdepartmental sewer projects (Central Subway, Van Ness BRT, Better Market Street, Geary BRT Phase 1 & 2, Masonic Ave, and Mission Bay Loop).
		f. Engage residents in locating green infrastructure where multiple benefits can be optimized using the Triple Bottom Line.	Utilize Triple Bottom Line and public process in development of EIPs.
4. Modify the System to Adapt to Climate Change			
	4.1. New infrastructure must accommodate expected sea level rise within the service life of the asset (i.e., 6 inches by 2030, 11 inches by 2050, 36 inches by 2100) and be consistent with the City s Guidance for Incorporating Sea Level Rise into Capital Planning.	a. Site new facilities to accommodate, or adapt to, expected sea level rise over the life of the asset.	Build new infrastructure at SEP (Headworks, Biosolids, Disinfection, Oxygen Generation Plant, Power Switchgear Building) and Mariposa Pump Station to accommodate expected sea level rise in 2100.
	4.2. Existing infrastructure that is impacted by sea level rise, within the service life of the asset, will be modified based on sea level rise projections.	b. Develop and implement an adaptation plan for existing infrastructure to address expected sea level rise within the service life of the asset.	Modify existing Bayside CSD structures that experience seawater intrusion. The following CSD structures are considered: Jackson St., Pierce St., Mariposa St., Beach St., Fifth St., Sixth St.-North., Division St., Howard St., Islais Creek-North, Marin St., Selby St., and Yosemite Ave.
5. Achieve Economic and Environmental Sustainability			
	5.1. Beneficial use of 100% of Biosolids.	a. Upgrade biosolids to treatment Class "A".	Upgrade SEP biosolids to treatment Class "A" which, contain no detectible levels of pathogens, and can be applied without restriction on food crops. Size the new Biosolids Digester Facilities to meet solids loading projections for the year 2045.
	5.2. Beneficialuse of 100% of methane generated by treatment facilities, during normal operation.	b. Provide cogeneration, or other beneficial methane use options, at SEP and OSP.	Construct cogeneration facilities at SEP and OSP for a total output of 5MW.
	5.3. Use non-potable water sources to meet WWE facilities non-potable water demands.	c. Incorporate conservation measures, recycled water, and other non-potable reuse facilities into projects, where feasible and appropriate.	In order to maximize use of non-potable water, upgrade the treated effluent pump system at SEP and incorporate its use into designs, where applicable. Accommodate space for recycled water treatment facilities at SEP and OSP.
6. Maintain Ratepayer Affordability			
	6.1. Combined sewer and water bill will be less than 2.5% of average household income for a single family residence.	a. Plan and phase projects to ensure affordability and predictability for ratepayers.	Plan and phase projects to ensure affordability and predictability for ratepayers.
			Identify and apply for Federal and State loans and grants to reduce the financial burden on ratepayers.

SEP: Southeast Treatment Plant OSP: Oceanside Treatment Plant NPF: North Point Wet Weather Facility NPDES: National Pollutant Discharge Elimination System (US EPA)

Appendix B

Minor Components

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Draft Minor Components Approach - 3/2/2016

Folsom Analysis Area Outline

The initial phase of the July 2015 analysis began with a brainstorming session held at Hydraulic Section conference room. Several ideas were drawn on a map, with additional ideas listed out in a table. Each option was simulated in the model on its own to determine how to package the individual components into alternatives, and the high performing options will be used in the current study. A description and performance summary is tabulated on the following page. The performance summary lists the freeboard at MHs and other model nodes within the analysis area outline at right. The high performing components were combined into a Combo scenario, and will be included in all four alternatives.

Brainstorming Map

Full List of Components:

R:\Modeling Work\Folsom\03_TM materials\Review of ScenarioDescriptionTable_20150724.xlsx

Minor Components Performance

	Gravity conveyance scenarios from previous analysis, plus recent requests, re-run using 1d network 2/24/2016	**LOS Storm Results At 352 Nodes Within Folsom Analysis Area**				
Row	**Scenario Name**	Nodes Meeting LOS	Nodes Not Meeting LOS	% Change	Flood Volume (Acre-Feet)	% Change
0	Baseline	178	174	-	5.1	-
1	10th Street - Dropout & Flap Gate	175	177	2%	7.6	49%
2	11th Street - Sewer Upsized	191	160	-8%	3.4	-32%
3	16th Harrison - Lower Weir	178	174	0%	4.5	-11%
4	16th Harrison - Lower Weir + Remove Vane	177	175	1%	4.5	-11%
5	17th Folsom Isolation	169	183	5%	3.3	-36%
6	CHS increased by 800 mgd + 16th Harrison - Lower Weir	178	174	0%	4.2	-17%
7	10th Street Dropout No Flap Gate	178	174	0%	5.1	0%
8	Division Street Outfall - Have Gates Open Earlier	178	174	0%	5.1	0%
9	Early Implementation Projects - #1+#4	173	179	3%	5.7	11%
10	Harrison Street 3x5 Upsize	177	173	-1%	4.4	-14%
11	Harrison Street 3x5 Upsize + Lower Weir + Remove Vane	180	170	-2%	3.7	-27%
12	Infinite Box Discharge (Free outfall @ DS end of Division Street sewer)	179	173	-1%	4.1	-20%
13	Treat Ave - Upsize Sewer (16^{th} to 18^{th})	177	175	1%	2.7	-47%
14	Combo - #2+#10+#13 - 11th St + Harrison 3x5 + Treat Ave	207	145	-17%	0.5	-90%

Appendix C

Shaft Location Considerations

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APPENDIX C: SHAFT LOCATION CONSIDERATIONS

C. SHAFT LOCATION CONSDIERATIONS

Appendix D describes conditions adjacent to possible shaft locations, which are approximate, and are based on a reconnaissance field trip on June 7, 2016 and review of the site based on Google Earth. Utility search was recently completed and was not factored into the analysis below. Moreover, adjacent foundation inquiries are in progress.

C.1 Alternative A1:

C.1.1 East Drive Shaft: Staging Area and Adjacent Buildings

Adjacent buildings and structures are compared to the proposed drive shaft location(s) and staging area(s) are numbered and listed as shown in Table C-1 and Figure C-1.

Table C1-1.1 List of Adjacent Buildings /Structures around Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	City Storage	500 Indiana Street	South side of Mariposa Street	4	79	New and in good condition
2	Cal-Steam-Wholesale Plumbing	777 Mariposa Street	South side of Mariposa Street. and at corner of Indian Street	2.5	79	In good condition
3	Digital Pre-Press International	645 Mariposa Street	SE- At corner of Mariposa and Minnesota Street	2	300	In good condition
4	Giannini's Auto Body Shop	625 Mariposa Street	SE- At corner of Mariposa and Tennessee Street	1	415	Old
5	Open storage area	595 Mariposa Street	SE- At corner of Mariposa and Tennessee Street	---	590	Abandoned
6	Residential Building-Condo	2002 3rd Street	SE- At corner of Mariposa and 3rd Street	4	710	New and in Good condition
7	Mariposa Park	---	North side of Mariposa Street	---	0	New
8	UCSF Benioff Children's Hospital	1975 4th Street	NE and E- At corner of Mariposa and Hospital Street	7	350	New
9	I-280 Freeway	---	West	---	230	Supported by piles on both sides of Mariposa Street.

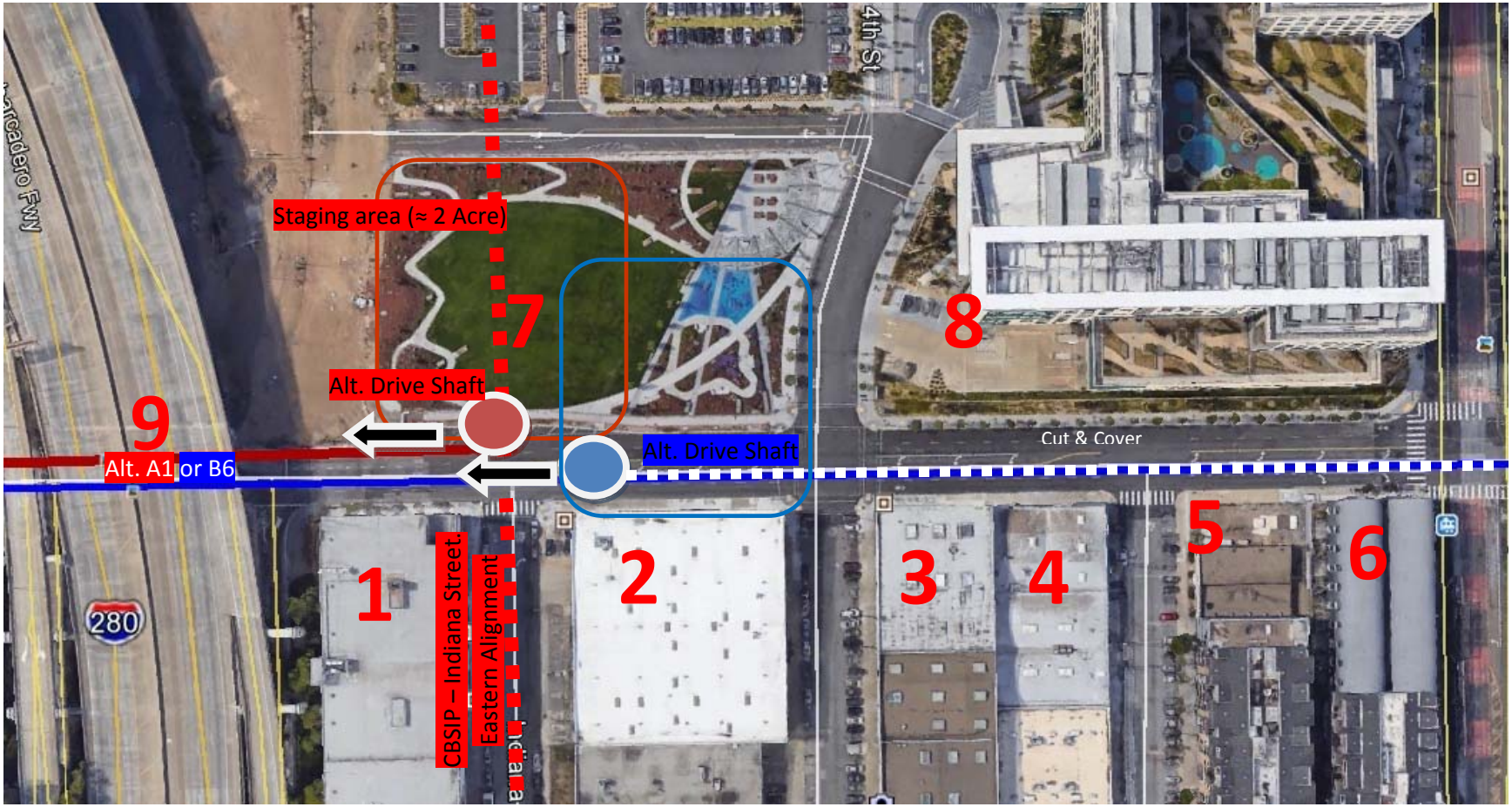

Figure C1-1. Alternative A1 or B6 Drive Shaft Locations / Staging Areas and Adjacent Structures

C.1.2 Tie-ins

The tie-in will be to the Central Bayside System Improvement Project (CBSIP). This may be done at the proposed shaft location or with and adit to the side of the CBSIP.

Other possible Tie-ins around the staging area are as follows:

- 66” and 30” on Indiana Street. Mariposa Street and 16th Street

C.1.3 Shoring

The shaft depth, geologic conditions and shoring systems considered in the drive shaft are shown in Table C-1.2. It should be noted that to control water during the excavation dewatering can be used. However, using dewatering system may result in the settlement in the adjacent buildings. Ground freezing may be problematic because of likely utilities, the relatively shallow depth of alluvium in this area. The relatively shallow undifferentiated alluvium over bedrock make secant pile walls a good possible alternative with conventional shoring such as ribs and lagging in the underlying Franciscan bedrock.

Table C1-1.2. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
15 to 30	+12	-28	40	Undifferentiated alluvium (Qu) underlain by Franciscan Complex – Serpentinite (Sp)	• Secant piles • H Piles and Ribs/Lagging • Sheet piles (silent) • Slurry wall (unlikely)

C.1.4 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulted from the construction can be problematic due to the adjacent hospital close to the shaft site.
3. Final shaft location should give due consideration to emergency room access.

C.1.5 West Retrieval Shaft: Staging Area and Adjacent

Adjacent buildings and structures compared to the proposed retrieval shaft location and staging area are listed and numbered as shown in Table C1-1.3 and Fig C-2. The proposed staging area could either be on17th between Harrison Street and Treat Ave or in the PG&E parking lot. However, if located in the street, it would require closing off the street unless decked over and a side adit to a shaft in the PG&E parking lot. Alternatively the main tunnel alignment could curve

with a 600 ft radius, with the retrieval shaft in the PG&E parking lot as shown in Figure C1-2. This radius is close to the minimum radius that will likely work in terms of the TBM operation.

It should be noted there are some power and telephone lines on 17th Street between Treat Avenue and Harrison Street. It should be also noted that 17th Street and Treat Ave is a major intersection of Muni Bus overhead lines.

Table C1-1.3. List of Adjacent Buildings /Structures around Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Shops/Guss Market	2111 Harrison St	East side of Harrison Street and at corner of 17th Street and Harrison Street	2	100	In good condition
2	Shops/Clubs and Apt.	2095 Harrison St	NE at corner of 17th St and Harrison Street	3	200	New and in good condition.
3	Condo	2030 Harrison St	North-North side of 17th Street	3 - 4	150	In new condition. There is a small parking lot adjacent to the condo
4	Shops	3030 17th St	NW- at corner of Treat Ave and 17th Street	2	142	Under repair and construction
5	Offices and Apt	400 Treat Ave	SW-at the corner of 17th St and Treat Avenue	2	153	In good condition
6	Offices and covered parking	2125 Harrison St	SE- on Harrison Street	2 - 3	150 to 200	In good condition.
7	Condo and large parking lot	2130 Harrison St	South	3	270	New in good condition

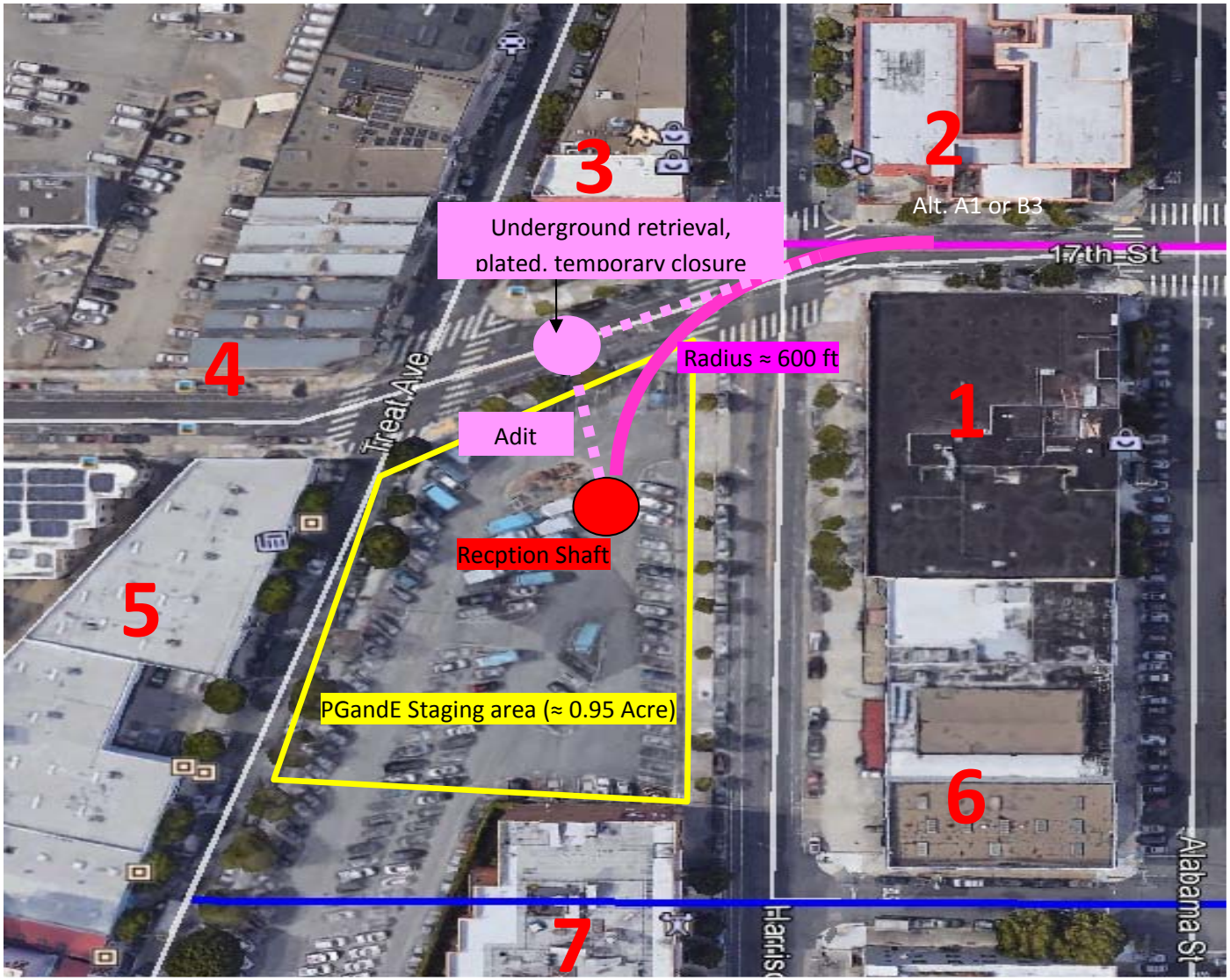

Figure C1-2: Alternative A1 or B3: Reception Shaft Locations / Staging Areas and Adjacent Structures

C.1.6 Tie-ins

The tie-ins around the staging area are as follows:

- 3’-0” by 5’-0” sewer on Harrison Street.
- 9’-6” by 9’-0” sewer on Treat Ave.

C.1.7 Shoring

The shaft conditions and shoring systems suggested in the drive shaft are shown in Table C1-1.4. It should be noted that to control of water during the excavation dewatering can be used. However, use of a dewatering system may result in the settlement of the adjacent buildings. Ground freezing is expected to be problematic because of expected utilities in the area but may be investigated in final design.

Table C1-1.4. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
15 to 30	+10	-48	58	Artificial Fill (Qaf) and Undifferentiated Alluvium (Qu)	• Secant piles • H Piles and Ribs/Lagging • Slurry Walls

C.1.8 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance from the construction can be problematic for condo adjacent to the shaft site.
3. Some power and telephone lines on 17th street may require relocation.
4. Due to the congested intersection and businesses between Treat Ave. and Harrison Street. Construction traffic will be problematic.

C.2 Alternative B1 and B1a

C.2.1 East Drive Shaft - Alternative B1a: Staging Area and Adjacent Buildings

Adjacent buildings and structures compared to the proposed drive shaft location and staging area on Alameda Street are listed and numbered in Tables C2-1.1 and shown on Figures C2-1.1.

Table C2-1.1. List of Adjacent Buildings /Structures Drive Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Jawbone /Commercials	99 Rhode Island St	North, North side of Alameda Street	3	25	In good conditions
2	Recology Golden Gate Yard	101-119 De Haro Street	East, On East side of De Haro Street	---	50	Yard/Open Parking Area
3	Volta Charging /Commercials	155 De Haro Street	SE- on East side of De Haro Street	1	150	Looks old- Including also some storage and open parking lot
4	Skool restaurant	1725 Alameda Street	South- at the corner of Haro St and Alameda Street	1	65	Including a backyard for customers
5	Commercial Building	1755 Alameda Street	South- South side of Alameda Street	1	130	In good conditions
6	Commercial building and offices	1801-1899 Alameda Street	SW- at corner of Alameda St and Rhode Island Street	4	290	Old in good conditions
7	New Condo Complex	1800 -1898 Alameda Street	NW- at corner of Alameda St and Rhode Island Street	6	270	New condo complex

It should be noted there are power and telephone lines at intersections of De Haro St and Rhode Island St with Alameda.

C.2.1.1 Tie-ins

The tie-ins around the staging area are as follows:

- 27” on De Haro Street

C.2.1.2 Shoring

The shaft conditions and shoring systems suggested in the drive shaft are shown in Table C2-1.2. It should be noted that to control of water during the excavation dewatering methods can be used. However, using dewatering system may result in the settlement in the adjacent buildings.

Table C2-1.2. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
25	+3	-27	31	Artificial Fill (Qaf)	• Secant piles • H Piles and Ribs/Lagging • Sheet piles (silent)

C.2.1.3 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulting from the construction can be problematic for the condo adjacent to the shaft site and in particular for the restaurant business.
3. There are power and telephone lines at intersections of De Haro St and Rhode Island St with Alameda. Relocation of these utilities may be required.
4. Since Alameda St between De Haro St and Rhode Island Street. should be totally closed during the construction the transportation may be problematic. Traffic control will be required.
5. The staging area is very small (0.3 acres). Compound staging areas and the associated traffic control will be required.
6. Alternative cut and cover construction alignments will be required from the shaft on Alameda around the Recology property as shown in Figure B2-1.1.

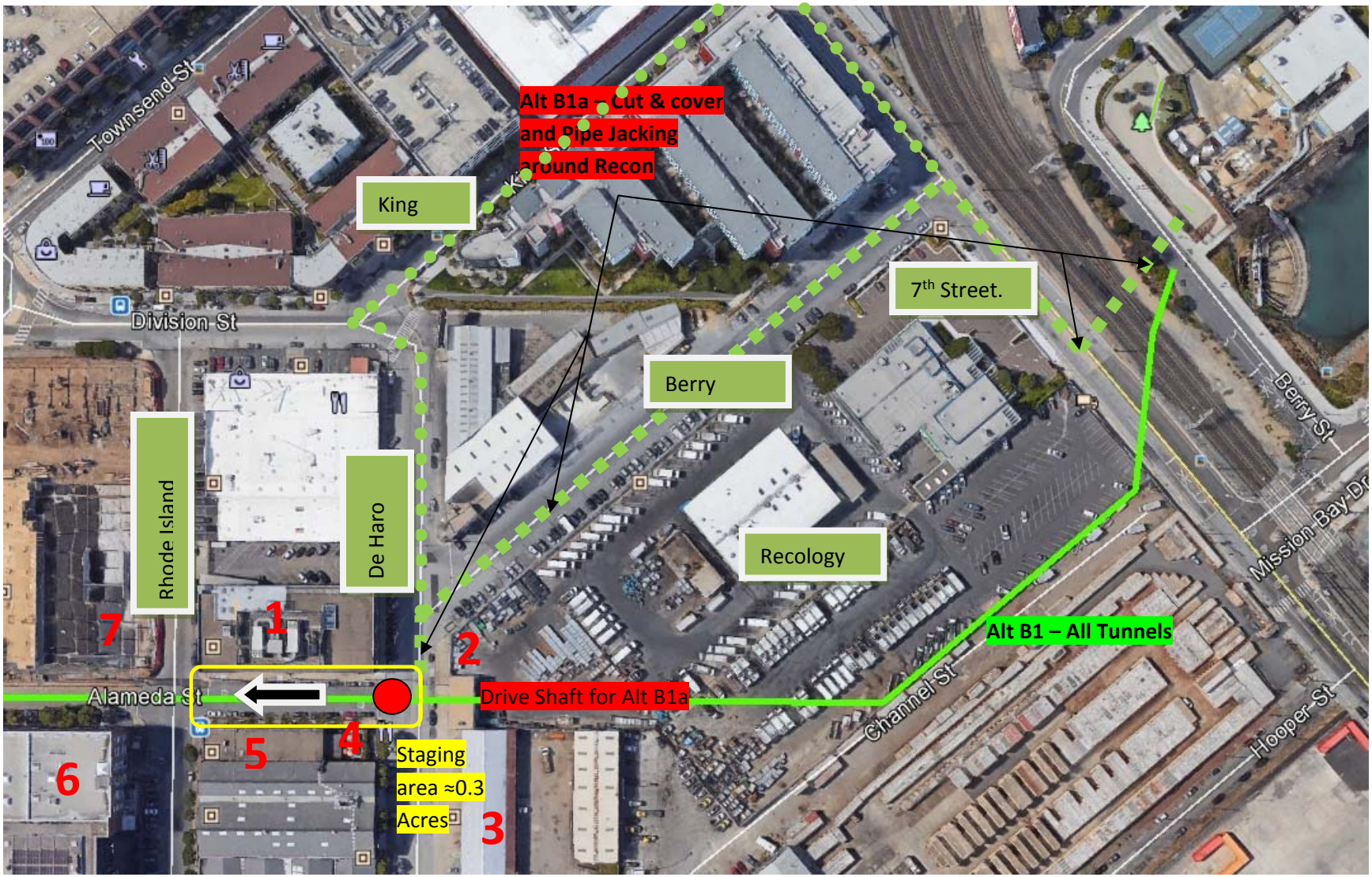

Figure C2-1.1. Alternative B1a Drive Shaft Locations / Staging Areas and Adjacent Structures

C.2.2 East Drive Shaft - Alternative B1: Staging Area and Adjacent Buildings

Adjacent buildings and structures compared to the proposed alternative drive shaft location and staging area in the Mission Bay Creek Park Dog are listed and numbered in Tables C2-2.1 and shown on Figures C2-2.1.

Table C2-2.1. List of Adjacent Buildings /Structures around Drive Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Channel Pump Station/ Tennis Court	455 Berry Street	NE- on Berry Street	2-3	0	Including the facilities and building and a tennis court
2	Recology Golden Gate and large parking lot	900 7th Street	SW- On 7th Street	1	300	In good conditions
3	Rail Road	---	NW, West, and SW, and South- Along Berry Street		100	3 to 4 tracks
4	Apt or Condo Complex	890 7th Street	W and NW- Westside of 7th Street	5	330	In good conditions
5	Condo Complex	420 Berry Street	North – North side of Berry St	4	250	
6	I-280	---	SE- Along the Berry Street and 7th Street and rail roads	---	Varies	Over piles and support

C.2.2.1 Tie-ins

The tie-ins around the staging area are as follows:

- 9’-8” by 8’-3” on Berry Street.

C.2.2.2 Shoring

The shaft conditions and shoring systems suggested in the drive shaft are shown in Table C2-2.2. It should be noted that to control of water during the excavation the dewatering methods can be used. However, using dewatering system may result in the settlement in the adjacent buildings.

Table C2-2.2. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
25	+5	-30	35	Artificial Fill (Qaf)	• and traffic control and impact to the businesses will be problematic. Traffic control is required.

C.2.2.3 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulted from the construction can be problematic for condo located on 420 Berry Street.
3. Since Berry Street. is very narrow and the only way for the transposition, this may be problematic.
4. Getting ROW permission to tunnel under the Recology property and to use Mission Bay Creek Park Dog for the main construction shaft will be problematic.
5. The staging area is small (0.35 acres). Compound staging areas and the associated traffic control will be required.

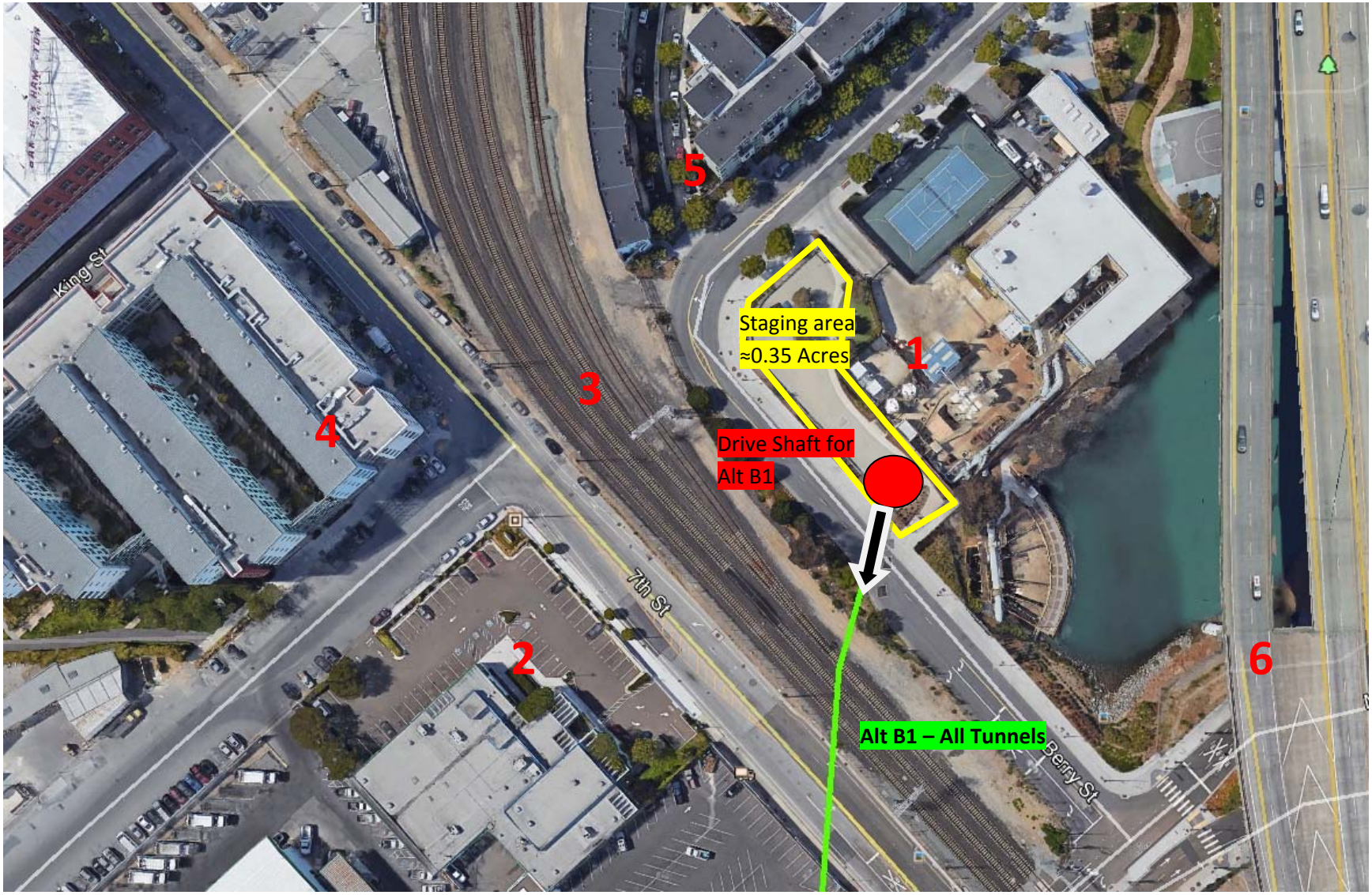

Figure C2-2.1. Alternative B1 Drive Shaft Locations / Staging Areas and Adjacent Structures

C.2.3 West Retrieval Shaft - Alternative B1 and B1a: Staging Area and Adjacent

There are two options for the retrieval shafts as shown on Figure C2-3.1.

C.2.3.1 Staging Area and Adjacent for West Retrieval Shaft – Alt.1

Adjacent buildings and structures compared to the proposed retrieval shaft and staging area located on the parking lot between Florida and Treat streets are numbered and listed in Tables C2-3.1 and shown on Figure C2-3.1.

Table C2-3.1. List of Adjacent Buildings /Structures around Retrieval Shaft-Alt.1

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Best Buy/ Commercials	1717 Harrison Street	NW - On west side of treat Street	2	120	In good condition
2	Parking/ Commercial Buildings	1200 15th Street	SW - On the west side of Treat St at corner of Alameda and Treat Street	4	200	Old but in good condition
3	Animal Care Center (SPCA)	201 Alabama Street		3 to 4	200 to 300	Good condition-including a large open parking lot
4	Storage or Commercial Building	1320 Bryant Street	NE- East side of Florida Street	2 to 3	160	In good condition
5	Associated Limousines, Inc	1398 Bryant Street	NE- East side of Florida Street	2	200	In good condition/Including small open parking lots and yard
6	Reality SF Office and other offices	1504 Bryant Street	SE- East side of Florida Street	2 to 3	320	In good condition/Including small open parking lot and yard

C.2.3.1.1 Tie-ins

The tie-ins around the staging area are as follows:

- 9’-6” by 9’-0” on Treat Street.
- Rout Treat Ave. Sewers

C.2.3.1.2 Shoring

The shaft conditions and shoring systems suggested in the retrieval shaft are shown in Table C2-3.1.3. It should be noted that to control water during excavation dewatering methods can be used. However, using dewatering system may result in the settlement in the adjacent buildings.

Table C2-3.1.3 Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
25	+10	-23	33	Artificial Fill (Qaf) and Undifferentiated Alluvium (Qu)	• Secant piles • H Piles and Ribs/Lagging • Sheet piles (silent)

C.2.3.1.3 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulting from construction can be problematic for the commercial buildings located around the parking lot.
3. Getting ROW permission to use the in the parking lot during the construction may be difficult.

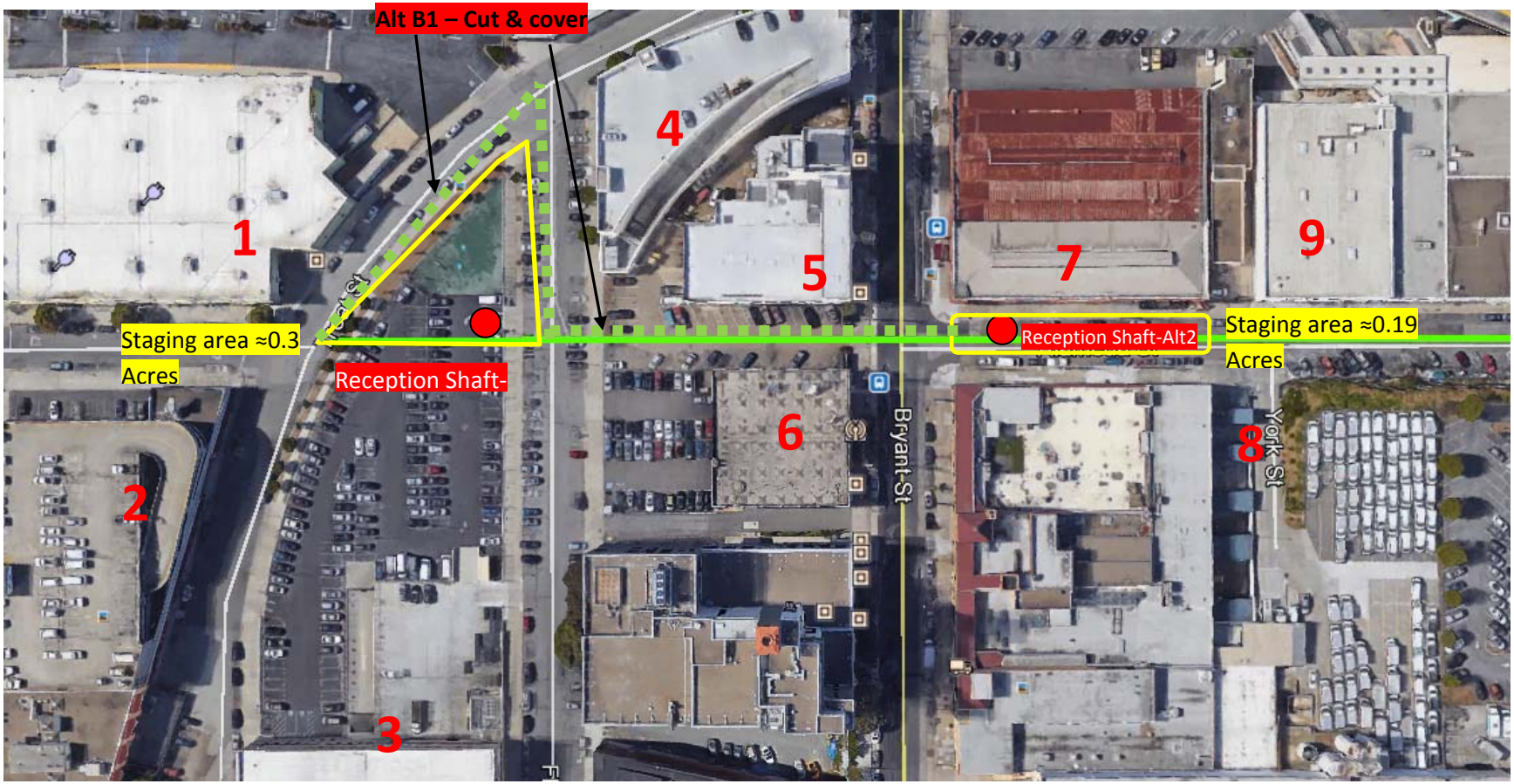

Figure C2-3.1. Alternative B1 Drive Shaft Locations / Staging Areas and Adjacent Structures

C.2.3.2Staging Area and Adjacent for West Retrieval Shaft – Alt.2

Adjacent buildings and structures compared to the proposed retrieval shaft located on the Alameda Street are listed in Tables C2-3.2 and shown on Figure C2-3.1. Figure C2-3.1 also shows the proposed staging area.

Table C2-3.1. List of Adjacent Buildings /Structures around Retrieval Shaft-Alt.2

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
5	Associated Limousines, Inc	1398 Bryant Street	NW- West side of Bryant Street	2	141	In good condition/Including small open parking lot and yard
6	Reality SF Office and other offices	1504 Bryant Street	SW- Bryant Street	2 to 3	150	In good condition/Including small open parking lot and yard
7	Commercial buildings	2502-2598 Alameda Street	North- North side of Alameda Street	1	25	Old-In good condition including a small yard
8	Self Storage/ UHAUL	1525 Bryant Street	South and SW- South side of Alameda Street and at corner with Bryant Street	3	25	Old/ In good condition- Including a large parking lot at top of slope.
9	Storage/ Commercial Buildings	2460 Alameda Street	North- North side of Alameda Street	2 to 3	230	New

C.2.3.2.1 Tie-ins

The Tie-ins around the staging area are as follows:

C.2.3.2.2 Shoring

The shaft conditions and shoring systems suggested in the retrieval shaft are shown in Table C2-3.2.3. It should be noted that the shaft will be most likely be excavated only through bedrock.

Table C2-3.2.3 Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System

25	+22	-23	45	Undifferentiated Alluvium (Qu) and Franciscan complex (SP) including bedrock	• H Piles and Ribs/Lagging • Rock bolt and shotcrete with mesh

C.2.3.1.3 Construction Issue:

1. Noise disturbance resulted from construction will be problematic for the commercial and industrial buildings located on Alameda Street.
2. Excavation of shaft in Alameda Street will likely be difficult and will require compound staging areas and the associated traffic control.
3. There are power and telephone lines along Alameda Street and at intersections of Bryant St with Alameda. Relocation may be required.
4. Alameda St between Bryant St and York Street will be totally closed during construction and traffic control and impact to the businesses will be problematic. Traffic control is required.
5. The staging area is very small (0.19 acres) and will require compound staging and the associated traffic control.

C3. Alternative B3

C.3.1 East Drive Shaft: Staging Area and Adjacent Buildings

There are two options for the east drive shaft as shown on Figure B3-1.1. This shaft location can also be an Intermediate Shaft for Alternative A1.

C.3.1.1Staging Area and Adjacent for East Drive Shaft – Alt.1

Adjacent buildings and structures compared to the proposed drive shaft and staging area located on Carolina Street are numbered and listed in Tables C3-1.1 and shown on Figure C3-1.1.

Table C3-1.1. List of Adjacent Buildings /Structures Drive Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Zesty	1640 17th Street	EaStreet. At corner of 17th and Carolina Street	1 to 2	30	Caterer
2	Chilton Auto Body/Storage	166 Wisconsin Street	NE- East side of Carolina Street	1	40	The back door and yard is on Carolina Street.
3	Fuseproject/ Design Co.	1401 16th Street	NW- West side of Carolina Street and at corner with 16th Street	1	90	Back door on Carolina Street.
4	Storage	1345 16th Street	NE- East side of Carolina St and at corner with 16th Street	1	120	Back door on Carolina Street.
5	Storage/ Office	1740 17th Street	West- West side of Carolina Street	1 to 2	50 to 100	Application unknown/ including a parking lot on the east side of Carolina Street.
6	Play area And baseball court	17th Street	SE- At corner of Carolina St and 17th Street	---	156	
7	Maverick Studios/condo	1715 -1717 17th Street	South- At corner of 17th St and Carolina Street	5 to 6	204	New/Large condos and offices including Philza coffee next to 17th Street.

C.3.1.1 Tie-ins

The Tie-ins around the staging area are as follows:

C.3.1.2 Shoring

The shaft conditions and shoring systems suggested in the drive shaft are shown in Table C3-1.2.It should be noted that to control of water during the excavation the dewatering methods can be used. However, using dewatering system may result in the settlement in the adjacent buildings.

Table C3-1.2. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
25	+7	-27	34	Old Bay Clay (Qbc) Undifferentiated Alluvium (Qus)	• Secant piles • H Piles and Ribs/Lagging • Sheet piles (silent)

C.2.1.3 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulting from the construction can be problematic for condo adjacent to the shaft site and in particular for the Caterer business.
3. Carolina St between 17th St and 16th Street. will be totally closed during construction (either for open cut or tunneling) and traffic control and impact to the businesses will be problematic.Traffic control is required.
4. The staging area is almost small (0.37 acres).

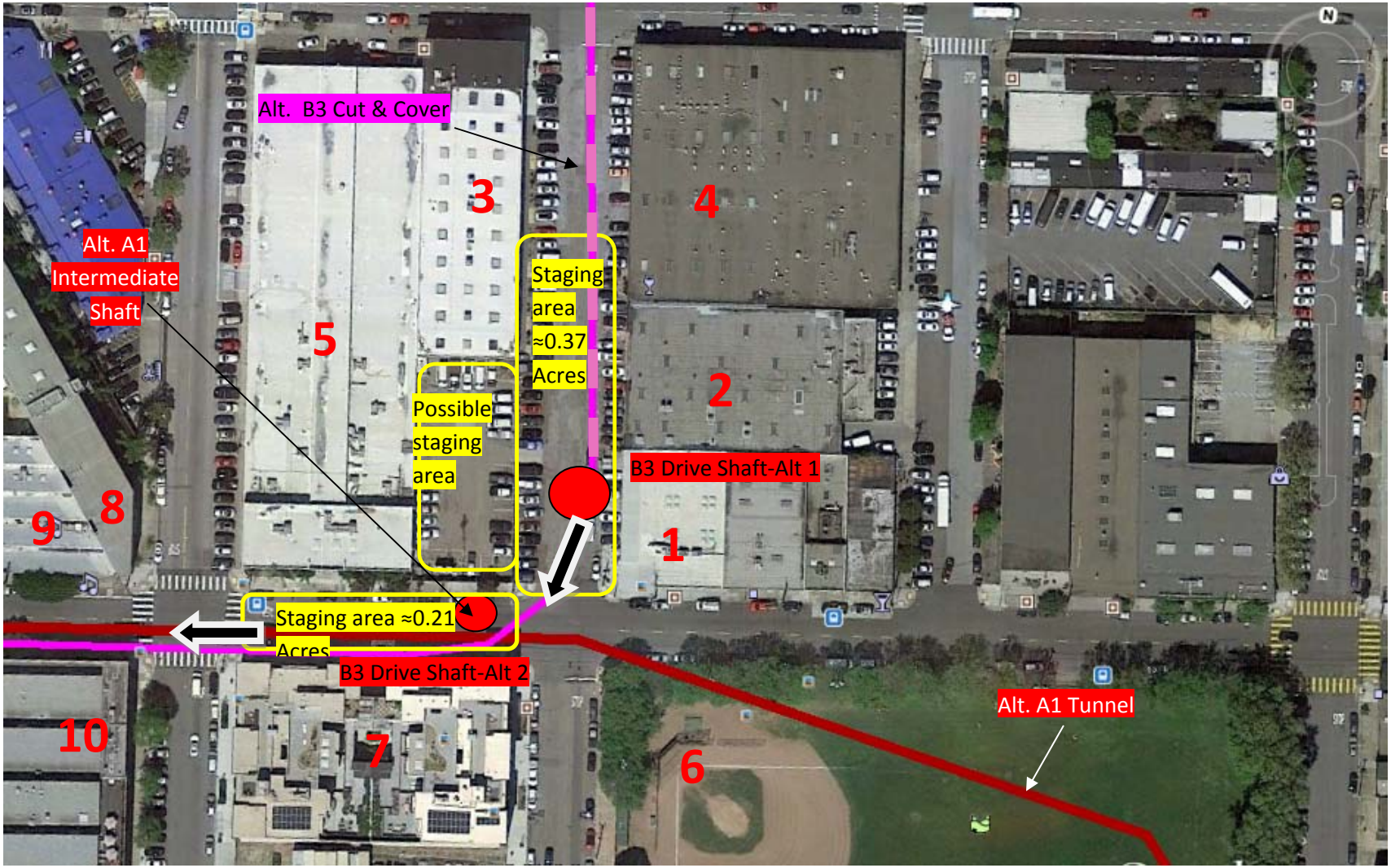

Figure C3-1.1 Alternative B3 Drive Shaft Locations or Alternative A1 Intermediate Shaft Location / Staging Areas and Adjacent Structures

D.3.1.2Staging Area and Adjacent for East Drive Shaft – Alt.2

Adjacent buildings and structures compared to the proposed drive shaft and staging area located on 17th Street are numbered and listed in Tables C3-1.2 and shown on Figure C3-1.1.

Table C3-1.2. List of Adjacent Buildings /Structures Drive Shaft

No.	Name	Address	Direction (Compared to Shaft Location)	Story No.	App. Dis.(ft)	Remarks
1	Zesty	1640 17th Street	NE and EaStreet. At corner of 17th and Carolina Street	1 to 2	102	Caterer
2	Chilton Auto Body/Storage	166 Wisconsin Street	NE- East side of Carolina Street	1	180	The back door and yard is on Carolina Street.
3	Fuseproject/ Design Co.	1401 16th Street	North- West side of Carolina Street and at corner with 16th Street	1	200	Back door on Carolina Street.
4	Storage	1345 16th Street	NE- East side of Carolina Street and at corner with 16th Street	1	278	Back door on Carolina Street.
5	Storage/ Office	1740 17th Street	North and NW- West side of Carolina Street	1 to 2	25 to 70	Application unknown/ including a parking lot on the east side of Carolina Street.
6	Play area And baseball court	17th Street	SE - At corner of Carolina St and 17th Street	---	105	
7	Maverick Studios/condo	1715 -1717 17th Street	South and SW- At corner of 17th Street and Carolina Street	5 to 6	27	New/Large condos and offices including Philza coffee next to 17th Street.
8	Residential Building Complex	370 De Haro Street	NW- at corner of 17th Street and De Haro Street	2 to 3	260	In good condition- There are some two story
9	Offices and commercial building	1830 17th Street	NW- at corner of 17th Street and De Haro Street	1	265	Old- including two or three stories.
10	De Haro Place/ Software company	444 De Haro Street	SW- at corner of 17th Street and De Haro Street	2 to 3	250	New

It should be noted there are power and telephone lines at intersections of De Haro St and Rhode Island St with Alameda.

C.3.1.1 Tie-ins

The Tie-ins around the staging area are as follows:

C.3.1.2 Shoring

The shaft conditions and shoring systems suggested in the drive shaft are shown in Table C3-1.2. It should be noted that to control of water during excavation dewatering methods can be used. However, using dewatering system may result in the settlement in the adjacent buildings.

Table C3-1.2. Geology and Shoring System in Drive Shaft

Shaft Diameter (ft)	Approx. Elevation at top	Approx. Elevation at bottom	Shaft Depth (ft)	Geology	Shoring System
25	+7	-27	34	Old Bay Clay (Qbc) Undifferentiated Alluvium (Qus)	• Secant piles • H Piles and Ribs/Lagging • Sheet piles (silent)

C.3.1.3 Construction Issue:

1. Dewatering system may impact the adjacent buildings during the construction.
2. Noise disturbance resulted from the construction can be problematic for condo and apartments adjacent to the shaft site and in particular for the Caterer business.
3. 17th St should be totally closed between De Haro St and Carolina Street. during construction, and traffic control and impact to the businesses will be problematic. Traffic control is required.
4. Power and telephone lines along 17th street and at intersection of 17th St with De Haro St and Carolina St may make cause issues during the construction. Relocation may be required.
5. The staging area is small (0.37 acres). Compound staging and the associated traffic control will be required.

C.3.2 East Retrieved Shaft: Staging Area and Adjacent Buildings

The staging area location and all conditions for the west retrieved shaft in Alternative B3 are the same as described in Section D1 for the west retrieval shaft in Alternative A1.

C4. Alternative B6

The location of the drive and retrieval shafts and all conditions for the staging areas are the same as described in Section C.1 for Alternative A1. However, the retrieval shaft would be located toward south and west in the PG&E parking lot so that a tunnel with a slight curve will be excavated from Mariposa Street. to the parking lot adjacent to Harrison St (see Figure C4-1).If the alignment curve comes to close to the condominium on Harrison Street and S-curve would be required to negotiate the corner at Mariposa and 17th streets.

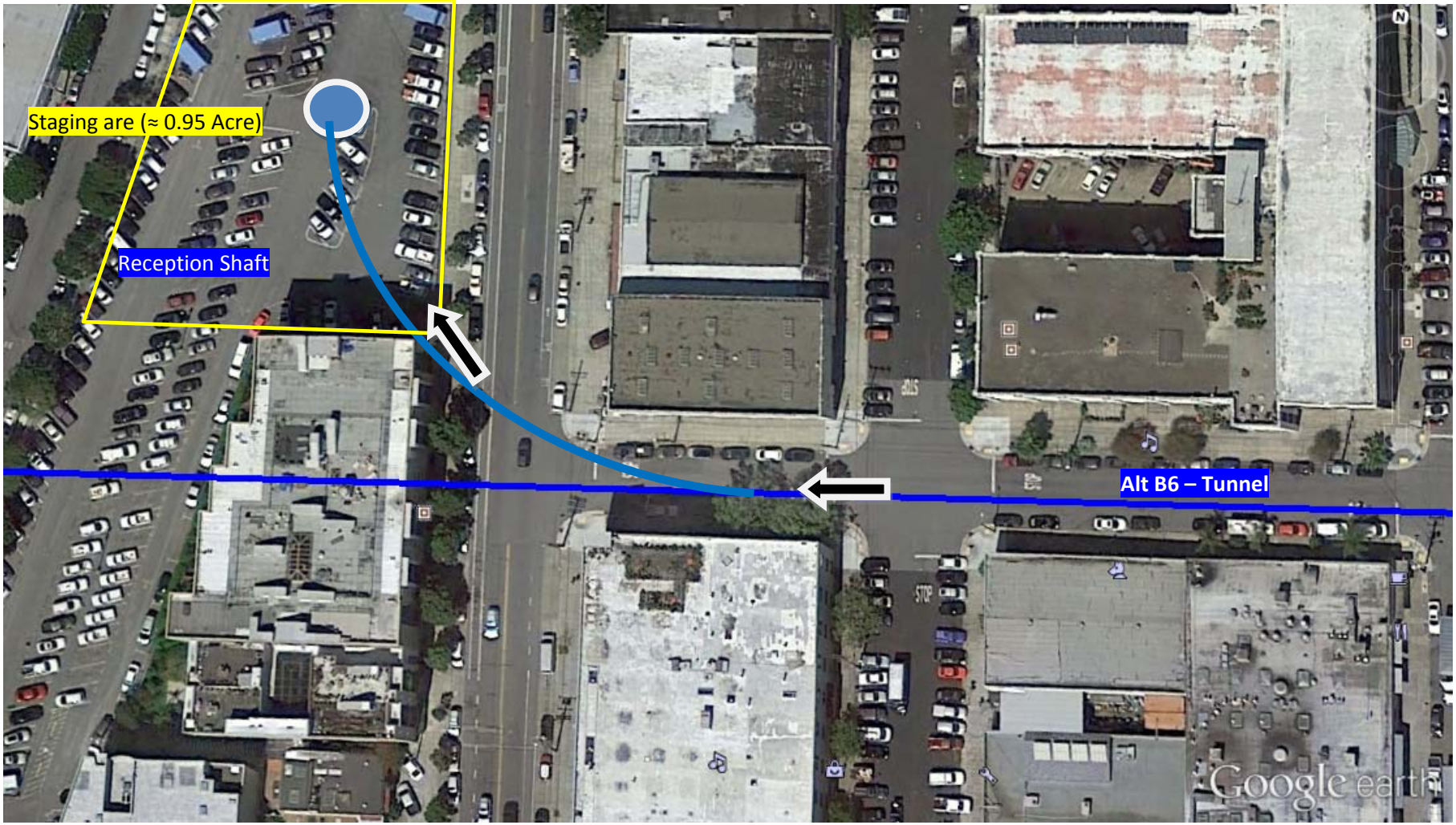

Figure C4-1. Alternative B6 Reception Shaft Locations / Staging Areas and Adjacent Structures

Appendix D

Tunneling Conditions Based on Rock Quality Evaluation

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APPENDIX D: TUNNELING CONDITIONS BASED ON ROCK QUALITY EVALUATION FOR FOLSOM TUNNEL ALTERNATIVE

D.1 Rock Quality for Tunneling Alternatives

This rock quality evaluation is based on (1) observation of street-side rock outcrops during a field inspection site walk on June 7, 2016, (2) summaries of boring logs and geologic cross-sections of CBSIP segments contained in Jacobs Engineering documents (progress copy May 2016), and (3) MWH/URS 2015 (CHTL) Alignment Alternatives Analysis TM (Section 5.3 and Appendix D).

The predominant rock type in all alternative alignments is Franciscan serpentinite. Serpentinite is a low-grade ultra-mafic metamorphic rock which is typically altered with soft minerals (e.g. clay, chlorite, talc, chrysotile, etc.). The rock is typically blocky and seamy with pervasive fractures and slickensided joint surfaces. Due to smooth geometry and slickenside coatings, joints in serpentinite typically have low frictional resistance. This means that despite local blockiness, the overall rock mass may behave as a generally strong material but have poor to very poor stability. The serpentinite mass in the vicinity (Potrero Hill) has been described by MWH-URS as slightly to moderately weathered with localized shear zones and soft matrices. Naturally occurring asbestos (NOA) minerals are commonly present in serpentinite at low concentrations, but the CHTL report assessed that concentrations are likely to exceed 1% which is the DTSC hazardous level. Therefore, rock waste would need to be disposed as Class II waste or specially permitted by DTSC to be used in confined backfill (isolated from contact with the environment). Presence of NOA may also affect permitting requirements for tunnel air quality and ventilation. This is not a significant tunnel alternative selection differentiator because all Folsom tunnel alternatives would intersect serpentinite rock.

Eight deep boreholes were drilled along the CBSIP alignments (MWH-URS, 2015 CHTL Report). Rock quality was evaluated in Appendix D of that report. Four of the 8 borings cored through Franciscan bedrock near end points of the Folsom alternatives:

- Boring B-40, near east end of Alt. B-6 and Alt. A-1
- Boring B-12, on 20th St. near Carolina St., 3 blocks south of Alt. B-6 and Alt. A-1
- Boring B-6, near 16th & Arkansas, 2 blocks east of Carolina Street.
- Boring B-57, at DeHaro and Berry streets at the northwest bend in Alt. B-3. This is also near the east end of Division Street (Alt. C1).
- Borings B-61, B-16, B-31, and B-55A were farther off the Folsom alternative alignments to the south, but the rock quality was fairly consistent with the other borings.

D.2 Reasoning for RMR IV to V Rock Mass Rating

The coverage of rock boring data for the Folsom tunnel alignments is best near the east ends of the alignments. In general, the rock core recovery in these borings was very high (near 100%) but locally as low as 40% to 60% at tunnel depths in B-40 and B-57 (see MWH-URS 2014 exhibits). This indicates an overall strong matrix; however, RQD (% core recovery in pieces greater than 4-inches long) was generally zero which indicates closely-spaced fracturing. Boring B-6 had somewhat better RQD, but still only 10% to 30%. Due to this pattern, the Bieniawski RMR is regarded as variable within the range of IV - poor rock to V - very poor rock.

D.2.1 Secondary RMR III Blocks

On geologic maps, some rock masses are identified as “Jspm” massive Franciscan serpentinite. It is likely that these blocks may have somewhat better rock quality and therefore may be rated as RMR III - fair. Likewise, the maps show some large blocks of Franciscan sandstone “ss”. These areas have also been rated as RMR III.

D.2.2 Quaternary Sediments Beneath California Street

Alt. A1 Soil Deposits. The geologic profile for Alt. A1 indicates that the tunnel may intersect Quaternary Old Bay Clay (Qbc) near station 34+00 to 39+00 below California Street. However, this is very interpretive and based on boring logs projected onto a cross-section Figure TU-102 from Jacobs (2016). It is uncertain whether Qbc extends all the way down to tunnel depth at California and 17th St. Alluvium (Qu/Qbc) may or may not extend to tunnel depth in the profile for Alternative A1. Much of the alluvium in this area is described as old Bay Clay (unpublished prelim. Jacobs 2016).

Alt. B3 Soil Deposits. This alignment intersects rock (serpentinite) from Harrison Street to approximately station 30+80. There is a boring log near 16th St and California St. and it is documented that there is a deep profile of alluvium and sedimentary units extending down to depths of more than 80 feet. This is where Alternative B3 bends to the north and transitions to cut-and-cover construction.

Alt. B6 Soil Deposits. Similar to the above comment on Alt. A1, the geologic profile for Alt. B6 indicates undifferentiated Quaternary sediments (Qu) extending down to tunnel depth at station 35+00 to 38+50. This depth is uncertain due to southward projection of boring log on California Street.

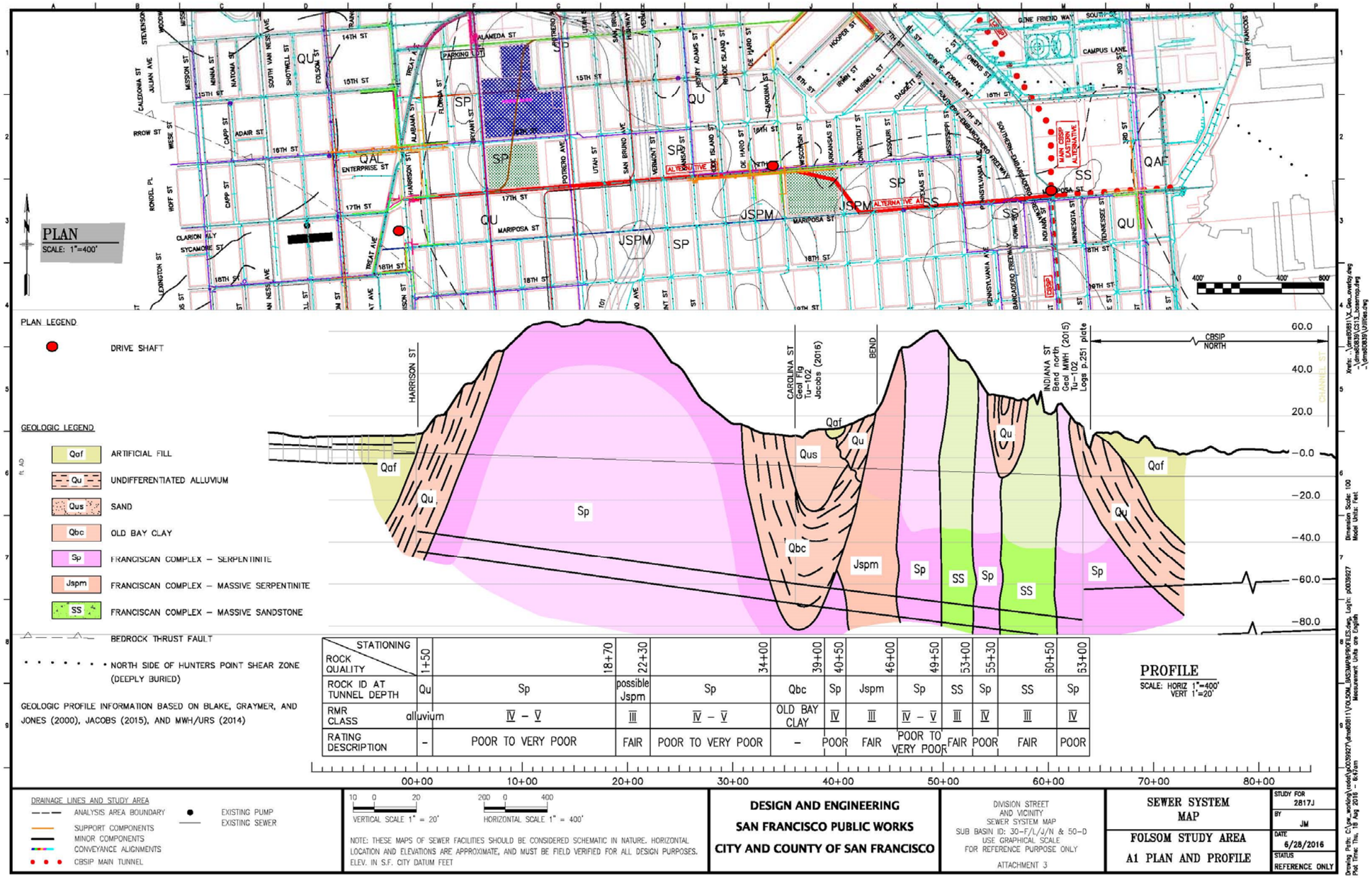

Figure D-1:Alt. A1 Geologic Plan and Profile

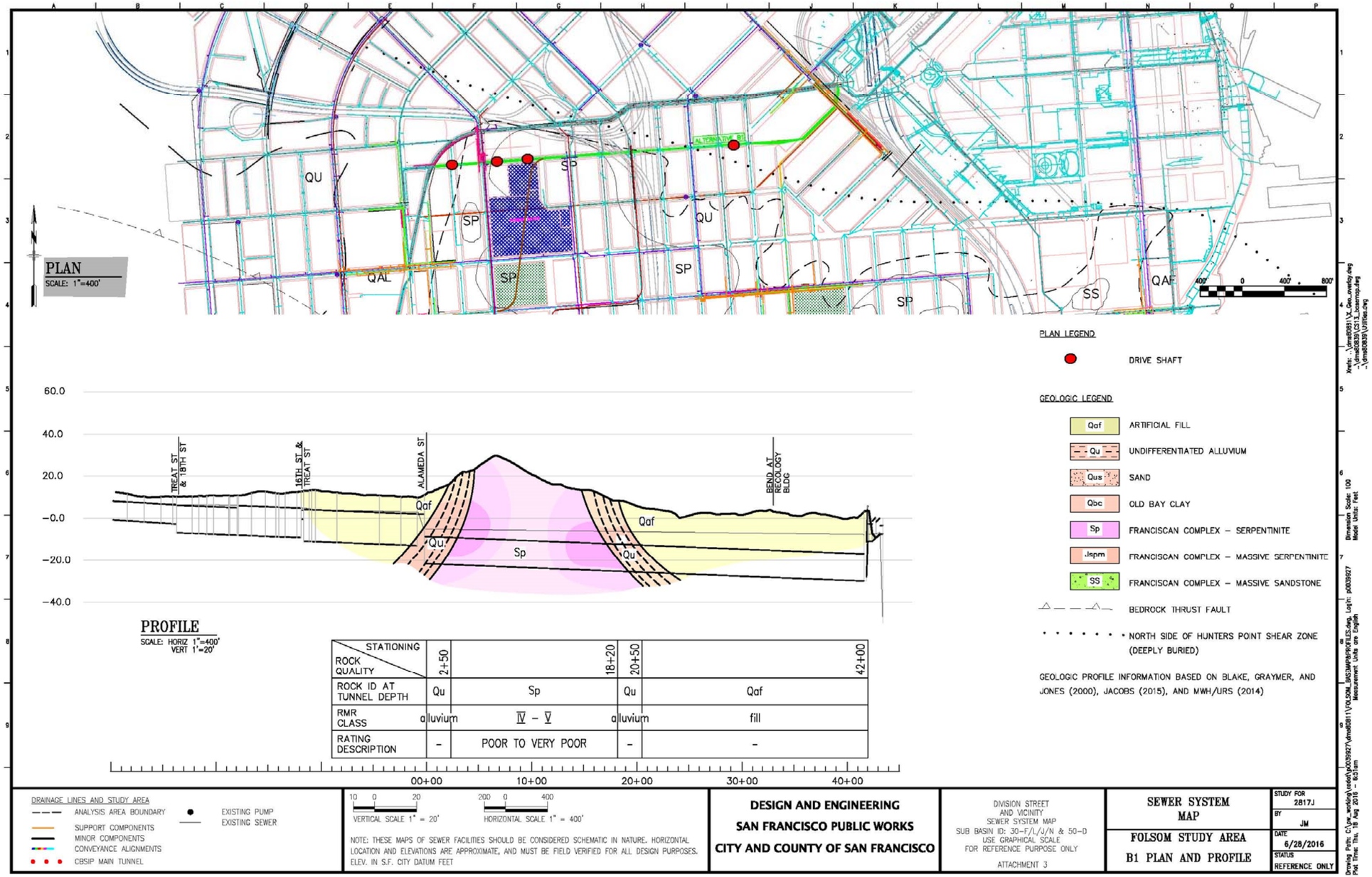

Figure D-2:Alt. B1 Geologic Plan and Profile

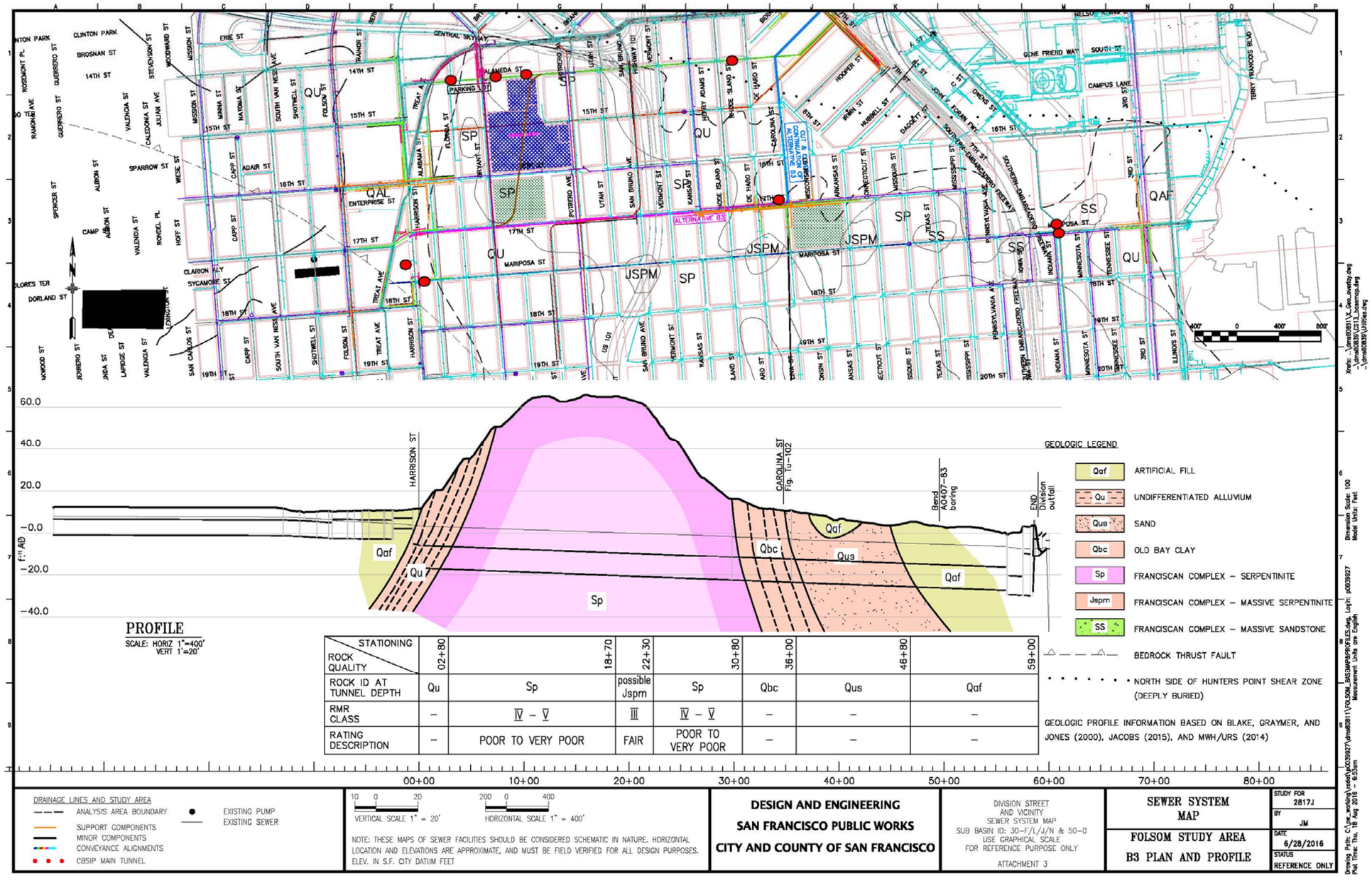

Figure D-3:Alt. B3 Geologic Plan and Profile

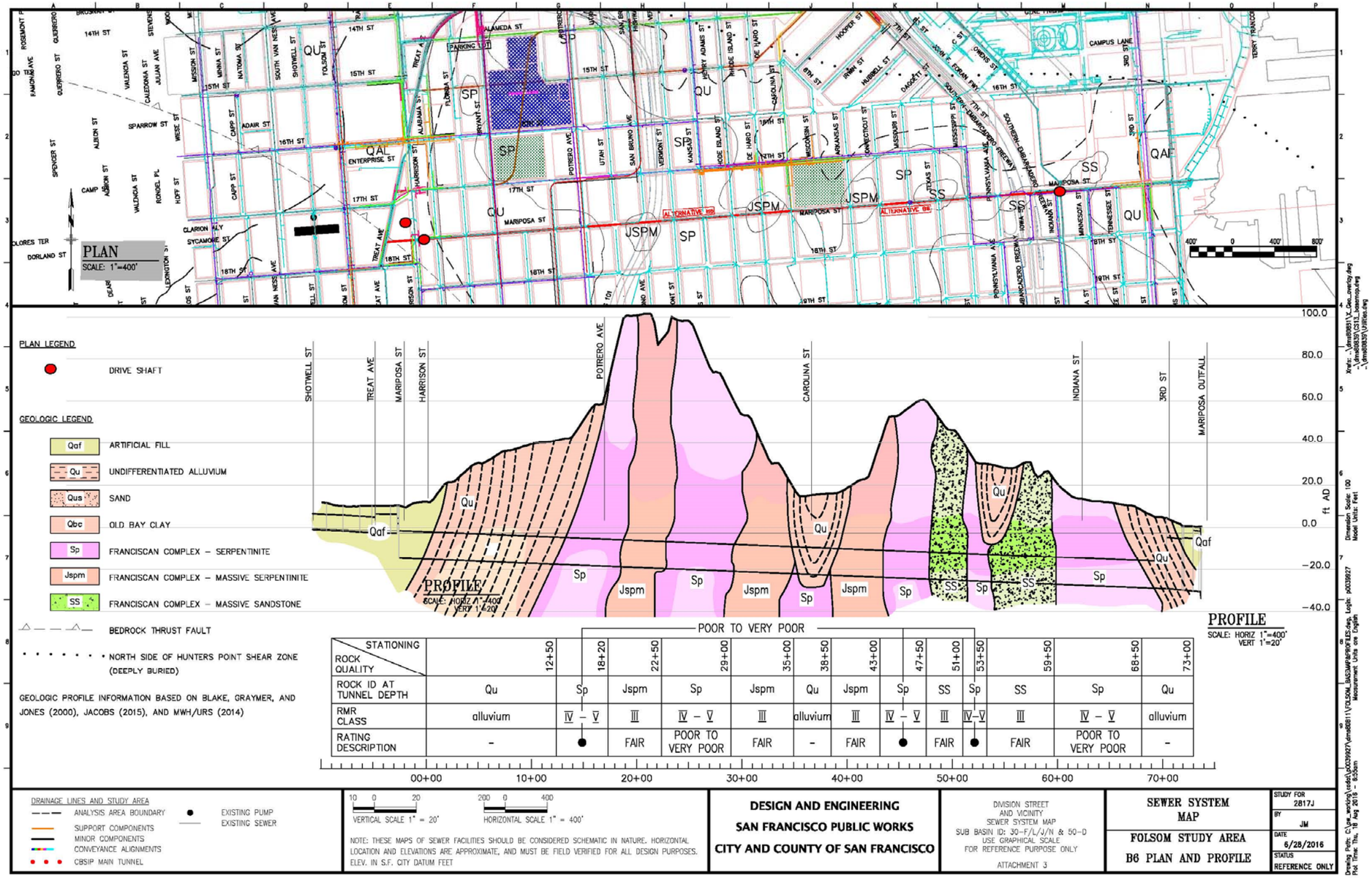

Figure D-4: Alt. B6 Geologic Plan and Profile

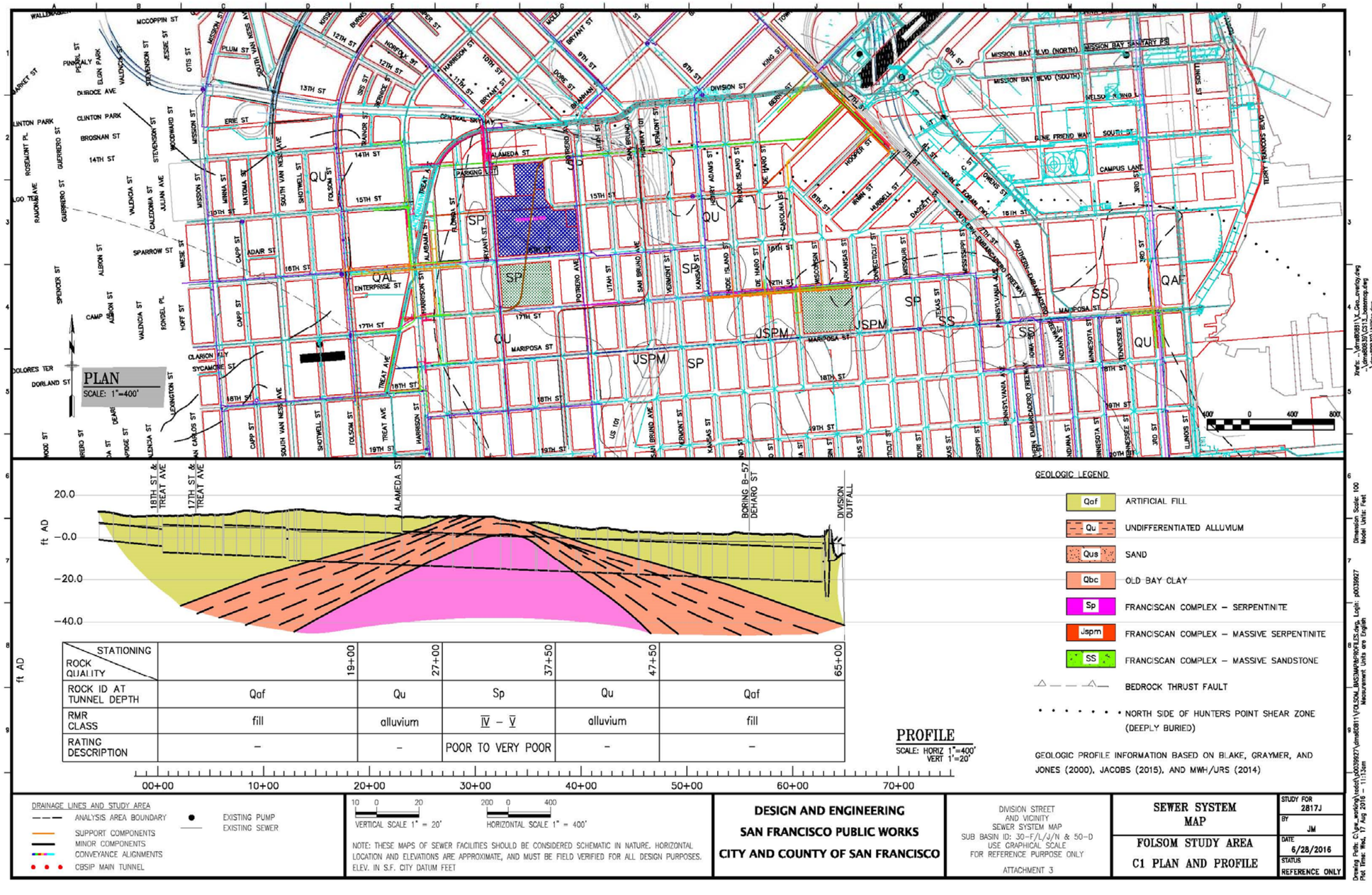

Figure D-5: Alt. C1 Geologic Plan and Profile

Appendix E

Conveyance Alternatives Cost Estimate

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APPENDIX E: CONVEYANCE ALTERNATIVE COST ESTIMATES

The basis of the Opinion of Probably Construction Costs (OPCC) provided in the main report are based on the methodology shown in Table E-1 (with 30% contingencies) and detailed back up is provided in Table E-2 for A, B3 and B6 (without 30% contingencies). Detailed backup for B1 are included in attachments. The ENR index corrections used is provided in Table E-3.

The accuracy of the cost estimate is a considered to be a level IV estimate with -30% and +50% accuracy, but the cost analysis is intended for comparison purposes only to evaluate the relative costs of the alternatives. This estimate has been prepared using the practices, skill, and care typical of similar projects and estimating standards. However, due to the indeterminate variables associated with future market conditions, differences between the indicative cost estimates they provide and eventual actual costs of the project may vary considerably.

General conditions for public work projects can be substantial and are not included and assumed to be constant for all alternatives.

The main sources and references for costs include the following:

> Engineering News Record, Historical Cost Indices as shown in Table E-3.
>
> SFPUC [San Francisco Public Utilities Commission], 2013, Collection System Validation Report, Appendix B – SSMP Basis of cost memorandum, dated May 8, 2007, prepared by SSIP PMC, May 2012.

The methodology for estimating the tunnel costs was to use:

> SFPUC 2013, the recommended equations for storage tunnel in soil and rock for less than 30 ft diameter. Liner costs were added to these at a rate of $3500 per foot.
>
> Shaft depths are variable and not included in the estimates; however, an average of 7.6 million dollars per shaft can be added.
>
> Two other parametric methods were used to check that the SFPUC guidelines were in the right ballpark as detailed in the summary back up sheets in Table D-2.

It should be noted that the SFPUC's Sunnydale Tunnel, which bid in April of 2010, the low bid for a unit cost of $ 9,345/FT. The project was through similar ground. Adjusting for inflation from 2010 to 2016 increases the amount to $11,185/FT (about $77.50 inch diameter/ft). The range of unit costs provided in Table D-1 is on the order of $10,500 (about $72.90 inch diameter/ft) about 6% lower than the Sunnydale costs.

The methodology for estimating the cut-and-cover costs was to use:

> SFPUC 2013, Figure 1.1 for cover > 12 ft, SD1 (Northern Kentucky).

The methodology for estimating the pipe jacking costs was to use:

> SFPUC 2013, Figure 1.5, Alcosan, for Pittsburg, PA curve was used.

Table E-1: Summary of Conveyance Costs

Alternative	Station to Station	Tunnel Length (ft)	Box or Multi-Pipes Jacking (ft)	Cut and Cover (ft)	Total Cost adjusted to 2016 plus 30% contingencies
A1	0+00 to 63+00	6,300			67,369,343
B1	0+00 to 42+00	4,200			75,770,792
B1a	0+00 to 51+00	3,200	300	1,600	81,242,630
B3	0+00 to 68+00	3,600	300	2,900	96,349,286
B6	0+00 to 73+30	7,330			87,387,199

A1, B3, B6 Cost Summary

Table E-2 Detailed Back-Up of Conveyance Costs (without 30% contingencies)

Alternative A1: 17th St./Mariposa St.

All Tunnel

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft)												Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
		Qu (Soil)	SP (Rock)	SPM (Rock	SP (Rock)	Qbc (Clay)	Sp (Rock)	JSPM (Rock)	SP (Rock)	SS Rock)	SP (Rock)	SS (Rock)	SP (Rock)													
12.5	9.5	150	1720	360	1170	500	150	550	350	350	230	520	250	650	5650	3,356,848	50,397,834	22,861,328	9,826,177	2.97%	55,351,197	26,996,856	13,574,561	56,378,287	11,251,362	**51,822,571**

Alternative B3: 17th St.

Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft)					Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
		Qu (Soil)	SP (Rock)	SPM (Rock	SP (Rock)	Qbc (Clay)													
15	12	280	1590	360	850	520	800	2800	5,656,185	34,202,038	15,534,235	5,305,547	2.97%	5,824,174	21,819,776	11,287,296	42,640,437	6,980,022	34,384,448

Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Not used	Total Length in soil (ft)	Total Length in Rock (ft)	Not used	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Urban Area Escalation 1.15 (refs 3)	ENR Escalation = 10507/9837.4 (refs 3 and ENR)	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
15	12		2900	0		12,598,186	12,149,743	24,872,418	1.15	1.068066766	15,474,059	14,923,247	30,550,214

Pipe or Box Jack Portion

Bored Dia (ft)	Pipe Dia. (ft)	Not used	Total Length in soil (ft)	Total Length in Rock (ft)	Not used	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Not used	ENR Escalation = 10507/9837.4 (refs 3 and ENR)	Not used	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
15	12		300	0		2,254,637	8,595,131		1.068066766		2,408,103	9,180,174
									TOTAL PIPE JACK and C&C			39,730,388
									Total Tunnel, Pipe Jack and C&C			**74,114,835**

Alternative B6: Mariposa St.

All Tunnel

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft)													Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
		Qu (Soil)	SP (Rock)	SPM (Rock	SP (Rock)	SPM (Rock	Qu (Soil)	JSPM (Rock)	SP (Rock)	SS Rock)	SP (Rock)	SS Rock)	SP (Rock)	Qu and Qaf													
15	12	1250	570	430	650	600	350	450	450	350	250	600	900	480	2080	5250	16,522,509	55,183,083	27,369,320	9,792,790	2.97%	73,835,248	45,195,416	27,096,863	73,252,013	13,961,697	**67,220,922**

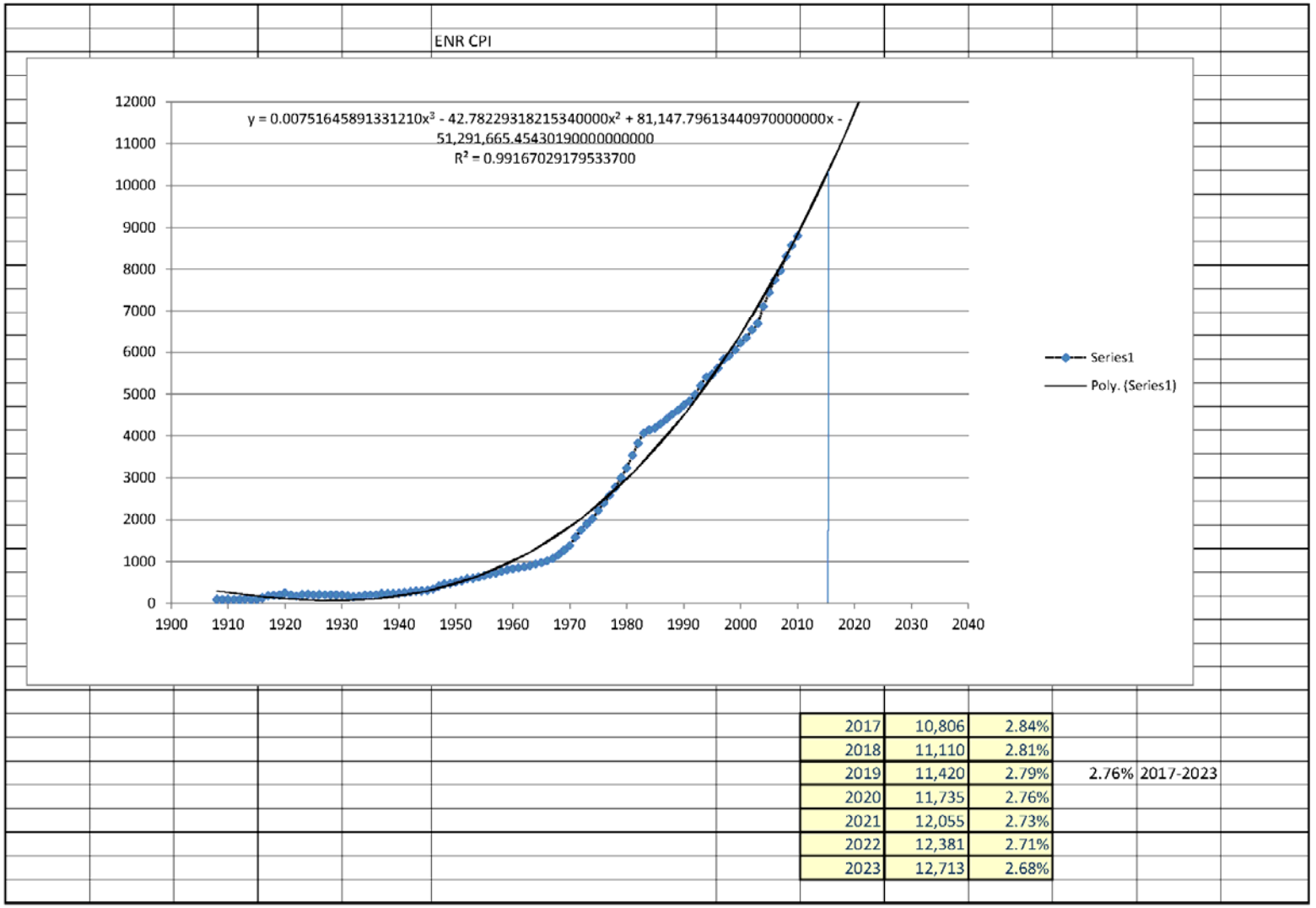
References

1. Min, S. and J. Kaneshiro, 2012, Parametric Unit Cost Estimate of Soft Ground Bored Tunneling for Planning Studies, North American Tunneling Conference, Indianapolis. — Used for comparison purposes check only
2. Sepehrmanesh, M., J. Rostatami, and E.A. Gharahbagh, 2012, Planning level cost estimation based on statistical analysis of historical data, North American Tunneling Conference, Indianapolis — Used for comparison purposes check only
3. SSIP - PMC, May 2013, Collection System Validation Report, Appendix B: SSMP Basis of Cost Memorandum dated May 8, 2012/Updated March 12, 2012 of January 2007 AECOM memo. — Basis of Estimate

Notes:

1. To be conservative, we could add $7,619,780 to each correlation due to the fixed costs of two shafts
2. The costs resulted from the Mixed faced correlation include the total cost (indirect and direct). Other correlations include only the direct costs.

Table E-3: ENR Construction Cost Index

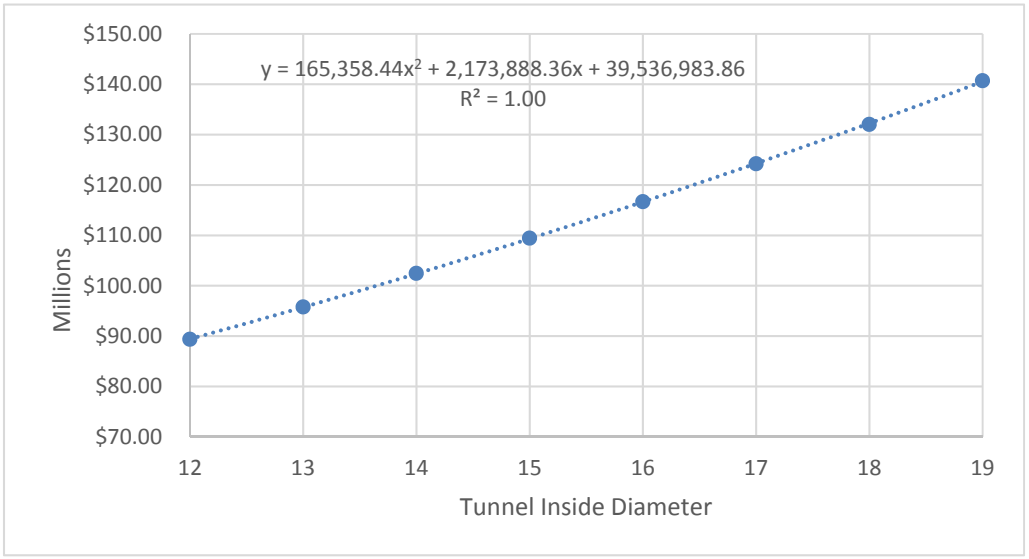


2017	10,806	2.84%		
2018	11,110	2.81%		
2019	11,420	2.79%	2.76%	2017-2023
2020	11,735	2.76%		
2021	12,055	2.73%		
2022	12,381	2.71%		
2023	12,713	2.68%		

8/7/2016

B1a Cost Summary

ID	Base Construction Cost	Total Construction Cost (Major)
12	$ 81,242,630	$ 89,366,893.02
13	$ 87,058,268	$ 95,764,095.14
14	$ 93,136,455	$ 102,450,100.47
15	$ 99,474,566	$ 109,422,022.94
16	$ 106,070,182	$ 116,677,200.64
17	$ 112,921,062	$ 124,213,168.38
18	$ 120,025,122	$ 132,027,634.69
19	$ 127,909,891	$ 140,700,880.08



Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	20,093,042
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	13,984,386
Subtotal																				$ 34,077,428
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 45,662,115
Total with contingency			30%																	$ 59,360,750

Soil
Rock

price/ft | Price inch ID/ft

$ 14,269	$ 51.70	3.673611111	$ 52,420.27	$ 189.93		
$ 18,550	$ 67.21	3.673611111	$ 68,146.35	$ 246.91		

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	20,093,042
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	13,984,386
Subtotal						Total Length in Rock (ft)									38,142,819			41,154,128		$ 34,077,428
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 46,069,398
Total with contingency			30%																	$ 59,890,218

Soil
Rock

price/ft | Price inch ID/ft

$ 14,397	$ 52.16	
$ 18,716	$ 67.81	

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
15	12					1600		12,837,119	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	24,284,523	3,341,932	7,752,730	7,476,765	15,306,104	1.292025	1.087	10,888,175	10,500,602	21,496,369
																						Price per foot			6,805	6,563	13,435
																						Price per inch inside diameter/foot			$ 24.66	$ 23.78	$ 48.68
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	15	12					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	2,217,975	2,254,637	3,628,314	1.292025	1.087	3,114,993	2,450,790.95	3,943,977.85
Price per foot						10,383	8,169	13,147
Price per inch inside diameter/foot						$ 37.62	$ 29.60	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking
	$ 1,744,700	$ 1,986,240
Price per foot	5,816	6,621
Price per inch inside diameter/foot	$ 21.07	$ 23.99
	seems low	seems low

TOTAL PIPE JACK and C&C 14,832,153

			Combined CCI, Akron to SF, SF Public Sector	
Total Tunnel, Pipe Jack and C&C				48,909,581
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12
Junction Structure/Tie-in*				$ 2,000,000.00
Total				$ 62,494,331
Total with contingency		30%		$ 81,242,630

*Reference Sunnydale Tunnel

without co

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
16	13	250	1570	230	1150	1630	1570	14,601,449	23,194,203	10,063,403	3,091,975	8.70%	12.35%	15.00%	41,083,874	26,810,694	19,232,752	43,345,947	6,729,529	21,837,465
16	13	250	1570	230	1150	1630	1570	14,601,449	23,194,203	10,063,403	3,091,975	8.70%	12.35%	15.00%	41,083,874	26,810,694	19,232,752	43,345,947	6,729,529	15,028,515
Subtotal																				$ 36,865,980
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 48,450,668
Total with contingency			30%																	$ 62,985,868

Soil
Rock
price/ft $ 15,141 $ 19,683
Price inch ID/ft $ 54.86 $ 71.32
3.673611111 $ 55,621.54 $ 201.53
3.673611111 $ 72,308.00 $ 261.99

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
16	13	250	1570	230	1150	1630	1570	14,601,449	23,194,203	10,063,403	3,091,975	8.70%	12.35%	15.00%	41,083,874	26,810,694	19,232,752	43,345,947	6,729,529	21,837,465
16	13	250	1570	230	1150	1630	1570	14,601,449	23,194,203	10,063,403	3,091,975	8.70%	12.35%	15.00%	41,083,874	26,810,694	19,232,752	43,345,947	6,729,529	15,028,515
Subtotal						Total Length in Rock (ft)									41,083,874			43,345,947		$ 36,865,980
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 48,857,951
Total with contingency			30%																	$ 63,515,336

price/ft $ 15,268 $ 19,849
Price inch ID/ft $ 55.32 $ 71.92

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
16	13					1600		14,341,738	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	25,577,888	3,423,579	8,952,515	8,119,619	20,219,585	1.292025	1.087	12,573,191	11,403,446	28,397,015
																						Price per foot			7,858	7,127	17,748
																						Price per inch inside diameter/foot			$ 28.47	$ 25.82	$ 64.30
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	16	13					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	2,385,329	2,502,046	3,628,314	1.292025	1.087	3,350,031	2,719,724	3,943,978
Price per foot						11,167	9,066	13,147
Price per inch inside diameter/foot						$ 40.46	$ 32.85	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking
	$ 1,851,820	$ 2,108,194
Price per foot	6,173	7,027
Price per inch inside diameter/foot	$ 22.36	$ 25.46
	seems low	seems low

TOTAL PIPE JACK and C&C 16,517,169

			Combined CCI, Akron to SF, SF Public Sector	
Total Tunnel, Pipe Jack and C&C				53,383,149
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12
Junction Structure/Tie-in*				$ 2,000,000.00
Total				$ 66,967,899
Total with contingency		30%		$ 87,058,268

without co

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
17	14	250	1570	230	1150	1630	1570	16,233,144	24,352,745	10,921,667	3,162,882	8.70%	12.35%	15.00%	44,116,862	29,517,279	21,083,481	45,511,062	6,883,854	23,634,036
17	14	250	1570	230	1150	1630	1570	16,233,144	24,352,745	10,921,667	3,162,882	8.70%	12.35%	15.00%	44,116,862	29,517,279	21,083,481	45,511,062	6,883,854	16,093,154
Subtotal																				$ 39,727,190
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 51,311,878
Total with contingency			30%																	$ 66,705,441

Soil
Rock

price/ft $ 16,035 | Price inch ID/ft $ 58.10 | 3.673611111 | $ 58,906.21 | $ 213.43

price/ft $ 20,845 | Price inch ID/ft $ 75.53 | 3.673611111 | $ 76,578.08 | $ 277.46

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
17	14	250	1570	230	1150	1630	1570	16,233,144	24,352,745	10,921,667	3,162,882	8.70%	12.35%	15.00%	44,116,862	29,517,279	21,083,481	45,511,062	6,883,854	23,634,036
17	14	250	1570	230	1150	1630	1570	16,233,144	24,352,745	10,921,667	3,162,882	8.70%	12.35%	15.00%	44,116,862	29,517,279	21,083,481	45,511,062	6,883,854	16,093,154
Subtotal						Total Length in Rock (ft)									44,116,862			45,511,062		$ 39,727,190
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 51,719,161
Total with contingency			30%																	$ 67,234,909

Soil
Rock

price/ft $ 16,162 | Price inch ID/ft $ 58.56

price/ft $ 21,011 | Price inch ID/ft $ 76.13

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
17	14					1600		15,943,402	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	26,855,494	3,502,091	10,244,368	8,762,474	26,710,365	1.292025	1.087	14,387,509	12,306,291	37,512,869
																						Price per foot			8,992	7,691	23,446
																						Price per inch inside diameter/foot			$ 32.58	$ 27.87	$ 84.95
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)
	17	14					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	2,555,971	2,755,251	3,628,314	1.292025	1.087	3,589,685	2,994,957	3,943,978
Price per foot						11,966	9,983	13,147
Price per inch inside diameter/foot						$ 43.35	$ 36.17	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking
	$ 1,958,940	$ 2,230,147
Price per foot	6,530	7,434
Price per inch inside diameter/foot	$ 23.66	$ 26.93
	seems low	seems low

TOTAL PIPE JACK and C&C 18,331,487

			Combined CCI, Akron to SF, SF Public Sector	
Total Tunnel, Pipe Jack and C&C				58,058,677
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12
Junction Structure/Tie-in*				$ 2,000,000.00
Total				$ 71,643,427
Total with contingency		30%		$ 93,136,455

without co

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
18	15	250	1570	230	1150	1630	1570	17,963,704	25,497,998	11,797,792	3,231,224	8.70%	12.35%	15.00%	47,242,870	32,350,746	23,038,886	47,651,341	7,032,596	25,481,445
18	15	250	1570	230	1150	1630	1570	17,963,704	25,497,998	11,797,792	3,231,224	8.70%	12.35%	15.00%	47,242,870	32,350,746	23,038,886	47,651,341	7,032,596	17,177,594
Subtotal																				$ 42,659,039
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 54,243,727
Total with contingency			30%																	$ 70,516,845

Soil
Rock

price/ft $ 16,951 | Price inch ID/ft $ 61.42 | 3.673611111 | $ 62,271.99 | $ 225.62

price/ft $ 22,037 | Price inch ID/ft $ 79.84 | 3.673611111 | $ 80,953.58 | $ 293.31

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
18	15	250	1570	230	1150	1630	1570	17,963,704	25,497,998	11,797,792	3,231,224	8.70%	12.35%	15.00%	47,242,870	32,350,746	23,038,886	47,651,341	7,032,596	25,481,445
18	15	250	1570	230	1150	1630	1570	17,963,704	25,497,998	11,797,792	3,231,224	8.70%	12.35%	15.00%	47,242,870	32,350,746	23,038,886	47,651,341	7,032,596	17,177,594
Subtotal						Total Length in Rock (ft)									47,242,870			47,651,341		$ 42,659,039
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 54,651,010
Total with contingency			30%																	$ 71,046,313

Soil
Rock

price/ft $ 17,078 | Price inch ID/ft $ 61.88

price/ft $ 22,202 | Price inch ID/ft $ 80.44

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
18	15					1600		17,642,111	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	28,118,445	3,577,762	11,628,288	9,405,328	35,284,779	1.292025	1.087	16,331,130	13,209,136	49,555,044
																						Price per foot			10,207	8,256	30,972
																						Price per inch inside diameter/foot			$ 36.98	$ 29.91	$ 112.22
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	18	15					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	2,729,786	3,628,314	1.292025	1.087	3,833,797	3,276,173	3,943,978
Price per foot					12,779	10,921	13,147
Price per inch inside diameter/foot					$ 46.30	$ 39.57	$ 47.63
					may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking
	$ 2,066,060	$ 2,352,101
Price per foot	6,887	7,840
Price per inch inside diameter/foot	$ 24.95	$ 28.41
	seems low	seems low

TOTAL PIPE JACK and C&C 20,275,108

Total Tunnel, Pipe Jack and C&C 62,934,147 without co

			Combined CCI, Akron to SF, SF Public Sector	
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12
Junction Structure/Tie-in*				$ 2,000,000.00
Total				$ 76,518,897
Total with contingency		30%		$ 99,474,566

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
19	16	250	1570	230	1150	1630	1570	19,793,127	26,630,841	12,691,128	3,297,228	8.70%	12.35%	15.00%	50,462,853	35,310,385	25,099,216	49,768,429	7,176,251	27,378,480
19	16	250	1570	230	1150	1630	1570	19,793,127	26,630,841	12,691,128	3,297,228	8.70%	12.35%	15.00%	50,462,853	35,310,385	25,099,216	49,768,429	7,176,251	18,281,186
Subtotal																				$ 45,659,666
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 57,244,353
Total with contingency			30%																	$ 74,417,659

Soil
Rock

price/ft $ 17,889 $ 23,256
Price inch ID/ft $ 64.81 $ 84.26
3.673611111 3.673611111
$ 65,716.72 $ 85,431.73
$ 238.10 $ 309.54

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
19	16	250	1570	230	1150	1630	1570	19,793,127	26,630,841	12,691,128	3,297,228	8.70%	12.35%	15.00%	50,462,853	35,310,385	25,099,216	49,768,429	7,176,251	27,378,480
19	16	250	1570	230	1150	1630	1570	19,793,127	26,630,841	12,691,128	3,297,228	8.70%	12.35%	15.00%	50,462,853	35,310,385	25,099,216	49,768,429	7,176,251	18,281,186
Subtotal						Total Length in Rock (ft)									50,462,853			49,768,429		$ 45,659,666
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 57,651,636
Total with contingency			30%																	$ 74,947,127

Soil
Rock

price/ft $ 18,016 $ 23,421
Price inch ID/ft $ 65.28 $ 84.86

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
19	16					1600		19,437,863	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	29,367,711	3,650,845	13,104,277	10,048,182	46,611,705	1.292025	1.087	18,404,055	14,111,981	65,462,931
																						Price per foot			11,503	8,820	40,914
																						Price per inch inside diameter/foot			$ 41.68	$ 31.96	$ 148.24
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	19	16					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	2,906,671	3,277,910	3,628,314	1.292025	1.087	4,082,220	3,563,088	3,943,978
Price per foot						13,607	11,877	13,147
Price per inch inside diameter/foot						$ 49.30	$ 43.03	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking	
	$ 2,173,180	$ 2,474,054	TOTAL PIPE JACK and C&C 22,348,032
Price per foot	7,244	8,247	
Price per inch inside diameter/foot	$ 26.25	$ 29.88	
	seems low	seems low	

			Total Tunnel, Pipe Jack and C&C	68,007,698	without co
			Combined CCI, Akron to SF, SF Public Sector		
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60	
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12	
Junction Structure/Tie-in*				$ 2,000,000.00	
Total				$ 81,592,448	
Total with contingency		30%		$ 106,070,182	

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
20	17	250	1570	230	1150	1630	1570	21,721,414	27,752,053	13,601,079	3,361,092	8.70%	12.35%	15.00%	53,777,658	38,395,550	27,264,684	51,863,778	7,315,247	29,324,016
20	17	250	1570	230	1150	1630	1570	21,721,414	27,752,053	13,601,079	3,361,092	8.70%	12.35%	15.00%	53,777,658	38,395,550	27,264,684	51,863,778	7,315,247	19,403,331
Subtotal																				$ 48,727,346
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 60,312,034
Total with contingency			30%																	$ 78,405,644

Soil
Rock

	price/ft	Price inch ID/ft				
	$ 18,848	$ 68.29	3.673611111	$ 69,238.42	$ 250.86	
	$ 24,502	$ 88.77	3.673611111	$ 90,009.95	$ 326.12	

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
20	17	250	1570	230	1150	1630	1570	21,721,414	27,752,053	13,601,079	3,361,092	8.70%	12.35%	15.00%	53,777,658	38,395,550	27,264,684	51,863,778	7,315,247	29,324,016
20	17	250	1570	230	1150	1630	1570	21,721,414	27,752,053	13,601,079	3,361,092	8.70%	12.35%	15.00%	53,777,658	38,395,550	27,264,684	51,863,778	7,315,247	19,403,331
Subtotal					Total Length in Rock (ft)										53,777,658			51,863,778		$ 48,727,346
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 60,719,317
Total with contingency			30%																	$ 78,935,112

Soil
Rock

	price/ft	Price inch ID/ft
	$ 18,975	$ 68.75
	$ 24,667	$ 89.37

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
20	17					1600		21,330,661	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	30,604,150	3,721,558	14,672,333	10,691,037	61,574,737	1.292025	1.087	20,606,282	15,014,825	86,477,481
																						Price per foot			12,879	9,384	54,048
																						Price per inch inside diameter/foot			$ 46.66	$ 34.00	$ 195.83
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	20	17					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	3,086,530	3,546,874	3,628,314	1.292025	1.087	4,334,819	3,855,452	3,943,978
Price per foot						14,449	12,852	13,147
Price per inch inside diameter/foot						$ 52.35	$ 46.56	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking	
	$ 2,280,300	$ 2,596,008	TOTAL PIPE JACK and C&C 24,550,260
Price per foot	7,601	8,653	
Price per inch inside diameter/foot	$ 27.54	$ 31.35	
	seems low	seems low	

Total Tunnel, Pipe Jack and C&C					73,277,606 without co
			Combined CCI, Akron to SF, SF Public Sector		
Drop Shafts (ea)	2	$ 3,689,357	1.404431175		$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175		$ 1,221,855.12
Junction Structure/Tie-in*					$ 2,000,000.00
Total					$ 86,862,356
Total with contingency		30%			$ 112,921,062

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
15	12	250	1570	230	1150	1630	1570	13,068,618	22,021,372	9,223,719	3,018,237	8.70%	12.35%	15.00%	38,142,819	24,231,770	17,486,411	41,154,128	6,569,040	26,697,408

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
21	18	250	1570	230	1150	1630	1570	23,748,566	28,862,324	14,527,100	3,422,986	8.70%	12.35%	15.00%	57,188,038	41,605,648	29,535,477	53,938,684	7,449,957	31,317,002
21	18	250	1570	230	1150	1630	1570	23,748,566	28,862,324	14,527,100	3,422,986	8.70%	12.35%	15.00%	57,188,038	41,605,648	29,535,477	53,938,684	7,449,957	20,543,476
Subtotal																				$ 51,860,478
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839.03
Odor Control (cfm)		30000	$ 29.00									8.70%	12.35%	15.00%						$ 1,221,848.57
Total																				$ 63,445,165
Total with contingency			30%																	$ 82,478,715

Soil
Rock
price/ft $ 19,827 $ 25,775
Price inch ID/ft $ 71.84 $ 93.39
3.673611111 $ 72,835.27 $ 263.90
3.673611111 $ 94,685.85 $ 343.06

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
21	18	250	1570	230	1150	1630	1570	23,748,566	28,862,324	14,527,100	3,422,986	8.70%	12.35%	15.00%	57,188,038	41,605,648	29,535,477	53,938,684	7,449,957	31,317,002
21	18	250	1570	230	1150	1630	1570	23,748,566	28,862,324	14,527,100	3,422,986	8.70%	12.35%	15.00%	57,188,038	41,605,648	29,535,477	53,938,684	7,449,957	20,543,476
Subtotal					Total Length in Rock (ft)										57,188,038			53,938,684		$ 51,860,478
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		40000	$ 29.00									8.70%	12.35%	15.00%						$ 1,629,131
Total																				$ 63,852,448
Total with contingency			30%																	$ 83,008,183

price/ft $ 19,954 $ 25,940
Price inch ID/ft $ 72.30 $ 93.99

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
21	18					1600		23,320,503	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	31,828,526	3,790,090	16,332,457	11,333,891	81,341,121	1.292025	1.087	22,937,812	15,917,670	114,238,006
																						Price per foot			14,336	9,949	71,399
																						Price per inch inside diameter/foot			$ 51.94	$ 36.05	$ 258.69
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

	Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
	21	18					300	0
	Quantity	Pipe Dia. (ft)					Total Length	
Alocasan	3	8					300	

	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling	SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
	3,269,274	3,820,641	3,628,314	1.292025	1.087	4,591,470	4,153,037	3,943,978
Price per foot						15,305	13,843	13,147
Price per inch inside diameter/foot						$ 55.45	$ 50.16	$ 47.63
						may be okay	may be okay	

	SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking
	$ 2,387,420	$ 2,717,962
Price per foot	7,958	9,060
Price per inch inside diameter/foot	$ 28.83	$ 32.83
	seems low	seems low

TOTAL PIPE JACK and C&C 26,881,790

			Combined CCI, Akron to SF, SF Public Sector	
Total Tunnel, Pipe Jack and C&C				78,742,268
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,894.60
Odor Control (cfm)	30000	$ 29.00	1.404431175	$ 1,221,855.12
Junction Structure/Tie-in*				$ 2,000,000.00
Total				$ 92,327,017
Total with contingency		30%		$ 120,025,122

without co

*Reference Sunnydale Tunnel

Alt B1a Tunnel Portion

Bored Dia (ft)	Pipe Dia. (ft)	Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SF Total Cost ($)
22	19	250	1570	230	1150	1630	1570	25,874,581	29,962,278	15,468,688	3,483,062	8.70%	12.35%	15.00%	78,418,605	44,940,134	41,230,569	72,345,656	9,794,414	41,355,161

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
22	19	250	1570	230	1150	1630	1570	25,874,581	29,962,278	15,468,688	3,483,062	8.70%	12.35%	15.00%	78,418,605	58,063,465	41,230,569	72,345,656	9,794,414	33,356,458
22	19	250	1570	230	1150	1630	1570	25,874,581	29,962,278	15,468,688	3,483,062	8.70%	12.35%	15.00%	78,418,605	58,063,465	41,230,569	72,345,656	9,794,414	21,701,108
Subtotal																				$ 55,057,566
Drop Shafts (ea)		2	$ 3,689,357									8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		35000	$ 29.00									8.70%	12.35%	15.00%						$ 1,425,490
Total																				$ 66,845,895
Total with contingency			30%																	$ 86,899,664

	price/ft	Price inch ID/ft			
Soil	$ 20,889	$ 75.69	3.673611111	$ 76,739.32	$ 278.04
Rock	$ 27,156	$ 98.39	3.673611111	$ 99,761.12	$ 361.45

Alt B1a

Bored Dia (ft)	Pipe Dia. (ft)	Geology Qu (soil)	SP (Rock)	Qu (soil)	Qaf (fill)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	Ref 3 Total Cost ($)
22	19	250	1570	230	1150	1630	1570	25,874,581	29,962,278	15,468,688	3,483,062	8.70%	12.35%	15.00%	78,418,605	58,063,465	41,230,569	72,345,656	9,794,414	33,356,458
22	19	250	1570	230	1150	1630	1570	25,874,581	29,962,278	15,468,688	3,483,062	8.70%	12.35%	15.00%	78,418,605	58,063,465	41,230,569	72,345,656	9,794,414	21,701,108
Subtotal																				$ 55,057,566
Drop Shafts (ea)		2	$ 3,689,357	#REF!								8.70%	12.35%	15.00%						$ 10,362,839
Odor Control (cfm)		35000	$ 29.00	#REF!								8.70%	12.35%	15.00%						$ 1,425,490
Total																				$ 66,845,895
Total with contingency			30%																	$ 86,899,664

	price/ft	Price inch ID/ft
Soil	$ 20,889	$ 75.69
Rock	$ 27,156	$ 98.39

Alt B1a Cut and Cover Portion

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in soil (ft)	Total Length in Rock (ft)	Ref 1 Cost in Soil ($)	Ref 2 Cost in Rock ($) Mixed	Ref 2 Cost in Rock ($) HardRock	Ref 2 Cost in Rock ($) Micro-T	CCI	Akron to SF RSMeans adjustment	SF Public Sector Factor	Ref 1+Ref 2 Total Cost ($) Soil + Mixed	Ref 1+Ref 2 Total Cost ($) Soil+HR	Ref 1+Ref 2 Total Cost ($) Soil+MicT	Ref 2 Total Cost ($) Mixed	Ref 2 Total Cost ($) Micro-T	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Figure 1.1 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.1 Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI	SFPUC 2007 Tentative Recommendation (refs 3) Total Cost ($)	SFPUC 2007 SD1 (refs 3) Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Total Cost ($)
22	19					1600		25,407,389	#NUM!	#NUM!	#NUM!	8.70%	12.35%	15.00%	#NUM!	#NUM!	#NUM!	42,690,243	4,982,808	18,084,649	11,976,746	107,452,800	1.292025	1.087	25,398,645	16,820,515	150,910,062
																						Price per foot			15,874	10,513	94,319
																						Price per inch inside diameter/foot			$ 57.52	$ 38.09	$ 341.73
																									may be okay	seems low	blows up

Pipe or Box Jack Portion 3-8'

Bored Dia (ft)	Pipe Dia. (ft)	Length (ft) Qaf (fill)	Qu (soil)	SP (Rock)	Qu (soil)	Total Length in	Total Length in
22	19					300	0
Quantity	Pipe Dia. (ft)					Total Length	
Alocasan 3	8					300	

		SFPUC 2007 Akron (refs 3) Figure 1.7 Soft Soil Tunneling Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)	Akron to SF RS Means + SF Public Sector Factor (refs 3)	CCI		SFPUC 2007 Akron (refs 3) Figure 1.7 Total Cost ($)	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking Total Cost ($)
		3,454,820	4,099,024	3,628,314	1.292025	1.087	4,852,058	4,455,639	3,943,978
Price per foot				0	0		16,174	14,852	13,147
Price per inch inside diameter/foot							$ 58.60	$ 53.81	$ 47.63
							may be okay	may be okay	

		SFPUC 2007 Tentative Recommendation (refs 3) Section 1.7	SFPUC 2007 Alocasan (refs 3) Figure 1.5 Pipe Jacking	
		$ 2,494,539	$ 2,839,915	TOTAL PIPE JACK and C&C 29,342,623
Price per foot		8,315	9,466	
Price per inch inside diameter/foot		$ 30.13	$ 34.30	
		seems low	seems low	

(918659.168*10^(0.319+0.901*LOG((H41+I41)/3208.8)+1.35*LOG(B41/3.2808+0.6096))/(H41+I41)+439.21)*(H41+I41)*(1+N41)+3500*(H41+I41)
(918659.168*10^(0.319+0.901*LOG((H41+I41)/3208.8)+1.35*LOG(B41/3.2808+0.6096))/(H41+I41)+439.21)*(H41+I41)

SFPUC 2013 Model

			Total Tunnel, Pipe Jack and C&C	84,400,189
			Combined CCI, Akron to SF, SF Public Sector	
Drop Shafts (ea)	2	$ 3,689,357	1.404431175	$ 10,362,895
Odor Control (cfm)	40000	$ 29.00	1.404431175	$ 1,629,140
Junction Structure/Tie-in*				$ 2,000,000
Total				$ 98,392,224
Total with contingency		30%		$ 127,909,891

*Reference Sunnydale Tunnel

Appendix F

Additional Plan Views

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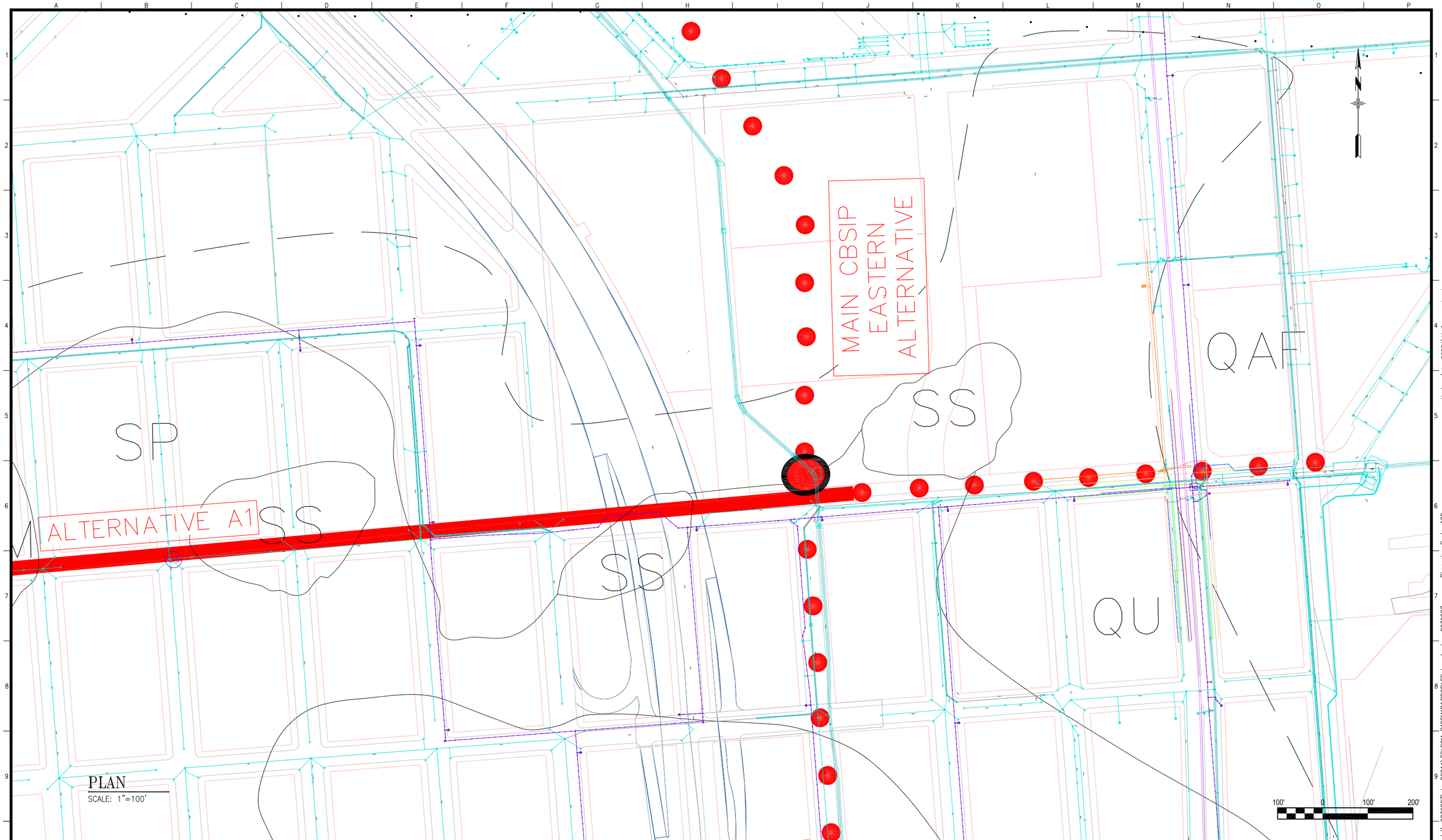

DRAINAGE LINES AND STUDY AREA

- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
- EXISTING PUMP
- EXISTING SEWER

10 0 20
VERTICAL SCALE 1" = 20'

200 0 400
HORIZONTAL SCALE 1" = 400'

NOTE: THESE MAPS OF SEWER FACILITIES SHOULD BE CONSIDERED SCHEMATIC IN NATURE. HORIZONTAL LOCATION AND ELEVATIONS ARE APPROXIMATE, AND MUST BE FIELD VERIFIED FOR ALL DESIGN PURPOSES. ELEV. IN S.F. CITY DATUM FEET

DESIGN AND ENGINEERING
SAN FRANCISCO PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO

DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
A1 PLAN EAST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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..\dms80839\old-Utilities.dwg

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Model Units: Feet
Measurement Units are English

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15TH ST
FLORIDA ST
ALABAMA ST
SP
BRYANT ST
6TH ST
POTRERO AVE
UTAH ST
SAN BRUNO AVE
QAL
ENTERPRISE ST
CIS
HARRISON ST
(S) FD
17TH ST
QU
MARIPOSA ST
PS
TREAT AVE
18TH ST
USPM

PLAN
SCALE: 1"=100'

100' 0 100' 200'

DRAINAGE LINES AND STUDY AREA
- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
- EXISTING PUMP
- EXISTING SEWER

10 0 20
VERTICAL SCALE 1" = 20'

200 0 400
HORIZONTAL SCALE 1" = 400'

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DESIGN AND ENGINEERING
SAN FRANCISCO PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO

DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
A1 PLAN WEST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

Xrefs: ..\dms808811\X_Geo_overlay.dwg
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..\dms808839\old-Utilities.dwg

Dimension Scale: 100
Model Units: Feet
Measurement Units are English

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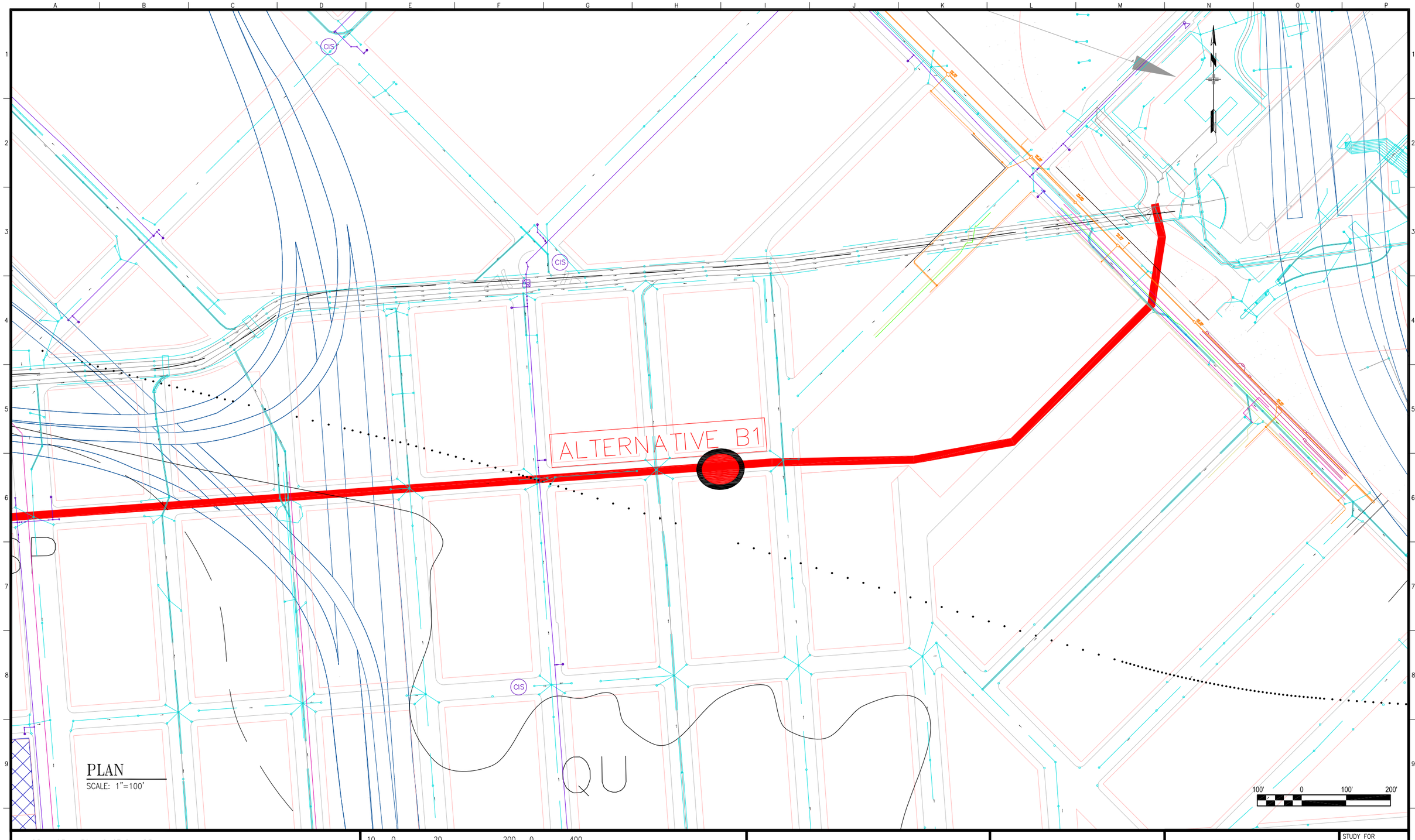

DRAINAGE LINES AND STUDY AREA

- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
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- EXISTING SEWER

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DESIGN AND ENGINEERING

SAN FRANCISCO PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA

B1 PLAN EAST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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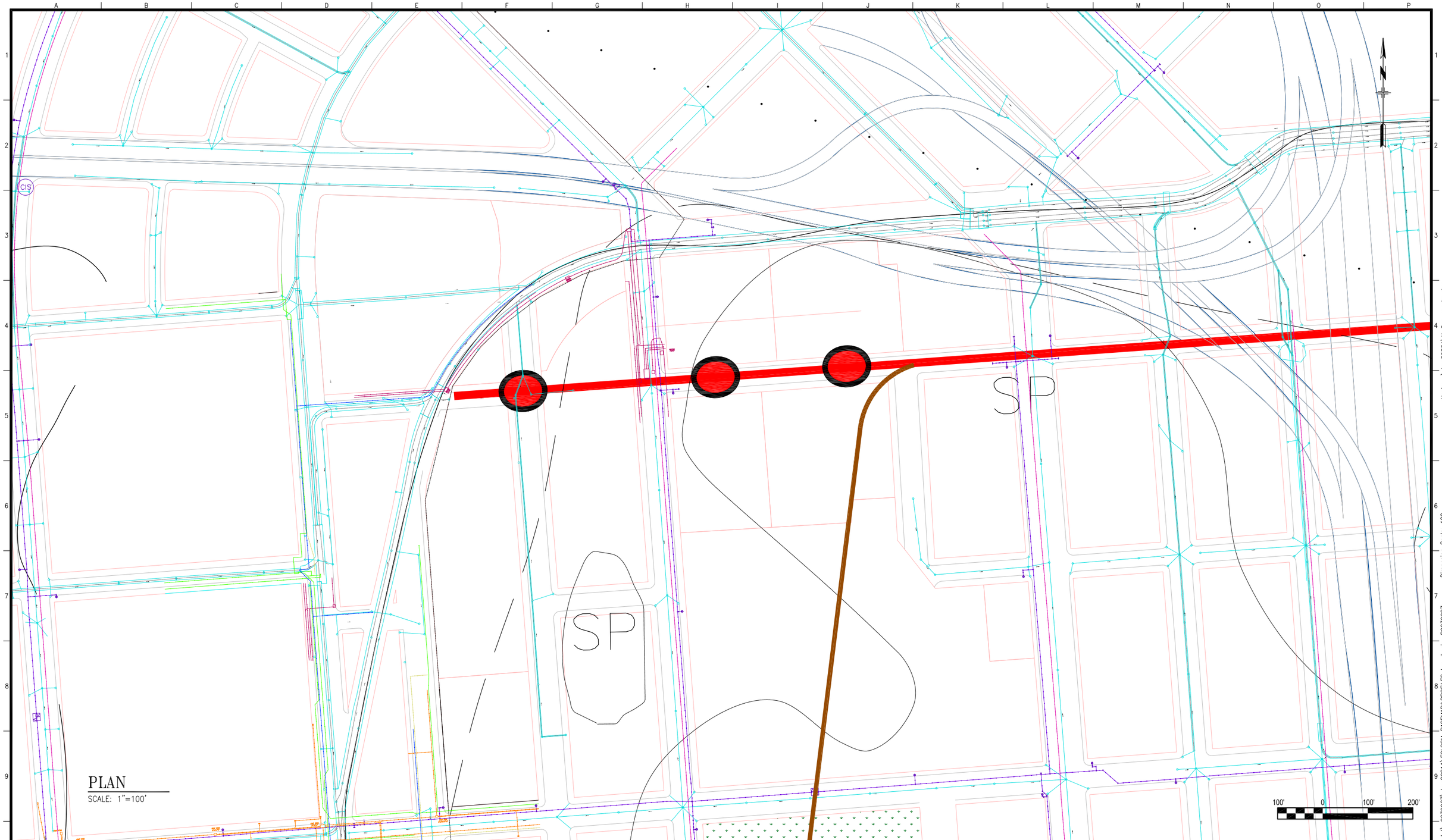

PLAN
SCALE: 1"=100'

DRAINAGE LINES AND STUDY AREA
- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
- EXISTING PUMP
- EXISTING SEWER

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DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
B1 PLAN WEST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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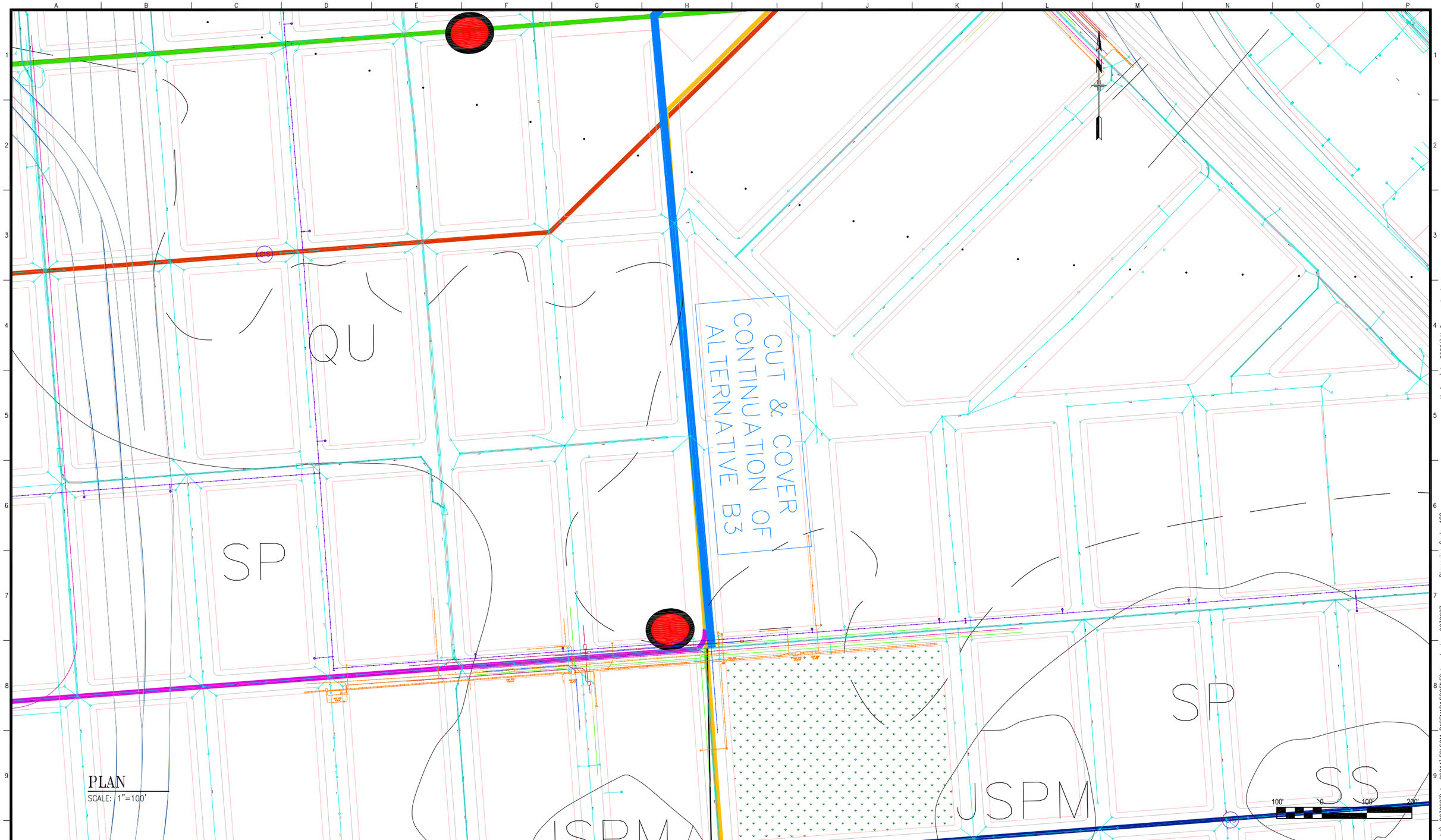

PLAN
SCALE: 1"=100'

DRAINAGE LINES AND STUDY AREA
- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
- EXISTING PUMP
- EXISTING SEWER

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DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
B3 PLAN EAST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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Measurement Units are English

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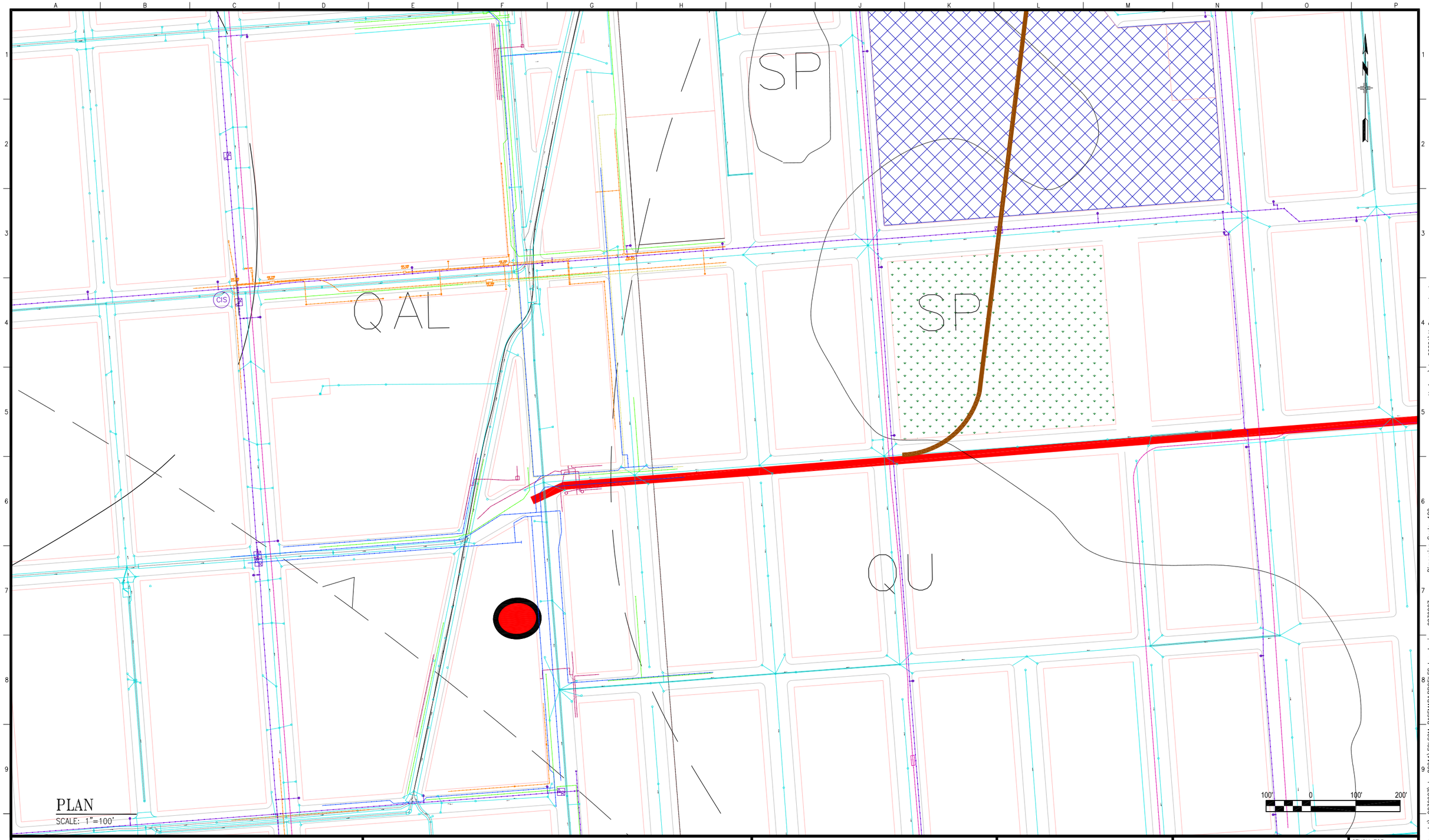

PLAN
SCALE: 1"=100'

DRAINAGE LINES AND STUDY AREA
- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
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AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
B3 PLAN WEST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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Measurement Units are English

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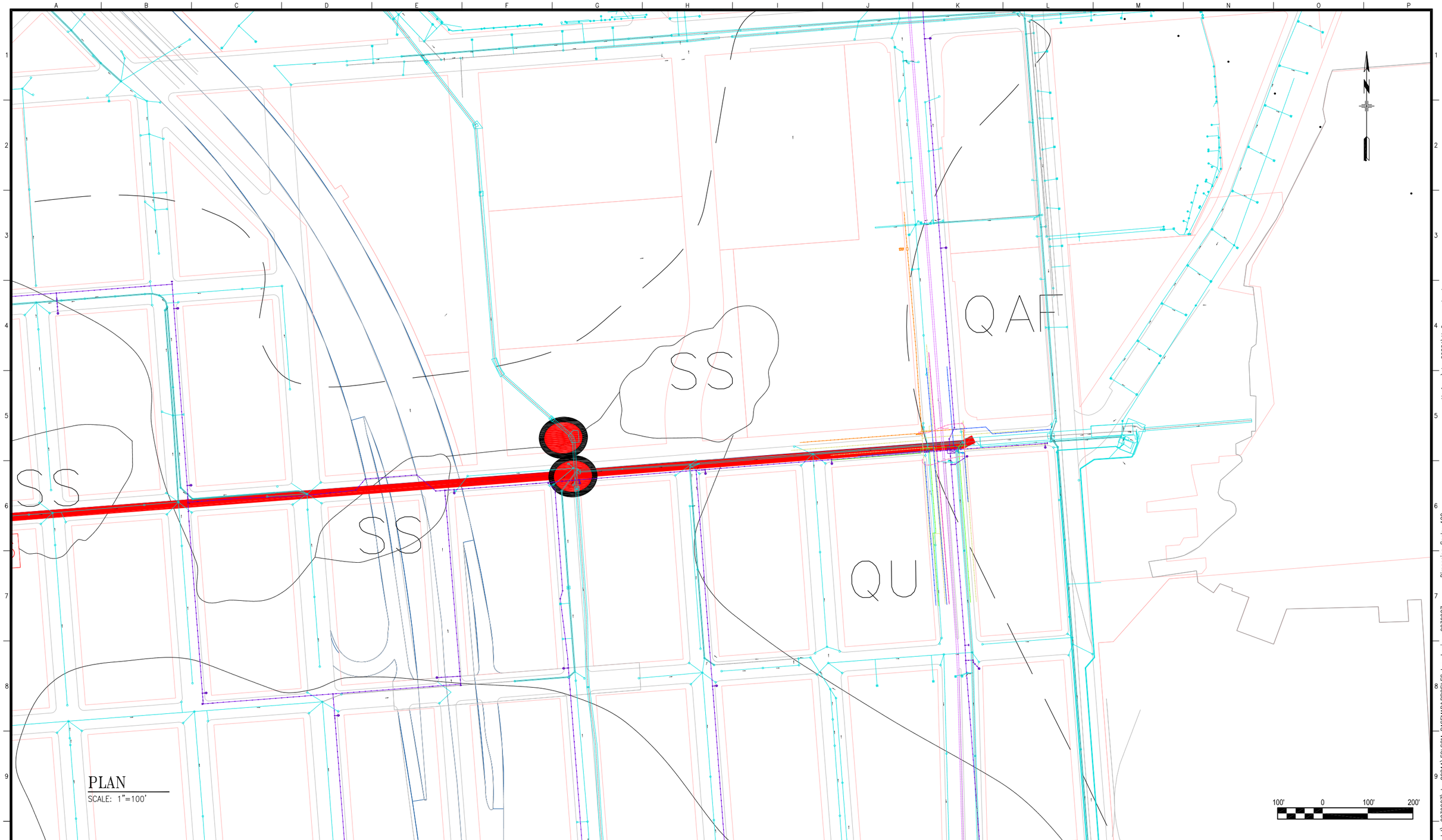

PLAN
SCALE: 1"=100'

DRAINAGE LINES AND STUDY AREA
- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
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DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA
B1 PLAN EAST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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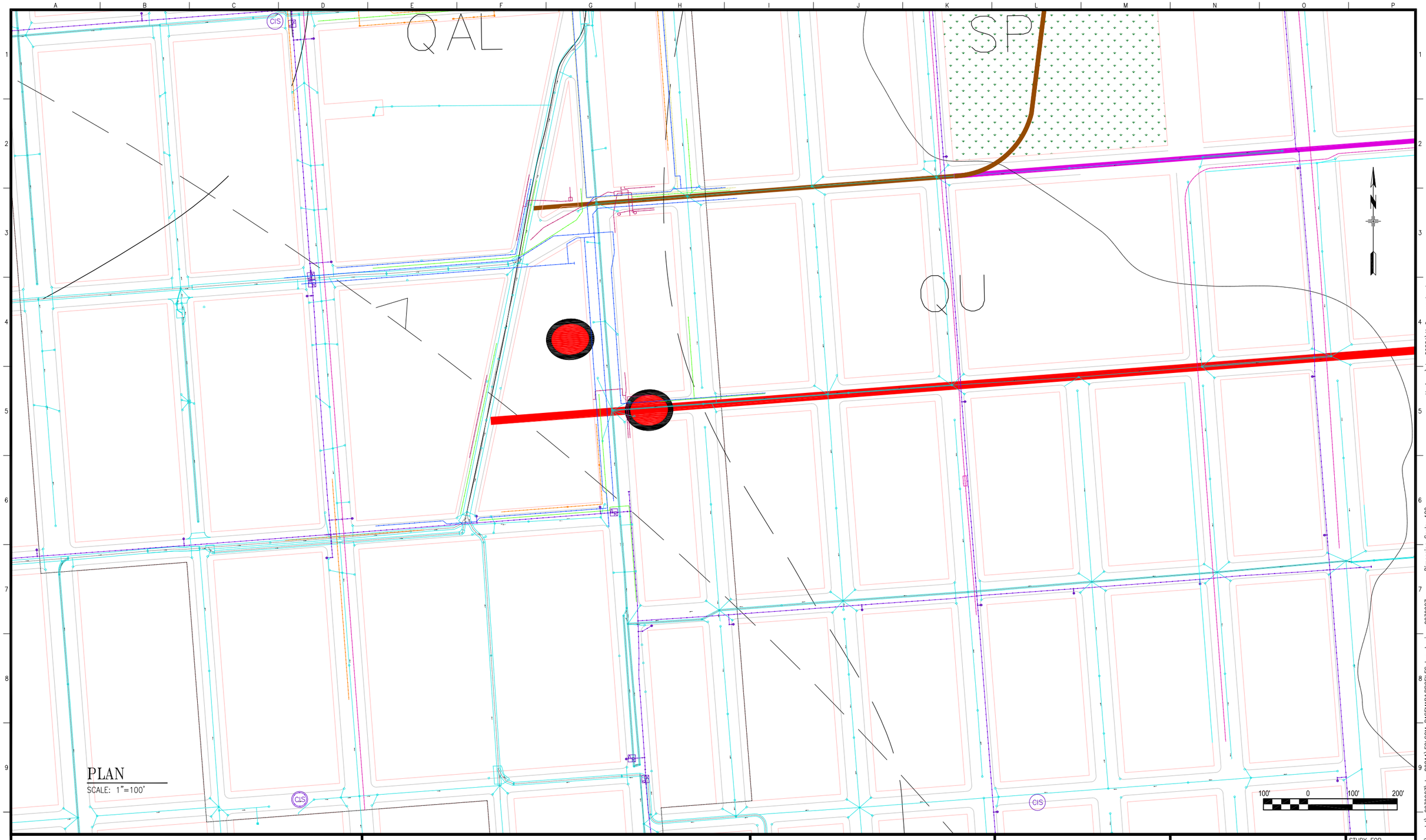

DRAINAGE LINES AND STUDY AREA

- ANALYSIS AREA BOUNDARY
- SUPPORT COMPONENTS
- MINOR COMPONENTS
- CONVEYANCE ALIGNMENTS
- CBSIP MAIN TUNNEL
- EXISTING PUMP
- EXISTING SEWER

10 0 20 — VERTICAL SCALE 1" = 20'

200 0 400 — HORIZONTAL SCALE 1" = 400'

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DESIGN AND ENGINEERING
SAN FRANCISCO PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO

DIVISION STREET
AND VICINITY
SEWER SYSTEM MAP
SUB BASIN ID: 30-F/L/J/N & 50-D
USE GRAPHICAL SCALE
FOR REFERENCE PURPOSE ONLY

ATTACHMENT 3

SEWER SYSTEM MAP

FOLSOM STUDY AREA

B6 PLAN WEST END

STUDY FOR	2817J
BY	JM
DATE	6/28/2016
STATUS	REFERENCE ONLY

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Appendix G.1

Hydraulic Performance Scorecards, Dated 5/9/2016

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Scorecard for Base

#Base#	A1	B1	B3	B6	C1	D4			

Brief Narrative: Base

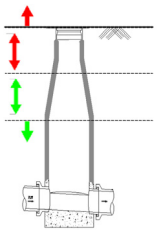
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	11.8	-1.8
18th & Shotwell	12.1	14.3	-2.2
Enterprise Alley	7.0	7.7	-0.7
14th & Harrison	6.1	7.8	-1.7
Henry Adams	2.2	2.2	0.0

Summary of Freeboard for Nodes within Analysis Area

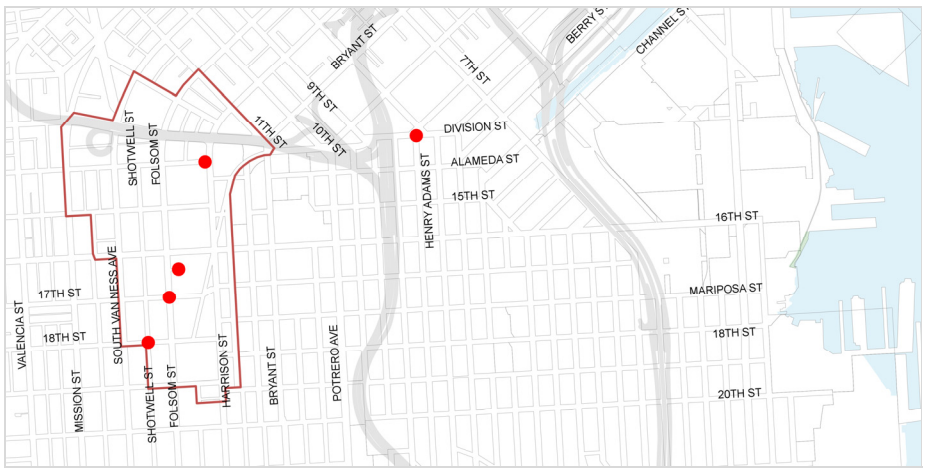
	Freeboard	# of Nodes
Freeboard Not Met	Negative	138
	0-2 feet	61
Freeboard Met	2-4 feet	51
	+4 feet	41

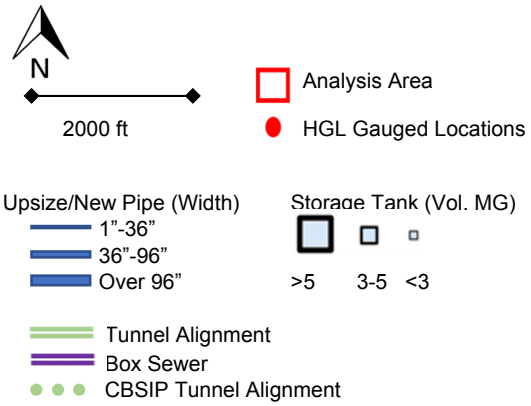


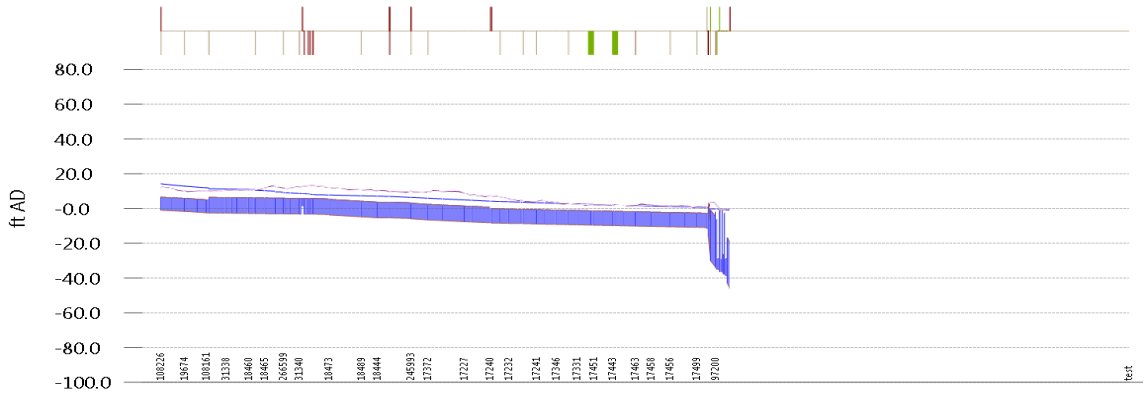
Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe		
Upsize Circular Pipe		
New Box Sewer		
Upsize Box Sewer		
Tunneling		
Detention		
Pumping		
CBSIP Main Tunnel		
Total Cost		

Analysis Area Plan & Profile







Scorecard for A1

Base	#A1#	B1	B3	B6	C1	D4			

Brief Narrative: Tunnel alignment from previous CBSIP study. Connector Tunnel redesigned for 5yr-3hr design storm. Primarily alignment along 17th Street and 18th Street. Sections of tunnel cross into the Mission Bay area from the Berry Street T/S Structure.

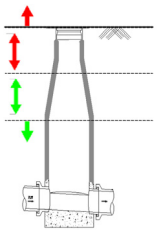
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	3.6	6.4
18th & Shotwell	12.1	8.9	3.2
Enterprise Alley	7.0	3.1	3.9
14th & Harrison	6.1	3.3	2.8
Henry Adams	2.2	-0.2	2.4

Summary of Freeboard for Nodes within Analysis Area

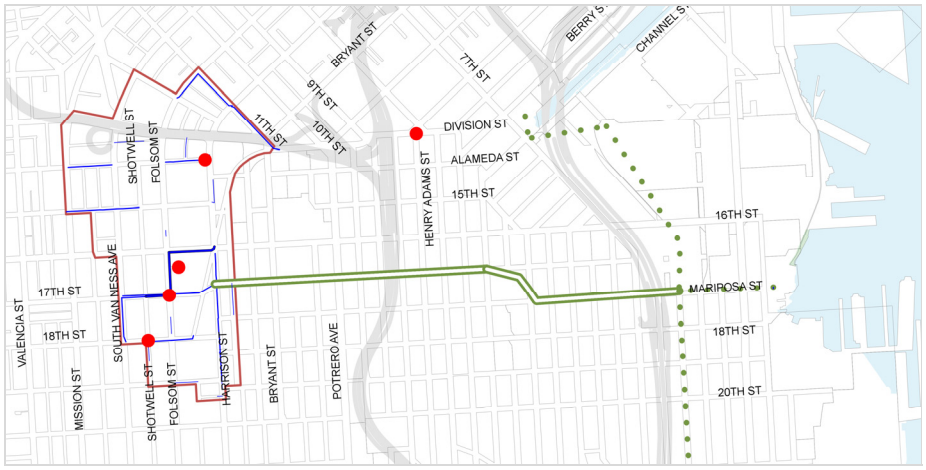
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	0
Freeboard Met	2-4 feet	79
	+4 feet	211



Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	6	
Upsize Circular Pipe	6	
New Box Sewer		
Upsize Box Sewer	1	
Tunneling	38	
Detention		
Pumping		
CBSIP Main Tunnel	371	
Total Cost	422	

Analysis Area Plan & Profile



Scorecard for B1

Base	A1	#B1#	B3	B6	C1	D4			

Brief Narrative: Tunnel alignment along Alameda Street with no Main CBSIP Tunnel

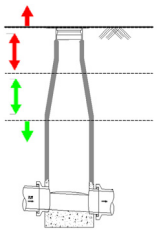
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.4	2.6
18th & Shotwell	12.1	9.1	3.0
Enterprise Alley	7.0	5.7	1.3
14th & Harrison	6.1	3.6	2.5
Henry Adams	2.2	1.3	0.9

Summary of Freeboard for Nodes within Analysis Area

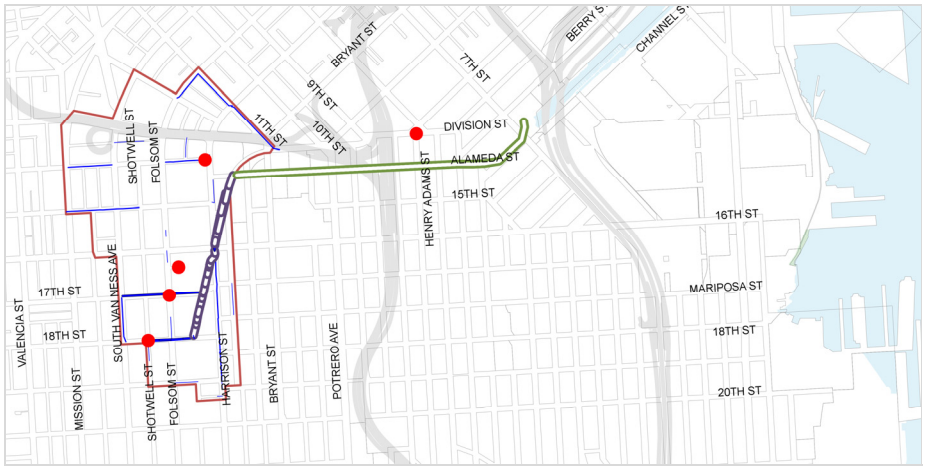
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	6
Freeboard Met	2-4 feet	103
	+4 feet	181

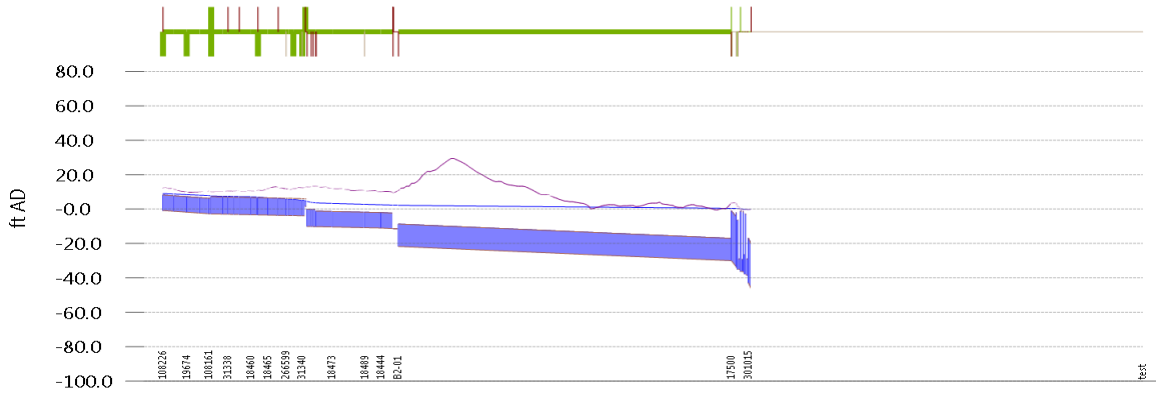


Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	4	
Upsize Circular Pipe	8	
New Box Sewer		
Upsize Box Sewer	7	
Tunneling	36	
Detention		
Pumping		
CBSIP Main Tunnel		
Total Cost	59	

Analysis Area Plan & Profile





Scorecard for B3

Base	A1	B1	#B3#	B6	C1	D4			

Brief Narrative: Tunnel alignment along 17th Street and De Haro Street with no Main CBSIP Tunnel . Modified to Match CBSIP Shallow Alignment

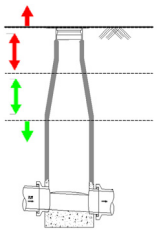
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	4.1	5.9
18th & Shotwell	12.1	8.9	3.2
Enterprise Alley	7.0	3.8	3.2
14th & Harrison	6.1	4.0	2.1
Henry Adams	2.2	1.4	0.8

Summary of Freeboard for Nodes within Analysis Area

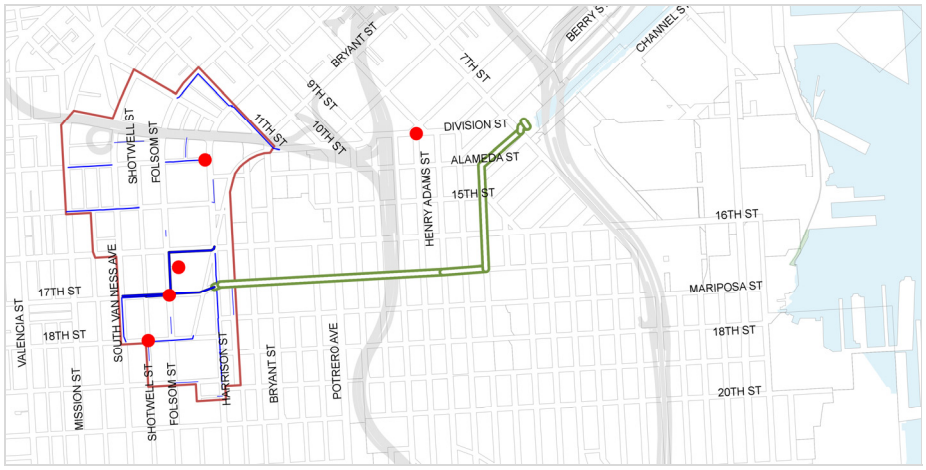
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	2
Freeboard Met	2-4 feet	89
	+4 feet	199

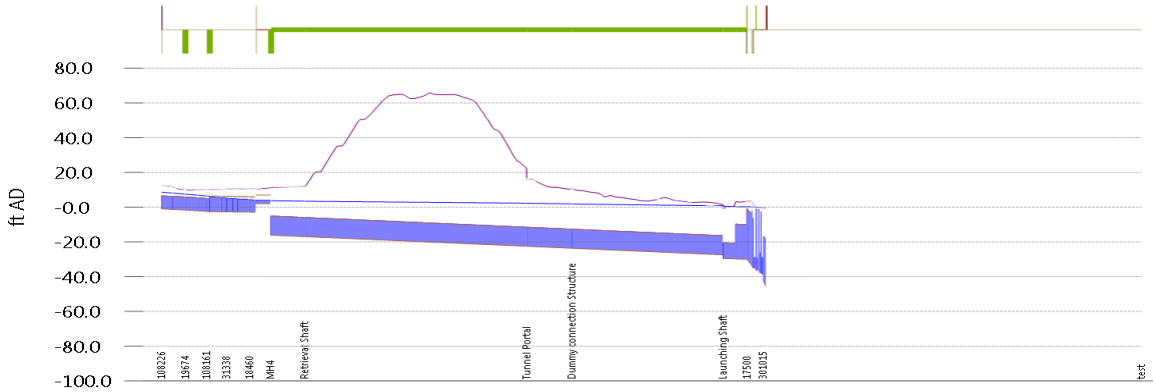


Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	7	
Upsize Circular Pipe	6	
New Box Sewer		
Upsize Box Sewer	1	
Tunneling	42	
Detention		
Pumping		
CBSIP Main Tunnel		
Total Cost	57	

Analysis Area Plan & Profile





Scorecard for B6

Base	A1	B1	B3	#B6#	C1	D4			

Brief Narrative: Tunnel alignment along Mariposa Street connecting to Mariposa Pump Station outfall. Assumes Mariposa Outfall Expansion.

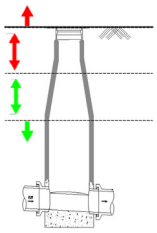
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	6.2	3.8
18th & Shotwell	12.1	9.0	3.1
Enterprise Alley	7.0	4.3	2.7
14th & Harrison	6.1	3.7	2.4
Henry Adams	2.2	0.5	1.7

Summary of Freeboard for Nodes within Analysis Area

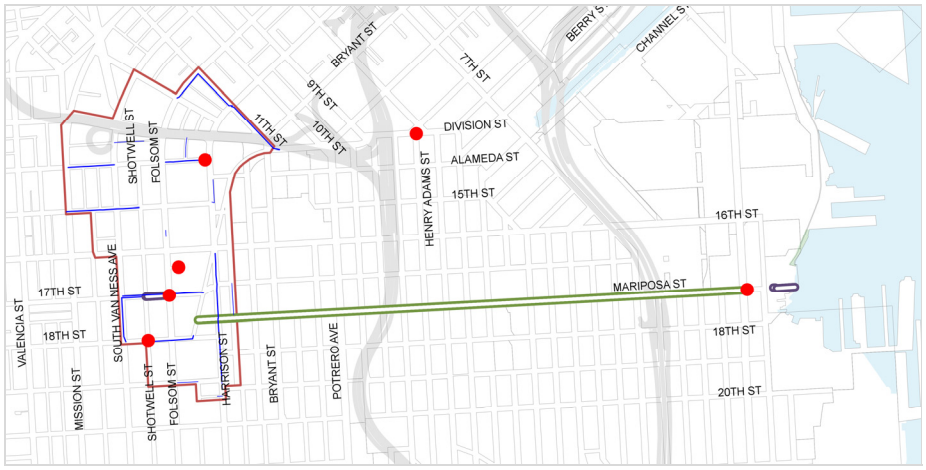
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	0
Freeboard Met	2-4 feet	105
	+4 feet	185

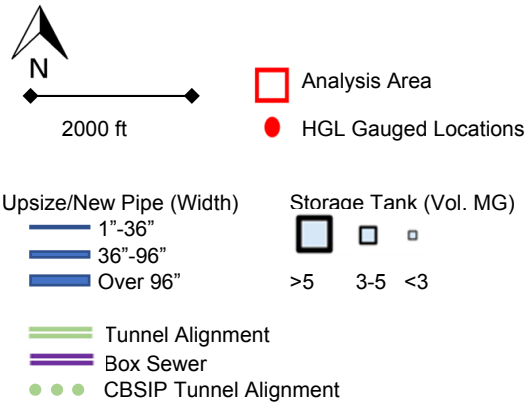


Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	3	
Upsize Circular Pipe	6	
New Box Sewer		
Upsize Box Sewer	2	
Tunneling	65	
Detention		
Pumping		
CBSIP Main Tunnel		
Total Cost	77	

Analysis Area Plan & Profile





Scorecard for C1

Base	A1	B1	B3	B6	#C1#	D4			

Brief Narrative: Deepening and regrading of one compartment of the 4-compartment sewer on Division Street

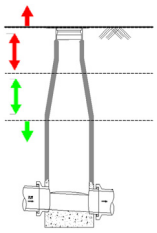
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.0	3.0
18th & Shotwell	12.1	9.6	2.5
Enterprise Alley	7.0	5.3	1.7
14th & Harrison	6.1	4.1	2.0
Henry Adams	2.2	1.4	0.8

Summary of Freeboard for Nodes within Analysis Area

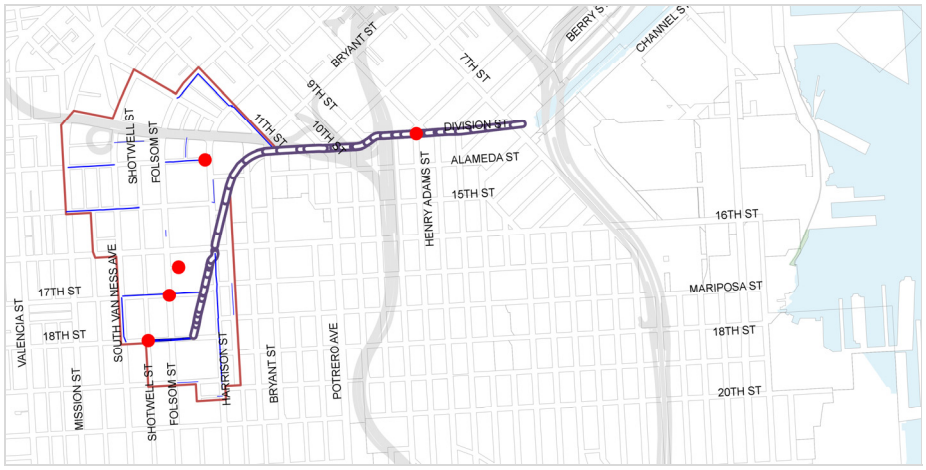
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	7
Freeboard Met	2-4 feet	108
	+4 feet	175

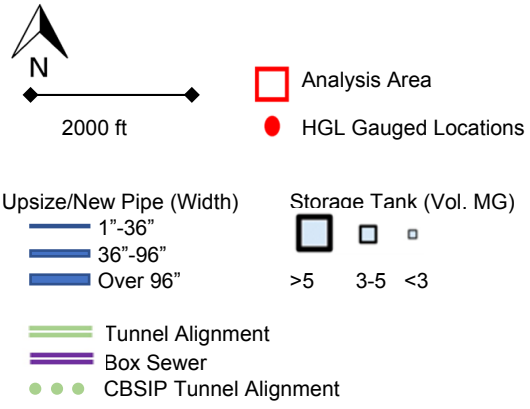


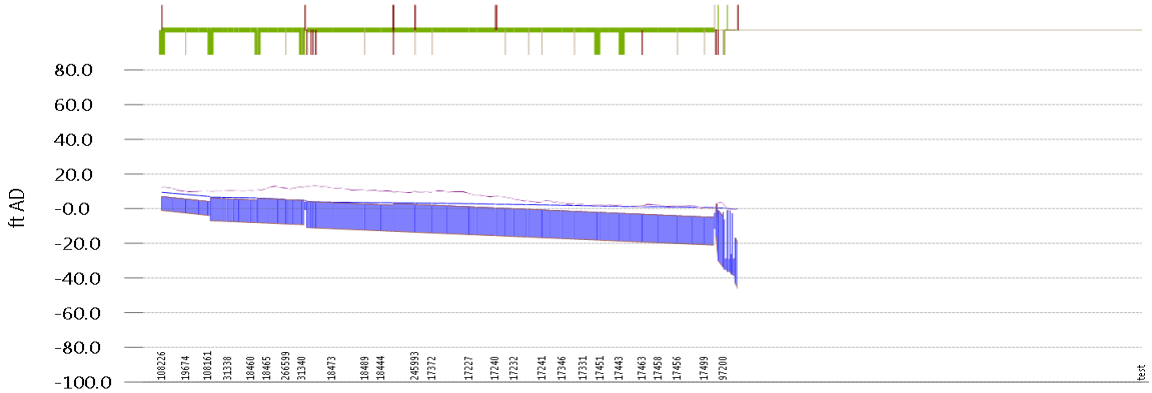
Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	3	
Upsize Circular Pipe	6	
New Box Sewer		
Upsize Box Sewer		
Tunneling		
Detention		
Pumping		
CBSIP Main Tunnel		
Total Cost	86	

Analysis Area Plan & Profile







Scorecard for D1

Base	A1	B1	B3	B6	C1	#D4#			

Brief Narrative: Distributed Storage at 17th Street & Folsom Street (2.3MG) and 14th Street & Folsom Street (3.0MG) plus Minor Projects.

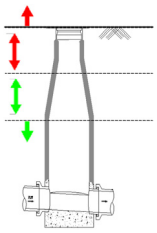
Simulation Design Storm: 5yr-3hr

Construction Cost by Element Type

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.9	2.1
18th & Shotwell	12.1	8.8	3.3
Enterprise Alley	7.0	6.4	0.6
14th & Harrison	6.1	5.4	0.7
Henry Adams	2.2	1.7	0.5

Summary of Freeboard for Nodes within Analysis Area

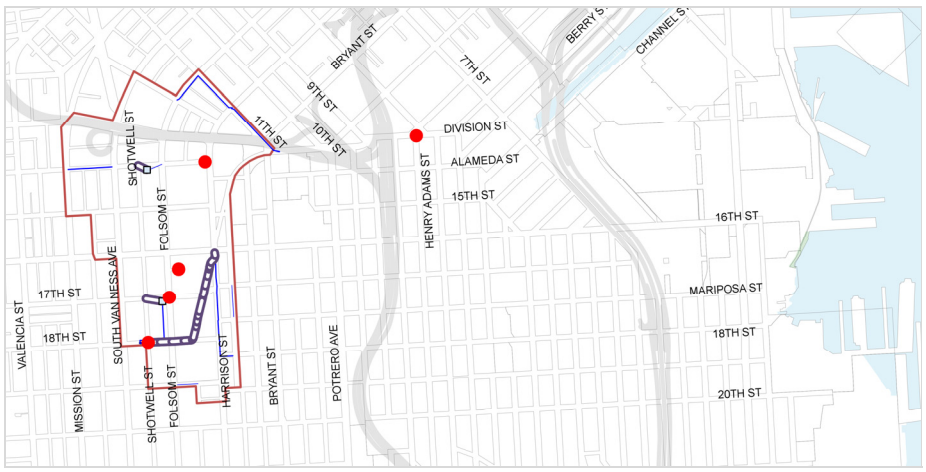
	Freeboard	# of Nodes
Freeboard Not Met	Negative	0
	0-2 feet	58
Freeboard Met	2-4 feet	108
	+4 feet	126

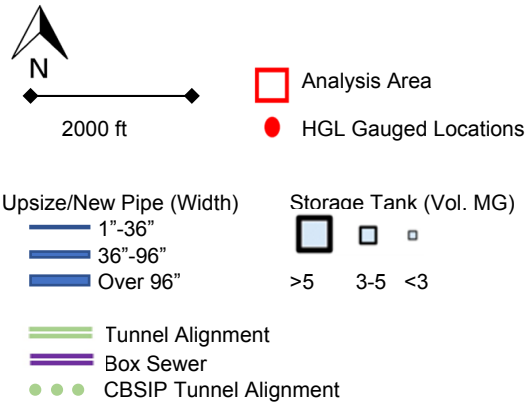


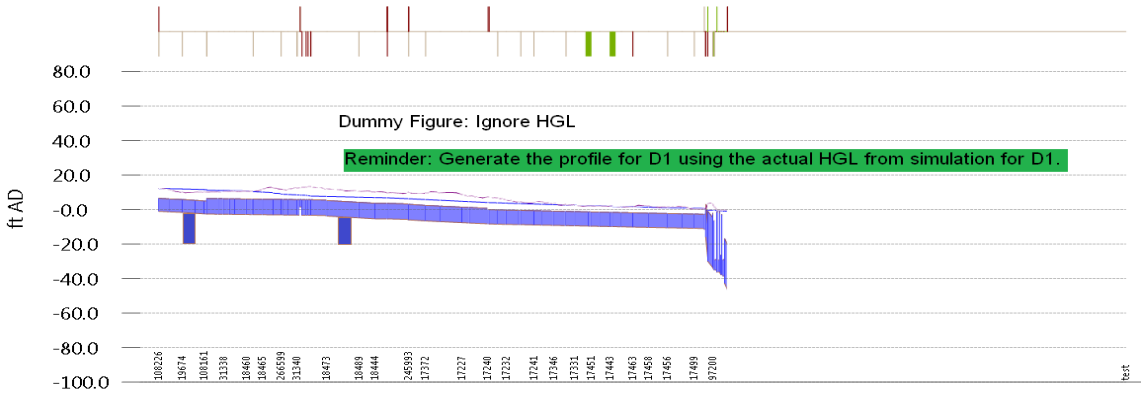
Construction Cost by Element Type

Element Type	Cost ($M)	$0M $100M
New Circular Pipe	4	
Upsize Circular Pipe	3	
New Box Sewer	1	
Upsize Box Sewer	6	
Tunneling		
Detention	19	
Pumping	5	
CBSIP Main Tunnel		
Total Cost	38	

Analysis Area Plan & Profile







Appendix G.2

Hydraulic Performance Scorecards, Dated 11/4/2016

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Scorecard for Base

#Base#	A	B1	C1	D4					

Brief Narrative: Base

Simulation Design Storm: 5yr-3hr

Total Construction Cost by Element Type[1]

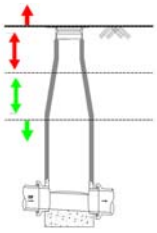
Element Type	Cost ($M)	$0M $100M
New Sewer		
Upsize Existing Sewer		
Deepen Box Sewer		
Tunneling		
Detention		
CBSIP Main Tunnel		
Total Cost		

Key Locations for Alternatives Performance Assessment

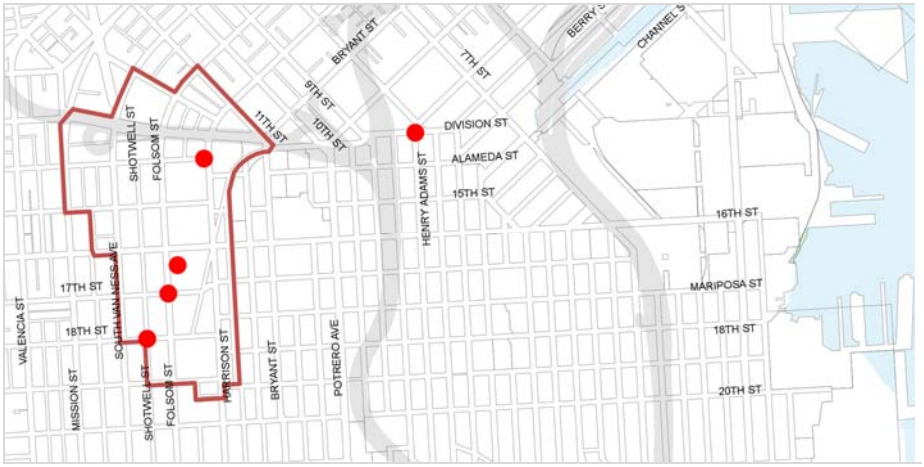
Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	11.8	-1.8
18th & Shotwell	12.1	14.3	-2.2
Enterprise Alley	7.0	7.7	-0.7
14th & Harrison	6.1	7.8	-1.7
Henry Adams	2.2	2.2	0.0

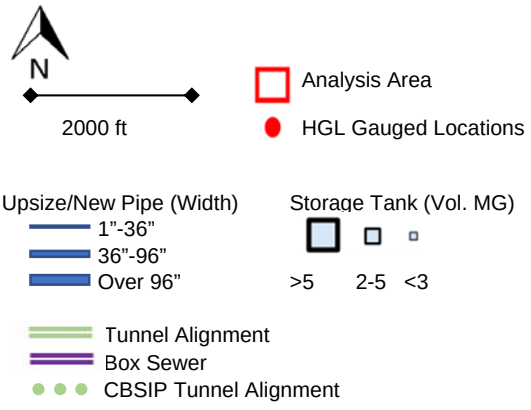
Summary of Freeboard for Nodes within Analysis Area

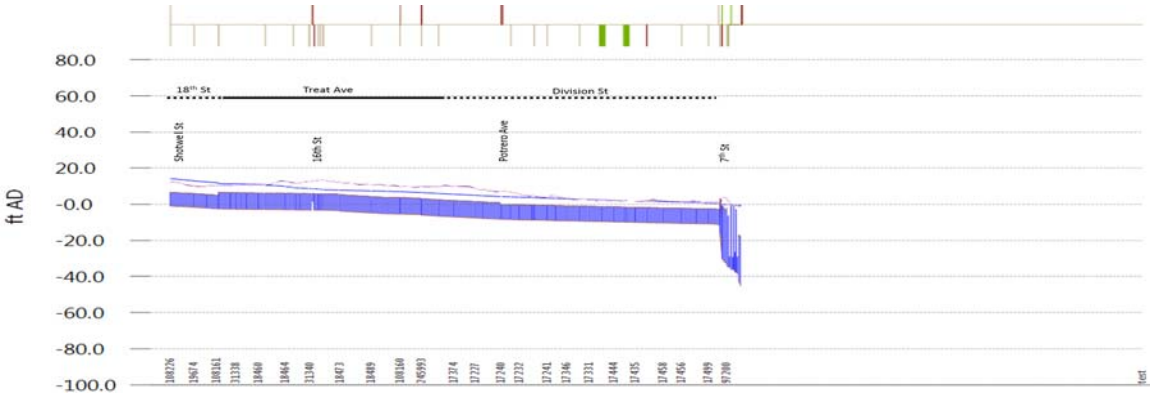
	Depth to Ground	# of Nodes
Freeboard Not Met	-0 feet	138
	0-2 feet	63
Freeboard Met	2-4 feet	53
	+4 feet	43



Analysis Area Plan & Profile







Note 1 Total Construction Cost estimates shown in 2016 Dollars. New Sewer, Deepen Box Sewer, Upsize Existing Sewer, Pumping, and Detention project elements assume 10% Contractor General Conditions and Requirements, 6.5% Contractor Overhead and Profit, 2.5% Bonding and Insurance and 30 % Design & Estimating Contingencies. Total Construction Cost estimates for Tunneling project elements assume a 30% Contingency.

Scorecard for A

Base	#A#	B1	C1	D4					

Brief Narrative: Tunnel alignment from previous CBSIP study. Connector Tunnel redesigned for 5yr-3hr design storm. Primarily alignment along 17th Street and Mariposa Street. Sections of tunnel cross into the Mission Bay area from the Berry Street T/S Structure.

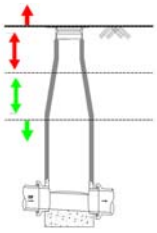
Simulation Design Storm: 5yr-3hr

Key Locations for Alternatives Performance Assessment

Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	4.7	5.3
18th & Shotwell	12.1	9.5	2.6
Enterprise Alley	7.0	4.0	3.0
14th & Harrison	6.1	3.8	2.3
Henry Adams	2.2	-0.7	2.9

Summary of Freeboard for Nodes within Analysis Area

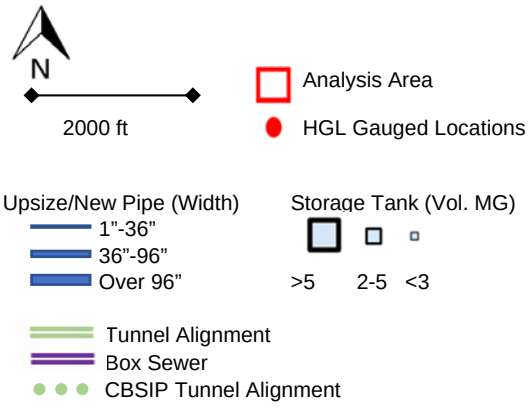
	Depth to Ground	# of Nodes
Freeboard Not Met	-0 feet	0
	0-2 feet	4
Freeboard Met	2-4 feet	100
	+4 feet	192

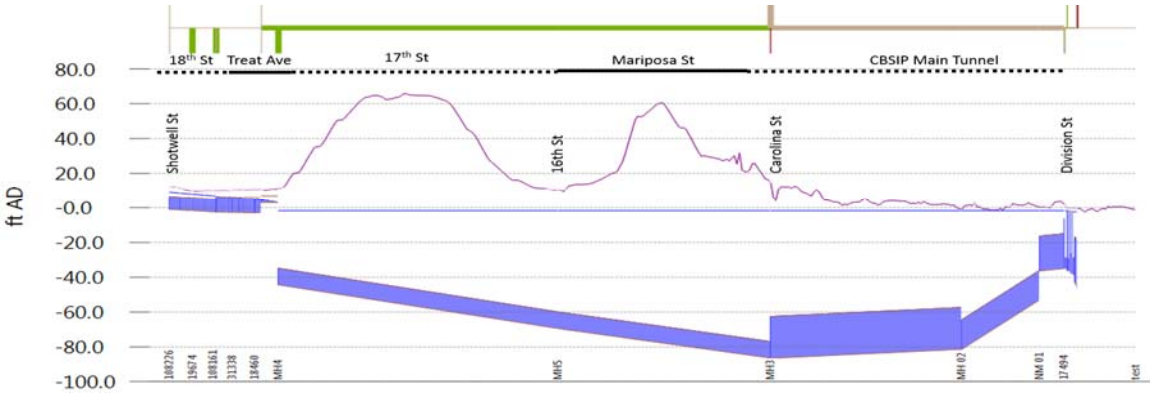


Total Construction Cost by Element Type[1]

Element Type	Cost ($M)	$0M $100M
New Sewer	6.3	
Upsize Existing Sewer	14.5	
Deepen Box Sewer		
Tunneling	74.1	
Detention		
CBSIP Main Tunnel	371.0	
Total Cost	465.9	

Analysis Area Plan & Profile





Note 1 Total Construction Cost estimates shown in 2016 Dollars. New Sewer, Deepen Box Sewer, Upsize Existing Sewer, Pumping, and Detention project elements assume 10% Contractor General Conditions and Requirements, 6.5% Contractor Overhead and Profit, 2.5% Bonding and Insurance and 30 % Design & Estimating Contingencies. Total Construction Cost estimates for Tunneling project elements assume a 30% Contingency.

Scorecard for B1

Base	A	#B1#	C1	D4					

Brief Narrative: Tunnel alignment along Alameda Street with no Main CBSIP Tunnel

Simulation Design Storm: 5yr-3hr

Total Construction Cost by Element Type[1]

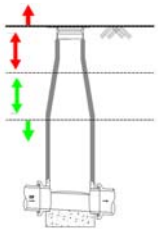
Element Type	Cost ($M)	$0M $100M
New Sewer	8.9	
Upsize Existing Sewer	16.6	
Deepen Box Sewer	17.3	
Tunneling	56.9	
Detention		
CBSIP Main Tunnel		
Total Cost	99.7	

Key Locations for Alternatives Performance Assessment

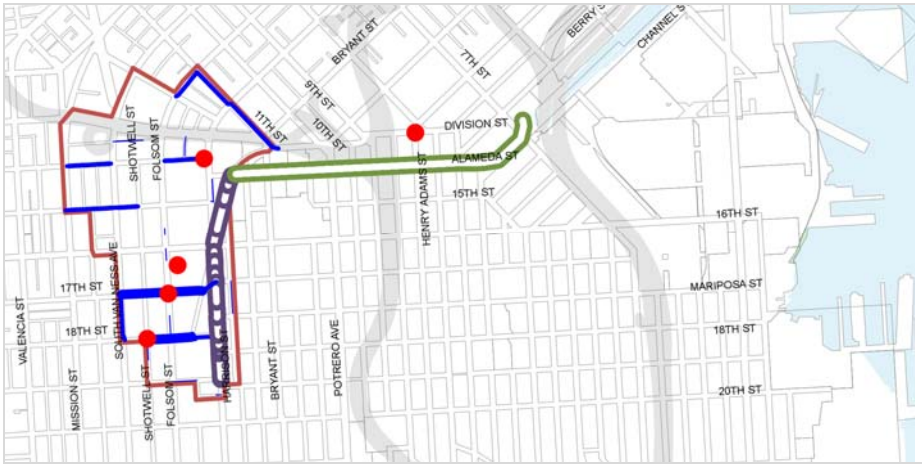
Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.8	2.2
18th & Shotwell	12.1	9.8	2.3
Enterprise Alley	7.0	6.1	0.9
14th & Harrison	6.1	3.8	2.3
Henry Adams	2.2	1.2	1.0

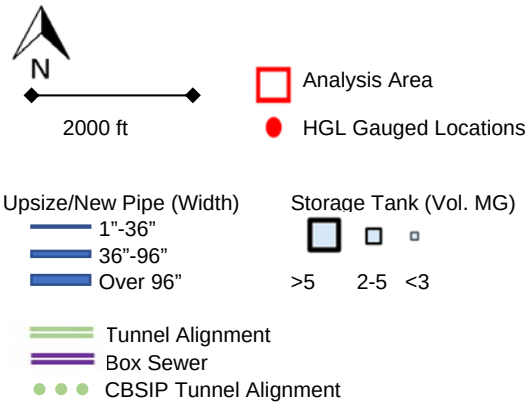
Summary of Freeboard for Nodes within Analysis Area

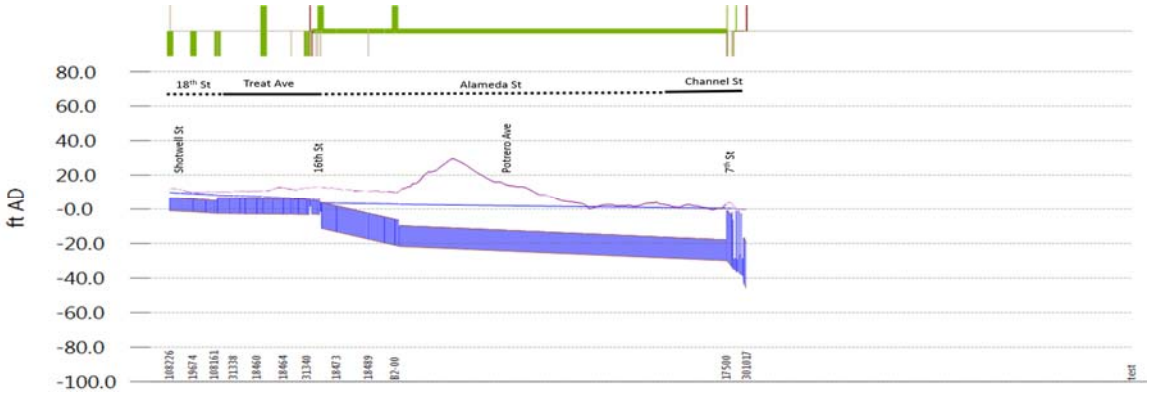
	Depth to Ground	# of Nodes
Freeboard Not Met	-0 feet	0
	0-2 feet	16
Freeboard Met	2-4 feet	108
	+4 feet	172



Analysis Area Plan & Profile







Note 1 Total Construction Cost estimates shown in 2016 Dollars. New Sewer, Deepen Box Sewer, Upsize Existing Sewer, Pumping, and Detention project elements assume 10% Contractor General Conditions and Requirements, 6.5% Contractor Overhead and Profit, 2.5% Bonding and Insurance and 30 % Design & Estimating Contingencies. Total Construction Cost estimates for Tunneling project elements assume a 30% Contingency.

Scorecard for C1

Base	A	B1	#C1#	D4					

Brief Narrative: Deepening and regrading of one compartment of the 4-compartment sewer on Division Street

Simulation Design Storm: 5yr-3hr

Total Construction Cost by Element Type[1]

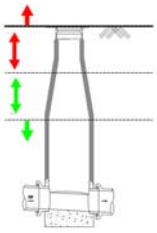
Element Type	Cost ($M)	$0M $100M
New Sewer	8.8	
Upsize Existing Sewer	16.1	
Deepen Box Sewer	77.2	
Tunneling		
Detention		
CBSIP Main Tunnel		
Total Cost	102.1	

Key Locations for Alternatives Performance Assessment

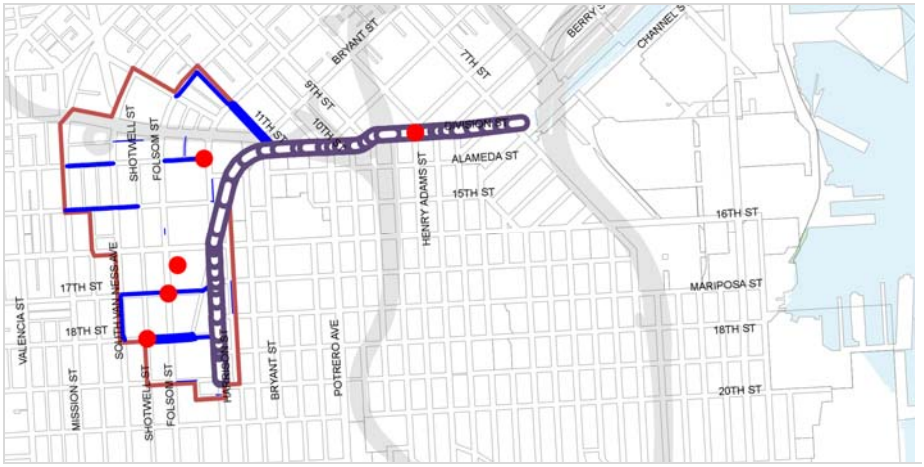
Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.9	2.1
18th & Shotwell	12.1	9.6	2.5
Enterprise Alley	7.0	6.0	1.0
14th & Harrison	6.1	3.9	2.2
Henry Adams	2.2	1.4	0.8

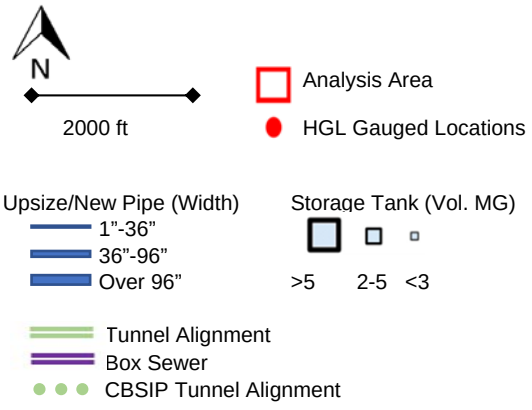
Summary of Freeboard for Nodes within Analysis Area

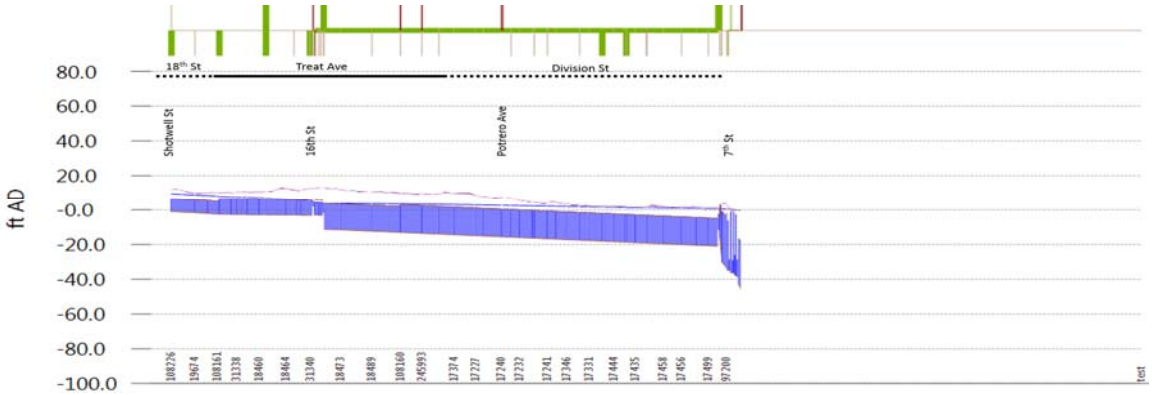
	Depth to Ground	# of Nodes
Freeboard Not Met	-0 feet	0
	0-2 feet	21
Freeboard Met	2-4 feet	102
	+4 feet	173



Analysis Area Plan & Profile







Note 1 Total Construction Cost estimates shown in 2016 Dollars. New Sewer, Deepen Box Sewer, Upsize Existing Sewer, Pumping, and Detention project elements assume 10% Contractor General Conditions and Requirements, 6.5% Contractor Overhead and Profit, 2.5% Bonding and Insurance and 30 % Design & Estimating Contingencies. Total Construction Cost estimates for Tunneling project elements assume a 30% Contingency.

Scorecard for D4

Base	A	B1	C1	#D4#					

Brief Narrative: Distributed Storage at 17th Street & Folsom Street (2.3MG) and 14th Street & Folsom Street (3.0MG) plus Minor Projects. Conveyance projects that bring flow to the storage were sized to provide 2 feet freeboard, but the storage tanks themselves were sized to provide 0 feet freeboard. The freeboard is reported in the same way as for the other alternatives, but there are more nodes in the 0-2 category due to the change in sizing criteria.

Simulation Design Storm: 5yr-3hr

Key Locations for Alternatives Performance Assessment

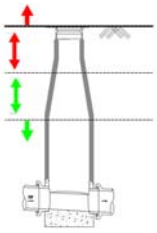
Location	Ground Elevation (ft)	Peak HGL Elevation (ft)	Freeboard (ft)
17th & Folsom	10.0	7.9	2.1
18th & Shotwell	12.1	9.2	2.9
Enterprise Alley	7.0	6.5	0.5
14th & Harrison	6.1	5.7	0.4
Henry Adams	2.2	1.7	0.5

Total Construction Cost by Element Type[1]

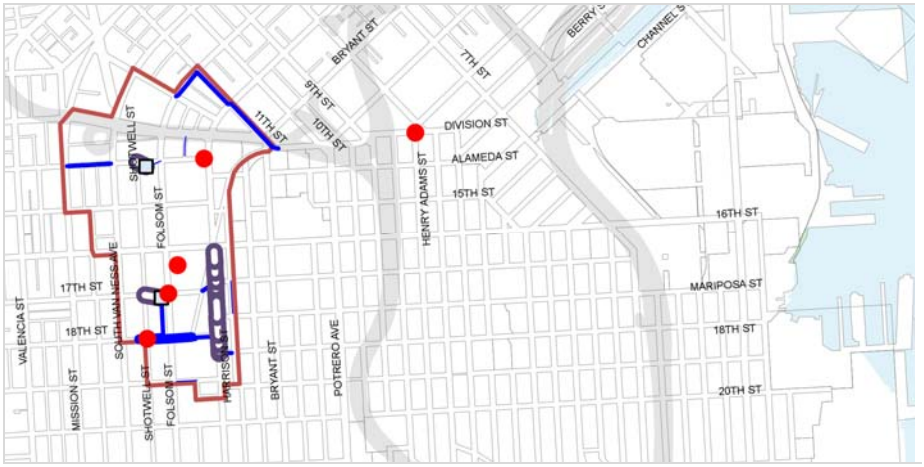
Element Type	Cost ($M)	$0M $100M
New Sewer	9.2	
Upsize Existing Sewer	10.8	
Deepen Box Sewer		
Tunneling		
Detention	44.0	
CBSIP Main Tunnel		
Total Cost	64.0	

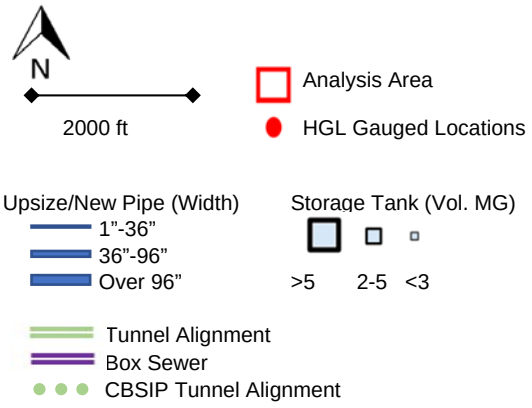
Summary of Freeboard for Nodes within Analysis Area

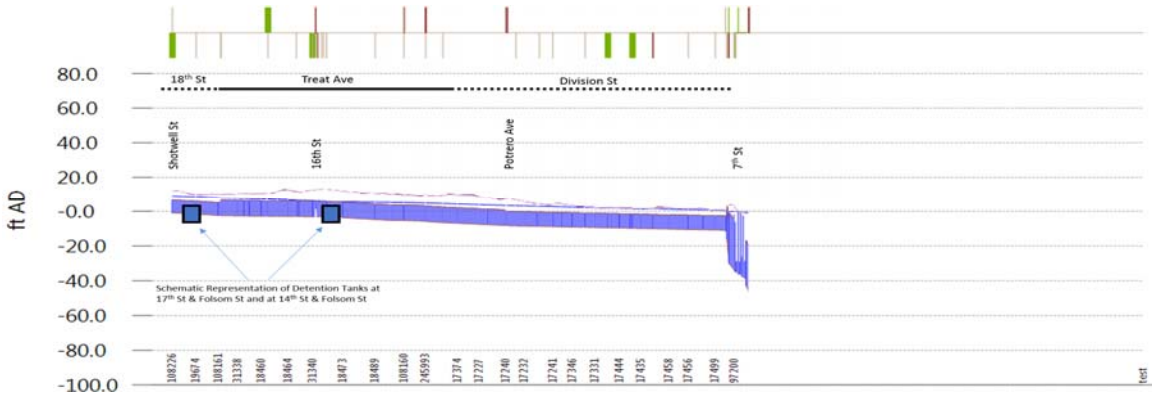
	Depth to Ground	# of Nodes
Freeboard Not Met	-0 feet	0
	0-2 feet	78
Freeboard Met	2-4 feet	89
	+4 feet	131



Analysis Area Plan & Profile







Note 1 Total Construction Cost estimates shown in 2016 Dollars. New Sewer, Deepen Box Sewer, Upsize Existing Sewer, Pumping, and Detention project elements assume 10% Contractor General Conditions and Requirements, 6.5% Contractor Overhead and Profit, 2.5% Bonding and Insurance and 30 % Design & Estimating Contingencies. Total Construction Cost estimates for Tunneling project elements assume a 30% Contingency.

Appendix H

Division Box Expansion Alternative Cost Estimate

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Total Contstruction Cost Summary Table
2016 Dollars

	Generalized Cross Section Dimensions				Unit Cost ($/LF)	Direct Construction Cost (DCC) ($M)	Escalation Basis	Escalated Factor	Escalated DCC ($M)	Contigencies Source	TCC Contigency Factor	Total Construction Unit Cost ($/LF)	Total Construction Cost ($M)
	Total Length (feet)	Width (inches)	Heigth (inches)	Equivalent Diameter (inches)									
M. Lee TO 64 Project Cost Estimate *Note 1*	2660	120	216	182	8860	23.6	None; Estimate in 2016 Dollars	1.000	23.6	TO 64 Project Cost Estimate	1.720	15239	40.5
Parametric Curves Linear Pipe Equivalent Diameter <=16ft depth	5050	120	192	171	4156	21.0	Annualized 4% over 4 Years	1.170	24.6	Section 6.6 of Program Validation Report	1.696	8246	41.6
Parametric Curves Linear Pipe Equivalent Diameter >=16ft depth	5050	120	192	171	6633	33.5	Annualized 4% over 4 Years	1.170	39.2	Section 6.6 of Program Validation Report	1.696	13161	66.5
Alternative C1 Main Alignment *Note 2*	5070	120	216	182	8860	44.9	None; Estimate in 2016 Dollars	1.000	44.9	TO 64 Project Cost Estimate	1.720	15239	77.3
Parsons Basis of Cost Gravity Pipe by Open Cut >12ft	6200	---	---	108	4150	25.7	Ratio of 2016 ENR CCI to Validation Report Project CCI (10507/9837.4)	1.068	27.5	Section 6.1 of Program Validation Report	1.495	6626	41.1
Parsons Basis of Cost Pipe Jacking	300	---	---	108	6667	2.0	Ratio of 2016 ENR CCI to Validation Report Project CCI (10507/9837.4)	1.068	2.1	Section 6.1 of Program Validation Report, No Urban Escalation	1.300	9257	2.8
Parsons Basis of Cost Total Costs	6500					27.7			29.6				43.9

Note 1	Assumes that the box width will be 12 feet Wide. Cost is dependent on heigth of Box
Note 2	Unit cost for Deeping Sewers from TO 64 Project Cost Estimate is applied to 5070 Linear feet of main conveyance alignment in Alternative C1
Note 3	Assumes 300 LF of C1 Project Length uses Borejacking/Microtunniling to get under 7th street not included in this summary
Notes	Section 6.6 uses a 1.696 Multiplier of DCC (Table 6.7)
	Section 6.1 uses a 30% Design estimate contigency and a 15% Urban Escalation
	ENR Escalation uses a multiplier of the ENR CCI in 2016 (10507) over the Project CCI in the Validation Report (9837.4) Multiplier comes out to 1.068.
	Annualized Escalation of 4% over 4 years (2012-->2016) Multiplier comes out to 1.170

SSIP PROGRAM
TO 84M FOLSOM AREA STORMWATER IMPROVEMENT
PRE-PLANNING LEVEL (AACE CLASS 5)
PROJECT COST ESTIMATE - SUMMARY

Date: **5/12/2017, Draft-R1**
By: ML/FL
PMC

ALL IN 2017 DOLLARS (UNESCALATED)

Alt	Description	Direct Construction Cost	Base Construction Cost	Total Construction Cost	Total Capital Project Cost
				From Attached Estimate Details	
	ALT C: DIVISION STREET BOX SEWER EXPANSION - ESTIMATE SUMMARY				
C1	Expand one compartment from 9.5'x8.25' to 10.0'Wx18.0'H, 5,070 ft long, top of slab 4 ft below street	$55,270,000	$86,277,000	$94,907,000	$140,607,000
C2	Expand two compartments 2@ 9.5'x8.25' to one 20' Wx12'.0'H, 5,070 ft long, top of slab 4 ft below street	$57,970,000	$90,487,000	$99,537,000	$147,467,000
C2a	Expand two compartments 2@ 9.5'x8.25' to one 20' Wx12'.0'H, 5,070 ft long, top of slab 6 ft below street	$60,480,000	$94,410,000	$103,850,000	$153,850,000

Important Notes:

1) Specifically excluded from the cost estimates:
   a) Cost escalation from 2017 dollars
   b) O&M cost

2) Scope for this estimate is based on following documents:
   a) Folsom Area Stormwater Improvement Project Needs Assessment and Alternatives Analysis Report dated, Jan 2017
   b) Division Street As-Built Drawings dated, March 1909, a total of 32 sheets
   c) Division Street Box Expansion section showing four boxes
   d) Clarifications from engineers

3) The estimate has been prepared based on preliminary information and design assumptions, which are subject to verifications and changes as the design progresses. An updated estimate should be prepared when more specific and detailed design is available.

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PROJECT COST ESTIMATE

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ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C1	**Expand one compartment from 9.5 x8.25 to 10.0 Wx18.0 H, 5,070 ft long, top of slab 4 ft below street**				
1					
2	**Key Quantities:**				
3	Segment length	5,070	lf		
4	Existing, 4 compartments/boxes @ 9.5'x8.25' each				
5	Proposed Alternative C1:				
6	Replace 1 box with 1 box 10'x18' deep at the south side				
7	i.e. remove 1 existing box and replaced with a new larger box				
8					
9	**Assumptions:**				
10	Top of box is 4 ft below street				
11					
12	Remove street paving, excavate to expose the top of the existing box at the south side, remove the top, bottom and the southern wall of the box, excavate to the new lower level, build the new box, back fill and restore street paving				
13	New box, like the existing boxes, will be on precast concrete piles				
14					
15	**Excavation & Demolition & Prep Work**				
16	Saw cut & remove (E) street paving	65,910	SF	4.00	263,640
17	Temporary shoring, 26 ft deep, both sides of box	267,671	SF	22.00	5,888,762
18	Excavate to top of (E) box, say average 4 ft deep	9,764	CY	25.00	244,100

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ALL IN 2017 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C1	**Expand one compartment from 9.5 x8.25 to 10.0 Wx18.0 H, 5,070 ft long, top of slab 4 ft below street**				
19	Haul-off and dispose	9,764	CY	35.00	341,740
20	Add for hazmat soil handling & disposal, say 60% of total	5,858	CY	150.00	878,760
21	Remove (E) manholes	26	EA	1,000.00	26,000
22	Saw cut top slab, 14" thick	10,140	LF	30.00	304,200
23	Saw cut bottom slab & vitrified brick, 2'-0" thick	10,140	LF	35.00	354,900
24	Remove top slab, 1'-4", breakup & haul off	2,373	CY	200.00	474,600
25	Remove bottom slab, 1' to 2' thick, breakup & haul off	2,676	CY	200.00	535,200
26	Remove existing sediment, say 6" thick	892	CY	125.00	111,500
27	Remove existing wall, 1' thick, breakup & haul off	26,242	CY	200.00	5,248,400
28	Excavate to deepen box, from 8.25' to 18', an addition of 10.75 ft	4,319	CY	85.00	367,115
29	Haul-off and dispose	4,319	CY	35.00	151,165
30	Add for hazmat soil handling & disposal, say 60% of total	2,591	CY	150.00	388,710
31	Cut off pile and remove	845	EA	200.00	169,000
32	Allow for dewatering	5,070	LF	150.00	760,500
33	Traffic control/management	45	Month	17,000.00	765,000
34	Utilities relocation/protection, SFPUC, allowance	5,070	LF	250.00	1,267,500
35	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		-
36	Misc. demolition	1	LS	200,000.00	200,000
37					-
38	**New Work:**				-
39	Piles 12" precast concrete, 35 ft long, two rows, at 3 ft o.c.	3380	EA	4,375.00	14,787,500

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ALL IN 2017 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C1	**Expand one compartment from 9.5 x8.25 to 10.0 Wx18.0 H, 5,070 ft long, top of slab 4 ft below street**				
40	Cut pile heads & connect to mat slab foundation	3380	EA	800.00	2,704,000
41	Pile testing program	1	LS	100,000.00	100,000
42	Imported backfill below bottom slab, 1' T, compacted	1,878	CY	80.00	150,240
43	Bottom slab, 1ft to 2 ft thick	3,380	CY	473.00	1,598,740
44	Top slab, 1'-4" thick	2,997	CY	1,020.00	3,056,940
45	Wall, 12" thick, 2 each, 18 ft H	6,760	CY	1,444.00	9,761,440
46	Water stops at wall and bottom slab	10,140	LF	15.00	152,100
47	Vitrified brick at bottom slab	50,700	SF	25.00	1,267,500
48	Manholes	26	EA	7,500.00	195,000
49	Modify (E) outfall	1	LS	150,000.00	150,000
50	Modify (E) junction structure	1	LS	250,000.00	250,000
51	Allow for hand mining at 2 busy intersections, allow	1	LS	1,000,000	1,000,000
52	Imported back fill above top of box and side	11,266	CY	50.00	563,300
53	Restore street paving	65,910	SF	12.00	790,920
54					
55	**Direct Cost Subtotal**	5,070	lf	10,901.00	55,268,472
56	Rounded-off				55,270,000
57	Add Markups:				
58	Contractor General Conditions and Requirements			10.00%	5,527,000
59	Market Factor			0.00%	N/A
60	Construction or Contract Phasing Factor			0.00%	N/A
61	General Contractor Overhead and Profit			6.50%	3,950,000
62	Bonding and Insurance			2.50%	1,620,000

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ALL IN 2017 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C1	**Expand one compartment from 9.5 x8.25 to 10.0 Wx18.0 H, 5,070 ft long, top of slab 4 ft below street**				
63	Design/Estimating Contingency			30.00%	19,910,000
64					
65	**Base Construction Cost (unescalated)**	5,070	lf	17,017.00	**86,277,000**
66	Construction Phase Contingency			10.00%	8,630,000
67					
68	**Total Construction Cost / Hardcost (Unescalated)**				94,907,000
69					
70	**Add for Project Softcost/Delivery Cost Allowance**			48.15%	45,700,000
71					
72	**Total Capital Project Cost**	5,070	lf	27,733.00	**140,607,000**
73	**In 2017 Dollars, Unescalated**				

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ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 4 ft below street**				
1					
2	**Key Quantities:**				
3	Segment length	5,070	lf		
4	Existing, 4 compartments/boxes @ 9.5'x8.25' each				
5	Proposed Alternative C2:				
6	Replace 2 boxes with 1 box 20'x12' deep at the south side				
7	i.e. remove 2 existing boxes and replaced with a new 20'x12' deep box				
8					
9	**Assumptions:**				
10	Top of box is 4 ft below street				
11					
12	Remove street paving, excavate to expose the top of two existing boxes at the south side, completely remove the two boxes, excavate to the new lower level, build the new box, back fill and restore street paving				
13	New box, like the existing boxes, will be on precast concrete piles				
14					
15	**Excavation & Demolition & Prep Work**				
16	Saw cut & remove (E) street paving	116,610	SF	4.00	466,440
17	Temporary shoring, 20.33 ft deep, both sides of box	207,081	SF	20.00	4,141,620
18	Excavate to top of (E) box, say average 4 ft deep	17,276	CY	22.00	380,072

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ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 4 ft below street**				
19	Haul-off and dispose	17,276	CY	35.00	604,660
20	Add for hazmat soil handling & disposal, say 60% of total	10,366	CY	150.00	1,554,840
21	Remove (E) manholes	52	EA	1,000.00	52,000
22	Saw cut top slab, 14" thick	10,140	LF	30.00	304,200
23	Saw cut bottom slab & vitrified brick, 2'-0' thick	10,140	LF	35.00	354,900
24	Remove top slab, 1'-4", breakup & haul off	5,245	CY	200.00	1,049,000
25	Remove bottom slab, 1' to 2' thick, breakup & haul off	5,915	CY	200.00	1,183,000
26	Remove existing sediment, say 6" thick	1,972	CY	125.00	246,500
27	Remove existing walls, 1' thick, breakup & haul off	4,225	CY	200.00	845,000
28	Excavate to deepen box, from 8.25' to 12', an addition of 3.75 ft	20,515	CY	85.00	1,743,775
29	Haul-off and dispose	20,515	CY	35.00	718,025
30	Add for hazmat soil handling & disposal, say 60% of total	12,309	CY	150.00	1,846,350
31	Cut off pile and remove	2,535	EA	200.00	507,000
32	Allow for dewatering	5,070	LF	200.00	1,014,000
33	Traffic control/management	45	Month	17,000.00	765,000
34	Utilities relocation/protection, SFPUC, allowance	5,070	LF	250.00	1,267,500
35	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		-
36	Misc. demolition	1	LS	200,000.00	200,000
37					-
38	**New Work:**				-
39	Piles 12" precast concrete, 35 ft long, two rows, at 3 ft o.c.	3380	EA	4,375.00	14,787,500
40	Cut pile heads & connect to mat slab foundation	3380	EA	800.00	2,704,000

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TO 84M FOLSOM AREA STORMWATER IMPROVEMENT — By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) — PMC

PROJECT COST ESTIMATE

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 4 ft below street**				
41	Pile testing program	1	LS	100,000.00	100,000
42	Imported backfill below bottom slab, compacted	3,756	CY	80.00	300,480
43	Bottom slab, 1ft to 2 ft thick	5,633	CY	473.00	2,664,409
44	Top slab, 1'-4" thick	4,995	CY	1,020.00	5,094,900
45	Wall, 12" thick, 2 each	4,507	CY	1,444.00	6,508,108
46	Water stops at wall and bottom slab	10,140	LF	15.00	152,100
47	Vitrified brick at bottom slab	101,400	SF	25.00	2,535,000
48	Manholes	52	EA	7,500.00	390,000
49	Modify (E) outfall	1	LS	150,000.00	150,000
50	Modify (E) junction structure	1	LS	250,000.00	250,000
51	Allow for hand mining at 2 busy intersections, allow	1	LS	1,000,000	1,000,000
52	Imported back fill to sides and top of box	18,403	CY	50.00	920,150
53	Restore street paving	116,610	SF	10.00	1,166,100
54					
55	**Direct Cost Subtotal**	5,070	lf	11,433.00	57,966,629
56	Rounded-off				**57,970,000**
57	Add Markups:				
58	Contractor General Conditions and Requirements			10.00%	5,797,000
59	Market Factor			0.00%	N/A
60	Construction or Contract Phasing Factor			0.00%	N/A
61	General Contractor Overhead and Profit			6.50%	4,140,000
62	Bonding and Insurance			2.50%	1,700,000
63	Design/Estimating Contingency			30.00%	20,880,000
64					

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ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 4 ft below street**				
65	**Base Construction Cost (unescalated)**	5,070	lf	17,848.00	**90,487,000**
66	Construction Phase Contingency			10.00%	9,050,000
67					
68	**Total Construction Cost / Hardcost (Unescalated)**				99,537,000
69					
70	**Add for Project Softcost/Delivery Cost Allowance**			48.15%	47,930,000
71					
72	**Total Capital Project Cost**	5,070	lf	29,086.00	**147,467,000**
73	**In 2017 Dollars, Unescalated**				

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ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2a	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 6 ft below street**				
1					
2	**Key Quantities:**				
3	Segment length	5,070	lf		
4	Existing, 4 compartments/boxes @ 9.5'x8.25' each				
5	Proposed Alternative C2:				
6	Replace 2 boxes with 1 box 20'x12' deep at the south side				
7	i.e. remove 2 existing boxes and replaced with a new 20'x12' deep box				
8					
9	**Assumptions:**				
10	Top of box is 6 ft below street				
11					
12	Remove street paving, excavate to expose the top of two existing boxes at the south side, completely remove the two boxes, excavate to the new lower level, build the new box, back fill and restore street paving				
13	New box, like the existing boxes, will be on precast concrete piles				
14					
15	**Excavation & Demolition & Prep Work**				
16	Saw cut & remove (E) street paving	116,610	SF	4.00	466,440
17	Temporary shoring, 22.33 ft deep, both sides of box	227,453	SF	20.00	4,549,060
18	Excavate to top of (E) box, say average 4 ft deep	25,913	CY	22.00	570,086

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ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2a	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 6 ft below street**				
19	Haul-off and dispose	25,913	CY	35.00	906,955
20	Add for hazmat soil handling & disposal, say 60% of total	15,548	CY	150.00	2,332,170
21	Remove (E) manholes	52	EA	1,000.00	52,000
22	Saw cut top slab, 14" thick	10,140	LF	30.00	304,200
23	Saw cut bottom slab & vitrified brick, 2'-0' thick	10,140	LF	35.00	354,900
24	Remove top slab, 1'-4", breakup & haul off	5,245	CY	200.00	1,049,000
25	Remove bottom slab, 1' to 2' thick, breakup & haul off	5,915	CY	200.00	1,183,000
26	Remove existing sediment, say 6" thick	1,972	CY	125.00	246,500
27	Remove existing walls, 1' thick, breakup & haul off	4,225	CY	200.00	845,000
28	Excavate to deepen box, from 8.25' to 12', an addition of 3.75 ft	20,515	CY	85.00	1,743,775
29	Haul-off and dispose	20,515	CY	35.00	718,025
30	Add for hazmat soil handling & disposal, say 60% of total	12,309	CY	150.00	1,846,350
31	Cut off pile and remove	2,535	EA	200.00	507,000
32	Allow for dewatering	5,070	LF	200.00	1,014,000
33	Traffic control/management	45	Month	17,000.00	765,000
34	Utilities relocation/protection, SFPUC, allowance	5,070	LF	250.00	1,267,500
35	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		-
36	Misc. demolition	1	LS	200,000.00	200,000
37					-
38	**New Work:**				-
39	Piles 12" precast concrete, 35 ft long, two rows, at 3 ft o.c.	3,380	EA	4,375.00	14,787,500
40	Cut pile heads & connect to mat slab foundation	3,380	EA	800.00	2,704,000

SSIP PROGRAM — **Date: 5/12/2017, Draft-R1**
TO 84M FOLSOM AREA STORMWATER IMPROVEMENT — By: ML/FL
PRE-PLANNING LEVEL (AACE CLASS 5) — PMC
PROJECT COST ESTIMATE

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2a	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 6 ft below street**				
41	Pile testing program	1	LS	100,000.00	100,000
42	Imported backfill below bottom slab, compacted	3,756	CY	80.00	300,480
43	Bottom slab, 1ft to 2 ft thick	5,633	CY	473.00	2,664,409
44	Top slab, 1'-4" thick	4,995	CY	1,020.00	5,094,900
45	Wall, 12" thick, 2 each	4,507	CY	1,444.00	6,508,108
46	Water stops at wall and bottom slab	10,140	LF	15.00	152,100
47	Vitrified brick at bottom slab	101,400	SF	25.00	2,535,000
48	Manholes	52	EA	7,500.00	390,000
49	Modify (E) outfall	1	LS	150,000.00	150,000
50	Modify (E) junction structure	1	LS	250,000.00	250,000
51	Allow for hand mining at 2 busy intersections, allow	1	LS	1,000,000	1,000,000
52	Imported back fill to sides and top of box	35,113	CY	50.00	1,755,650
53	Restore street paving	116,610	SF	10.00	1,166,100
54					
55	**Direct Cost Subtotal**	5,070	lf	11,929.00	60,479,208
56	Rounded-off				**60,480,000**
57	Add Markups:				
58	Contractor General Conditions and Requirements			10.00%	6,050,000
59	Market Factor			0.00%	N/A
60	Construction or Contract Phasing Factor			0.00%	N/A
61	General Contractor Overhead and Profit			6.50%	4,320,000
62	Bonding and Insurance			2.50%	1,770,000
63	Design/Estimating Contingency			30.00%	21,790,000
64					

SSIP PROGRAM
TO 84M FOLSOM AREA STORMWATER IMPROVEMENT
PRE-PLANNING LEVEL (AACE CLASS 5)
PROJECT COST ESTIMATE

Date: **5/12/2017, Draft-R1**
By: ML/FL
PMC

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
C2a	**Expand two compartments 2 9.5 x8.25 to one 20 Wx12 .0 H, 5,070 ft long, top of slab 6 ft below street**				
65	**Base Construction Cost (unescalated)**	5,070	lf	18,621.00	**94,410,000**
66	Construction Phase Contingency			10.00%	9,440,000
67					
68	**Total Construction Cost / Hardcost (Unescalated)**				103,850,000
69					
70	**Add for Project Softcost/Delivery Cost Allowance**			48.15%	50,000,000
71					
72	**Total Capital Project Cost**	5,070	lf	30,345.00	**153,850,000**
73	**In 2017 Dollars, Unescalated**				

Appendix I

Storage Alternatives Cost Estimate

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FOLSOM STORMWATER IMPROVEMENT PROJECT
UNDERGROUND DETENTION TANKS

SAN FRANCISCO, CA

CONTRACT NO. WW-XXX
PROJECT NO. XXXXX

PRE-PLANNING LEVEL CONSTRUCTION COST ESTIMATE (AN OPINION OF PROBABLE CONSTRUCTION COST) BASED ON PRE-PLANNING LEVEL INFORMATION/ASSUMPTIONS

Owner:
WASTEWATER ENTERPRISE
SAN FRANCISCO PUBLIC UTILITIES COMMISSION (SFPUC)
CITY AND COUNTY OF SAN FRANCISCO
Attention: Saed Toloui
Email: SToloui@sfwater.org

Prepared by
SSIP PMC Team
TASK ORDER 64
Task Order Manager: Bryce Wilson
Email: Bryce.wilson@aecom.com; Ph: 415-955-2937
Lead Cost Estimator: Martin Lee, PE, CPE
Email: mlee@mleecorp.com; Ph: 415-693-0236

7/25/2016 Draft

MLC: 1000 TO-64 Folsom Stormwater Detention

FOLSOM STORMWATER IMPROVEMENT PROJECT
UNDERGROUND DETENTION TANKS

PRE-PLANNING LEVEL CONSTRUCTION COST ESTIMATE
(AN OPINION OF PROBABLE CONSTRUCTION COST)
BASED ON
PRE-PLANNING LEVEL INFORMATION/ASSUMPTIONS

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7/25/2016 Draft

SSIP PROGRAM **DRAFT**
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)
BASIS OF ESTIMATE, ASSUMPTIONS AND QUALIFICATIONS:

Date: 7/25/2016
By: ML/FL
PMC Team

1) Scope for this estimate is based on following documents:
a) An email form Michele Miller of AECOM dated June 10, 2016 with a brief description of the detention requirements
b) Markups on Google Map showing potential tank footprints, a total of 5 sheets, dated June 2016
c) Clarifications from planners

2) Specifically excluded from the cost estimates:
Cost escalation from 2016 dollars
O&M cost
Abatement of contaminated soil and water

3) Cost estimates are based on the following assumed construction:
a) Cast-in-place reinforced concrete tank supported by piles.
b) Piles to be 12"x12" precast prestressed concrete, average 75 ft long, at one per 100 SF of tank base area.
c) Tanks near 14th/Folsom have an overflow structure: 18'Wx5'Hx132'L
d) Tanks near 17th/Folsom have an overflow structure: 17'Wx5'Hx221'L and overflow pipe: 6' dia x850'L
e) Discharge pipe to be 12" dia x 300 ft
f) Stormwater from tank to sewer system be sent via pumps and 12" discharge pipe
g) Pumps to be submersible, 2100 gpm and 1600 gpm

4) Terminology:
"Direct Construction Cost" is equivalent to subcontractor's bids to general contractor or the portion of work performed directly by the general contractor (self-performed work). This includes costs for materials, labor & equipment and subcontractor's markups

Base construction cost is the estimated construction bid submitted by general contractor to Owner.

Total construction cost (Hardcost) is the estimated base construction cost plus 10% contingency allowance for change orders during construction.

Soft cost is the estimated expense incurred by Owner for design, engineering, construction management, project administration and other related costs required to deliver the project in addition to the amount pay to the Contractor.

Total Capital Project Cost is the sum of hardcost and softcost

5) Limitations
The estimate has been prepared using accepted practices and it represents our opinion of probable construction costs. It is intended to be a determination of fair market value for the project construction. It is not a prediction of low bid. Since we have no control over market conditions and other factors which may affect the bid prices, we cannot and do not warrant nor guarantee that bids or ultimate construction costs will not vary from the cost estimate.

It should be noted that the cost estimate is a "snapshot in time" and that the reliability of this opinion of probable construction cost will inherently degrade over time.

Please note that the estimate has been prepared based on preliminary information and design assumptions which are subject to verifications and changes as the design progresses. An updated estimate should be prepared when more specific and detailed design information is available.

Client acknowledges that our service is consistent with and limited to the standard of care applicable to such services, which is that we provide our services consist with the professional skill and care ordinarily provided by consultants practicing in the same or similar locality under the same or similar circumstances. The estimate is intended to be a determination of fair market value for the project construction. Since we have no control over market conditions and other factors which may affect the bid prices, we cannot and do not warrant or guarantee that bids or ultimate construction costs will not vary from the cost estimate. We make no other warranties, either expressed or implied, and are not responsible for the interpretation by others of the contents herein the cost estimate.

6) Abbreviations used in the estimate:
CY = cubic yard
EA= each
GSF = gross square foot
LB = pound
LF = linear foot
LOC=location
LS = lump sum
SF = square foot

DRAFT

SSIP PROGRAM — **Date: 7/25/2016**
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS — By: ML/FL
PRE-PLANNING LEVEL (AACE CLASS 5) — PMC Team
PROJECT COST ESTIMATE

ALL IN 2016 DOLLARS (UNESCALATED)

Option	Option Description	Base Construction Cost	Total Construction Cost	Total Capital Project Cost	$/CF
		From Attached Detailed Estimates			
1	PG&E Parking Lot, 17th Street				
	A) Rectangular tank, 10' deep, 512' Lx66' W	$19,600,000	$21,560,000	$31,940,000	$94
	B) Rectangular tank, 20' deep, 168' Lx90' W	$12,130,000	$13,340,000	$19,770,000	$65
	C) Silo tank, 75' deep x 72' dia	$14,800,000	$16,280,000	$24,120,000	$79
2	Comcast Parking Lot, 17th Street				
	A) Rectangular tank, 10' deep, 150' Lx140' W	$13,430,000	$14,780,000	$21,890,000	$104
	B) Rectangular tank, 10' deep, 173' Lx61' W	$9,050,000	$9,960,000	$14,750,000	$139
	C) Rectangular tank, 20' deep, 135' Lx107' W	$11,710,000	$12,880,000	$19,080,000	$66
	D) Silo tank, 75' deep x 72' dia	$14,800,000	$16,280,000	$24,120,000	$79
3	Best Buy Parking Lot, 14th Street				
	A) Rectangular tank, 10' deep, 220' Lx185' W	$20,380,000	$22,420,000	$33,220,000	$82
	B) Rectangular tank, 20' deep, 110' Lx185' W	$13,250,000	$14,580,000	$21,600,000	$53
	C) Silo tank, 75' deep x 88' dia	$16,310,000	$17,940,000	$26,580,000	$58
4	Foods Co Parking Lot,14th Street				
	A) Rectangular tank, 10' deep - None				
	B) Rectangular tank, 20' deep, 159' Lx130' W	$13,350,000	$14,680,000	$21,760,000	$53
	C) Silo tank, 75' deep x 88' dia	$16,310,000	$17,940,000	$26,580,000	$58
5	Office Max Parking Lot, 14th Street				
	A) Rectangular tank, 10' deep - None				
	B) Rectangular tank, 20' deep - None				
	C) Silo tank, 75' deep x 88' dia	$16,310,000	$17,940,000	$26,580,000	$58

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	PG&E PARKING LOT				
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street				
1	**Key Quantities/Assumed Dimensions**				
2	Cast in place reinforced concrete tank		LF		
3	Cover to top of tank		4.0		
4	Thickness of top slab		2.0		
5	Thickness of base slab		3.0		
6	Thickness of top wall		2.0		
7					
8		Plan Area	Depth	Perimeter	Volume
9		SF	LF	LF	CY
10	A) Rectangular tank, 10' deep, 512' Lx66' W	33,800	10.0	1,160	12,520
11	B) Rectangular tank, 20' deep, 168' Lx90' W	15,100	20.0	520	11,190
12	C) Silo tank, 75' deep x 72' dia	4,070	75.0	226	11,310
13					
14					
15	**Estimate Summary**	Base Construction Cost		Total Construction Cost	Total Capital Project Cost
16	A) Rectangular tank, 10' deep, 512' Lx66' W	$19,600,000		$21,560,000	$31,940,000
17	B) Rectangular tank, 20' deep, 168' Lx90' W	$12,130,000		$13,340,000	$19,770,000
18	C) Silo tank, 75' deep x 72' dia	$14,800,000		$16,280,000	$24,120,000
19					

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	PG&E PARKING LOT				
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street				
20					
21	**A) Rectangular tank, 10 deep, 512 Lx66 W**				
22	Tank Construction:				
23	Remove asphalt paving	33,800	SF	2.00	67,600
24	Remove aggregate base, say 9" thick	939	CY	40.00	37,560
25	Remove trees & planting		None		-
26	Temporary shoring	22,040	SF	25.00	551,000
27	Excavation	23,790	CY	25.00	594,750
28	Backfill from top of tank	5,010	CY	30.00	150,300
29	Haul-off and dispose excessive excavated	18,780	CY	20.00	375,600
30	Piles, say 12"x12"x75ft at one per 100 SF	338	EA	9,000.00	3,042,000
31	Base slab, 3 ft thick	33,800	SF	57.00	1,926,600
32	Perimeter wall, 2 ft thick	11,600	SF	63.00	730,800
33	Top slab, 2 ft thick	33,800	SF	61.00	2,061,800
34	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
35	Access ladder	2	EA	2,400.00	4,800
36	Pump	2	EA	35,000.00	70,000
37	Electrical power for pump	1	LS	50,000.00	50,000
38					-
39	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
40	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
41	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
42					-
43	Parking Lot Restoration & Misc. Items:				-
44	Aggregate base, say 9"	939	CY	55.00	51,645
45	Asphalt concrete paving, say 6"	33,800	SF	4.00	135,200
46	Parking lot striping	33,800	SF	0.50	16,900
47	Parking lot lighting		None		-
48	Parking lot stormwater drainage	33,800	SF	2.50	84,500
49	Allow for dewatering	1	LS	50,000.00	50,000
50	Traffic control/management	1	LS	200,000.00	200,000
51	Utilities relocation/protection, SFPUC, allowance	1	LS	68,000.00	68,000
52	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
53	Misc. & incidental work	1	LS	68,000.00	68,000
54					
55	**Direct Cost Subtotal**	338,040	CF	37.14	12,554,277
56	Add Markups:				

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	PG&E PARKING LOT					
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street					
57	Contractor General Conditions and Requirements				10.00%	1,255,428
58	Market Factor				0.00%	N/A
59	Construction or Contract Phasing Factor				0.00%	N/A
60	General Contractor Overhead and Profit				6.50%	897,631
61	Bonding and Insurance				2.50%	367,683
62	Design/Estimating Contingency				30.00%	4,522,506
63						
64	**Base Construction Cost (unescalated)**	338,040	CF		57.97	**19,597,525**
65	Construction Phase Contingency				10.00%	1,959,753
66						
67	**Total Construction Cost / Hardcost (Unescalated)**	338,040	CF		63.77	**21,557,278**
68						
69	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	10,379,829
70						
71	**Total Capital Project Cost**	338,040	CF		94.48	31,937,107
72	**In 2016 Dollars, Unescalated**			use		**31,940,000**
73						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	PG&E PARKING LOT				
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street				
74					
75	**B) Rectangular tank, 20 deep, 168 Lx90 W**				
76	Tank Construction:				
77	Remove asphalt paving	15,100	SF	2.00	30,200
78	Remove aggregate base, say 9" thick	419	CY	40.00	16,760
79	Remove trees & planting		None		-
80	Temporary shoring	15,080	SF	25.00	377,000
81	Excavation	16,220	CY	25.00	405,500
82	Backfill from top of tank	2,240	CY	30.00	67,200
83	Haul-off and dispose excessive excavated	13,980	CY	20.00	279,600
84	Piles, say 12"x12"x75ft at one per 100 SF	151	EA	9,000.00	1,359,000
85	Base slab, 3 ft thick	15,100	SF	57.00	860,700
86	Perimeter wall, 2 ft thick	10,400	SF	63.00	655,200
87	Top slab, 2 ft thick	15,100	SF	61.00	921,100
88	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
89	Access ladder	2	EA	3,900.00	7,800
90	Pump	2	EA	45,000.00	90,000
91	Electrical power for pump	1	LS	50,000.00	50,000
92					-
93	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
94	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
95	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
96					-
97	Parking Lot Restoration & Misc. Items:				-
98	Aggregate base, say 9"	419	CY	55.00	23,045
99	Asphalt concrete paving, say 6"	15,100	SF	4.00	60,400
100	Parking lot striping	15,100	SF	0.50	7,550
101	Parking lot lighting		None		-
102	Parking lot stormwater drainage	15,100	SF	2.50	37,750
103	Allow for dewatering	1	LS	45,000.00	45,000
104	Traffic control/management	1	LS	200,000.00	200,000
105	Utilities relocation/protection, SFPUC, allowance	1	LS	30,000.00	30,000
106	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
107	Misc. & incidental work	1	LS	30,000.00	30,000
108					
109	**Direct Cost Subtotal**	302,130	CF	25.72	7,771,027
110	Add Markups:				

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	PG&E PARKING LOT					
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street					
111	Contractor General Conditions and Requirements				10.00%	777,103
112	Market Factor				0.00%	N/A
113	Construction or Contract Phasing Factor				0.00%	N/A
114	General Contractor Overhead and Profit				6.50%	555,628
115	Bonding and Insurance				2.50%	227,594
116	Design/Estimating Contingency				30.00%	2,799,406
117						
118	**Base Construction Cost (unescalated)**	302,130	CF		40.15	**12,130,758**
119	Construction Phase Contingency				10.00%	1,213,076
120						
121	**Total Construction Cost / Hardcost (Unescalated)**	302,130	CF		44.17	**13,343,834**
122						
123	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	6,425,056
124						
125	**Total Capital Project Cost**	302,130	CF		65.43	19,768,890
126	**In 2016 Dollars, Unescalated**			use		**19,770,000**
127						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	PG&E PARKING LOT				
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street				
128					
129	**C) Silo tank, 75 deep x 72 dia**				
130	Tank Construction:				
131	Remove asphalt paving	6,241	SF	2.00	12,482
132	Remove aggregate base, say 9" thick	173	CY	40.00	6,920
133	Remove trees & planting		None		-
134	Slurry wall, say 2 ft thick x 84 ft deep	18,984	SF	89.00	1,689,576
135	Excavation	19,420	CY	30.00	582,600
136	Backfill from top of tank	920	CY	30.00	27,600
137	Haul-off and dispose excessive excavated	18,500	CY	20.00	370,000
138	Piles, say 12"x12"x150ft at one per 100 SF	62	EA	22,500.00	1,395,000
139	Base slab, 3 ft thick	6,241	SF	83.00	518,003
140	Perimeter wall, 2 ft thick	16,950	SF	96.00	1,627,200
141	Top slab, 2 ft thick	6,241	SF	66.00	411,906
142	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
143	Access ladder	2	EA	12,150.00	24,300
144	Pump	2	EA	100,000.00	200,000
145	Electrical power for pump	1	LS	50,000.00	50,000
146					-
147	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
148	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
149	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
150					-
151	Parking Lot Restoration & Misc. Items:				-
152	Aggregate base, say 9"	173	CY	55.00	9,515
153	Asphalt concrete paving, say 6"	6,241	SF	4.00	24,964
154	Parking lot striping	6,241	SF	0.50	3,121
155	Parking lot lighting		None		-
156	Parking lot stormwater drainage	6,241	SF	2.50	15,603
157	Allow for dewatering	1	LS	170,000.00	170,000
158	Traffic control/management	1	LS	100,000.00	100,000
159	Utilities relocation/protection, SFPUC, allowance	1	LS	12,000.00	12,000
160	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
161	Misc. & incidental work	1	LS	12,000.00	12,000
162					
163	**Direct Cost Subtotal**	305,370	CF	31.04	9,480,011
164	Add Markups:				

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	PG&E PARKING LOT					
	Located at parking lot bounded by 17th Street, Treat Ave, Harrison St & 16th Street					
165	Contractor General Conditions and Requirements				10.00%	948,001
166	Market Factor				0.00%	N/A
167	Construction or Contract Phasing Factor				0.00%	N/A
168	General Contractor Overhead and Profit				6.50%	677,821
169	Bonding and Insurance				2.50%	277,646
170	Design/Estimating Contingency				30.00%	3,415,044
171						
172	**Base Construction Cost (unescalated)**	305,370	CF		48.46	**14,798,523**
173	Construction Phase Contingency				10.00%	1,479,852
174						
175	**Total Construction Cost / Hardcost (Unescalated)**	305,370	CF		53.31	**16,278,375**
176						
177	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	7,838,038
178						
179	**Total Capital Project Cost**	305,370	CF		78.97	24,116,413
180	**In 2016 Dollars, Unescalated**			use		**24,120,000**
181						

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	COMCAST PARKING LOT				
	Located at parking lot at 17th Street & Treat Ave				
1	**Key Quantities/Assumed Dimensions**				
2	Cast in place reinforced concrete tank		LF		
3	Cover to top of tank		4.0		
4	Thickness of top slab		2.0		
5	Thickness of base slab		3.0		
6	Thickness of top wall		2.0		
7					
8		Plan Area	Depth	Perimeter	Volume
9		SF	LF	LF	CY
10	A) Rectangular tank, 10' deep, 150' Lx140' W	21,000	10.0	580	7,780
11	B) Rectangular tank, 10' deep, 173' Lx61' W	10,600	10.0	470	3,930
12	C) Rectangular tank, 20' deep, 135' Lx107' W	14,400	20.0	480	10,670
13	D) Silo tank, 75' deep x 72' dia	4,070	75.0	226	11,310
14					
15					
16	**Estimate Summary**	Base Construction Cost		Total Construction Cost	Total Capital Project Cost
17	A) Rectangular tank, 10' deep, 150' Lx140' W	$13,430,000		$14,780,000	$21,890,000
18	B) Rectangular tank, 10' deep, 173' Lx61' W	$9,050,000		$9,960,000	$14,750,000
19	C) Rectangular tank, 20' deep, 135' Lx107' W	$11,710,000		$12,880,000	$19,080,000
20	D) Silo tank, 75' deep x 72' dia	$14,800,000		$16,280,000	$24,120,000
21					

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	COMCAST PARKING LOT				
	Located at parking lot at 17th Street & Treat Ave				
22					
23	**A) Rectangular tank, 10 deep, 150 Lx140 W**				
24	Tank Construction:				
25	Remove asphalt paving	21,000	SF	2.00	42,000
26	Remove aggregate base, say 9" thick	583	CY	40.00	23,320
27	Remove trees & planting		None		-
28	Temporary shoring	11,020	SF	25.00	275,500
29	Excavation	14,780	CY	25.00	369,500
30	Backfill from top of tank	3,110	CY	30.00	93,300
31	Haul-off and dispose excessive excavated	11,670	CY	20.00	233,400
32	Piles, say 12"x12"x75ft at one per 100 SF	210	EA	9,000.00	1,890,000
33	Base slab, 3 ft thick	21,000	SF	57.00	1,197,000
34	Perimeter wall, 2 ft thick	5,800	SF	63.00	365,400
35	Top slab, 2 ft thick	21,000	SF	61.00	1,281,000
36	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
37	Access ladder	2	EA	2,400.00	4,800
38	Pump	2	EA	35,000.00	70,000
39	Electrical power for pump	1	LS	50,000.00	50,000
40					-
41	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
42	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
43	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
44					-
45	Parking Lot Restoration & Misc. Items:				-
46	Aggregate base, say 9"	583	CY	55.00	32,065
47	Asphalt concrete paving, say 6"	21,000	SF	4.00	84,000
48	Parking lot striping	21,000	SF	0.50	10,500
49	Parking lot lighting		None		-
50	Parking lot stormwater drainage	21,000	SF	2.50	52,500
51	Allow for dewatering	1	LS	31,000.00	31,000
52	Traffic control/management	1	LS	200,000.00	200,000
53	Utilities relocation/protection, SFPUC, allowance	1	LS	42,000.00	42,000
54	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
55	Misc. & incidental work	1	LS	42,000.00	42,000
56					
57	**Direct Cost Subtotal**	210,060	CF	40.97	8,606,507
58	Add Markups:				
59	Contractor General Conditions and Requirements			10.00%	860,651

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	COMCAST PARKING LOT					
	Located at parking lot at 17th Street & Treat Ave					
60	Market Factor				0.00%	N/A
61	Construction or Contract Phasing Factor				0.00%	N/A
62	General Contractor Overhead and Profit				6.50%	615,365
63	Bonding and Insurance				2.50%	252,063
64	Design/Estimating Contingency				30.00%	3,100,376
65						
66	**Base Construction Cost (unescalated)**	210,060	CF		63.96	**13,434,962**
67	Construction Phase Contingency				10.00%	1,343,496
68						
69	**Total Construction Cost / Hardcost (Unescalated)**	210,060	CF		70.35	**14,778,458**
70						
71	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	7,115,828
72						
73	**Total Capital Project Cost**	210,060	CF		104.23	21,894,286
74	**In 2016 Dollars, Unescalated**			use		**21,890,000**
75						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	COMCAST PARKING LOT				
	Located at parking lot at 17th Street & Treat Ave				
76					
77	**B) Rectangular tank, 10 deep, 173 Lx61 W**				
78	Tank Construction:				
79	Remove asphalt paving	10,600	SF	2.00	21,200
80	Remove aggregate base, say 9" thick	294	CY	40.00	11,760
81	Remove trees & planting		None		-
82	Temporary shoring	8,930	SF	25.00	223,250
83	Excavation	7,460	CY	25.00	186,500
84	Backfill from top of tank	1,570	CY	30.00	47,100
85	Haul-off and dispose excessive excavated	5,890	CY	20.00	117,800
86	Piles, say 12"x12"x75ft at one per 100 SF	106	EA	9,000.00	954,000
87	Base slab, 3 ft thick	10,600	SF	57.00	604,200
88	Perimeter wall, 2 ft thick	4,700	SF	63.00	296,100
89	Top slab, 2 ft thick	10,600	SF	61.00	646,600
90	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
91	Access ladder	2	EA	2,400.00	4,800
92	Pump	2	EA	35,000.00	70,000
93	Electrical power for pump	1	LS	50,000.00	50,000
94					-
95	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
96	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
97	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
98					-
99	Parking Lot Restoration & Misc. Items:				-
100	Aggregate base, say 9"	294	CY	55.00	16,170
101	Asphalt concrete paving, say 6"	10,600	SF	4.00	42,400
102	Parking lot striping	10,600	SF	0.50	5,300
103	Parking lot lighting		None		-
104	Parking lot stormwater drainage	10,600	SF	2.50	26,500
105	Allow for dewatering	1	LS	16,000.00	16,000
106	Traffic control/management	1	LS	200,000.00	200,000
107	Utilities relocation/protection, SFPUC, allowance	1	LS	21,000.00	21,000
108	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
109	Misc. & incidental work	1	LS	21,000.00	21,000
110					
111	**Direct Cost Subtotal**	106,110	CF	54.65	5,798,902
112	Add Markups:				
113	Contractor General Conditions and Requirements			10.00%	579,890

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	COMCAST PARKING LOT					
	Located at parking lot at 17th Street & Treat Ave					
114	Market Factor				0.00%	N/A
115	Construction or Contract Phasing Factor				0.00%	N/A
116	General Contractor Overhead and Profit				6.50%	414,621
117	Bonding and Insurance				2.50%	169,835
118	Design/Estimating Contingency				30.00%	2,088,974
119						
120	**Base Construction Cost (unescalated)**	106,110	CF		85.31	**9,052,222**
121	Construction Phase Contingency				10.00%	905,222
122						
123	**Total Construction Cost / Hardcost (Unescalated)**	106,110	CF		93.84	**9,957,444**
124						
125	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	4,794,509
126						
127	**Total Capital Project Cost**	106,110	CF		139.03	14,751,953
128	**In 2016 Dollars, Unescalated**			use		**14,750,000**

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	COMCAST PARKING LOT				
	Located at parking lot at 17th Street & Treat Ave				
129					
130	**C) Rectangular tank, 20 deep, 135 Lx107 W**				
131	Tank Construction:				
132	Remove asphalt paving	14,400	SF	2.00	28,800
133	Remove aggregate base, say 9" thick	400	CY	40.00	16,000
134	Remove trees & planting		None		-
135	Temporary shoring	13,920	SF	25.00	348,000
136	Excavation	15,470	CY	25.00	386,750
137	Backfill from top of tank	2,130	CY	30.00	63,900
138	Haul-off and dispose excessive excavated	13,340	CY	20.00	266,800
139	Piles, say 12"x12"x75ft at one per 100 SF	144	EA	9,000.00	1,296,000
140	Base slab, 3 ft thick	14,400	SF	57.00	820,800
141	Perimeter wall, 2 ft thick	9,600	SF	63.00	604,800
142	Top slab, 2 ft thick	14,400	SF	61.00	878,400
143	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
144	Access ladder	2	EA	3,900.00	7,800
145	Pump	2	EA	45,000.00	90,000
146	Electrical power for pump	1	LS	50,000.00	50,000
147					-
148	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
149	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
150	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
151					-
152	Parking Lot Restoration & Misc. Items:				-
153	Aggregate base, say 9"	400	CY	55.00	22,000
154	Asphalt concrete paving, say 6"	14,400	SF	4.00	57,600
155	Parking lot striping	14,400	SF	0.50	7,200
156	Parking lot lighting		None		-
157	Parking lot stormwater drainage	14,400	SF	2.50	36,000
158	Allow for dewatering	1	LS	43,000.00	43,000
159	Traffic control/management	1	LS	200,000.00	200,000
160	Utilities relocation/protection, SFPUC, allowance	1	LS	29,000.00	29,000
161	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
162	Misc. & incidental work	1	LS	29,000.00	29,000
163					
164	**Direct Cost Subtotal**	288,090	CF	26.03	7,499,072
165	Add Markups:				

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	COMCAST PARKING LOT					
	Located at parking lot at 17th Street & Treat Ave					
166	Contractor General Conditions and Requirements				10.00%	749,907
167	Market Factor				0.00%	N/A
168	Construction or Contract Phasing Factor				0.00%	N/A
169	General Contractor Overhead and Profit				6.50%	536,184
170	Bonding and Insurance				2.50%	219,629
171	Design/Estimating Contingency				30.00%	2,701,438
172						
173	**Base Construction Cost (unescalated)**	288,090	CF		40.63	**11,706,230**
174	Construction Phase Contingency				10.00%	1,170,623
175						
176	**Total Construction Cost / Hardcost (Unescalated)**	288,090	CF		44.70	**12,876,853**
177						
178	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	6,200,205
179						
180	**Total Capital Project Cost**	288,090	CF		66.22	19,077,058
181	**In 2016 Dollars, Unescalated**			use		**19,080,000**
182						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	COMCAST PARKING LOT				
	Located at parking lot at 17th Street & Treat Ave				
183					
184	**D) Silo tank, 75 deep x 72 dia**				
185	Tank Construction:				
186	Remove asphalt paving	6,241	SF	2.00	12,482
187	Remove aggregate base, say 9" thick	173	CY	40.00	6,920
188	Remove trees & planting		None		-
189	Slurry wall, say 2 ft thick x 84 ft deep	18,984	SF	89.00	1,689,576
190	Excavation	19,420	CY	30.00	582,600
191	Backfill from top of tank	920	CY	30.00	27,600
192	Haul-off and dispose excessive excavated	18,500	CY	20.00	370,000
193	Piles, say 12"x12"x150ft at one per 100 SF	62	EA	22,500.00	1,395,000
194	Base slab, 3 ft thick	6,241	SF	83.00	518,003
195	Perimeter wall, 2 ft thick	16,950	SF	96.00	1,627,200
196	Top slab, 2 ft thick	6,241	SF	66.00	411,906
197	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
198	Access ladder	2	EA	12,150.00	24,300
199	Pump	2	EA	100,000.00	200,000
200	Electrical power for pump	1	LS	50,000.00	50,000
201					-
202	Flow structure at 17th/Folsom: 17' wide x 5 ft tall 221 ft long with 4 ft cover	221	LF	8,132.00	1,797,172
203	Overflow Pipe (at 18th and Shotwell): 6" dia x 850 ft long	850	LF	311.00	264,350
204	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
205					-
206	Parking Lot Restoration & Misc. Items:				-
207	Aggregate base, say 9"	173	CY	55.00	9,515
208	Asphalt concrete paving, say 6"	6,241	SF	4.00	24,964
209	Parking lot striping	6,241	SF	0.50	3,121
210	Parking lot lighting		None		-
211	Parking lot stormwater drainage	6,241	SF	2.50	15,603
212	Allow for dewatering	1	LS	170,000.00	170,000
213	Traffic control/management	1	LS	100,000.00	100,000
214	Utilities relocation/protection, SFPUC, allowance	1	LS	12,000.00	12,000
215	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
216	Misc. & incidental work	1	LS	12,000.00	12,000
217					
218	**Direct Cost Subtotal**	305,370	CF	31.04	9,480,011
219	Add Markups:				

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	COMCAST PARKING LOT					
	Located at parking lot at 17th Street & Treat Ave					
220	Contractor General Conditions and Requirements				10.00%	948,001
221	Market Factor				0.00%	N/A
222	Construction or Contract Phasing Factor				0.00%	N/A
223	General Contractor Overhead and Profit				6.50%	677,821
224	Bonding and Insurance				2.50%	277,646
225	Design/Estimating Contingency				30.00%	3,415,044
226						
227	**Base Construction Cost (unescalated)**	305,370	CF		48.46	**14,798,523**
228	Construction Phase Contingency				10.00%	1,479,852
229						
230	**Total Construction Cost / Hardcost (Unescalated)**	305,370	CF		53.31	**16,278,375**
231						
232	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	7,838,038
233						
234	**Total Capital Project Cost**	305,370	CF		78.97	24,116,413
235	**In 2016 Dollars, Unescalated**			use		**24,120,000**
236						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	BEST BUY PARKING LOT				
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St				
1	**Key Quantities/Assumed Dimensions**				
2	Cast in place reinforced concrete tank		LF		
3	Cover to top of tank		4.0		
4	Thickness of top slab		2.0		
5	Thickness of base slab		3.0		
6	Thickness of top wall		2.0		
7					
8		Plan Area	Depth	Perimeter	Volume
9		SF	LF	LF	CY
10	A) Rectangular tank, 10' deep, 220' Lx185' W	40,700	10.0	810	15,070
11	B) Rectangular tank, 20' deep, 110' Lx185' W	20,350	20.0	590	15,070
12	C) Silo tank, 75' deep x 88' dia	6,080	75.0	276	16,890
13					
14					
15	**Estimate Summary**	Base Construction Cost		Total Construction Cost	Total Capital Project Cost
16	A) Rectangular tank, 10' deep, 220' Lx185' W	$20,380,000		$22,420,000	$33,220,000
17	B) Rectangular tank, 20' deep, 110' Lx185' W	$13,250,000		$14,580,000	$21,600,000
18	C) Silo tank, 75' deep x 88' dia	$16,310,000		$17,940,000	$26,580,000
19					

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	BEST BUY PARKING LOT				
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St				
20					
21	**A) Rectangular tank, 10 deep, 220 Lx185 W**				
22	Tank Construction:				
23	Remove asphalt paving	40,700	SF	2.00	81,400
24	Remove aggregate base, say 9" thick	1,131	CY	40.00	45,240
25	Remove trees & planting	1	LS	5,000.00	5,000
26	Temporary shoring	15,390	SF	25.00	384,750
27	Excavation	28,640	CY	25.00	716,000
28	Backfill from top of tank	6,030	CY	30.00	180,900
29	Haul-off and dispose excessive excavated	22,610	CY	20.00	452,200
30	Piles, say 12"x12"x75ft at one per 100 SF	407	EA	9,000.00	3,663,000
31	Base slab, 3 ft thick	40,700	SF	57.00	2,319,900
32	Perimeter wall, 2 ft thick	8,100	SF	63.00	510,300
33	Top slab, 2 ft thick	40,700	SF	61.00	2,482,700
34	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
35	Access ladder	2	EA	2,400.00	4,800
36	Pump	2	EA	35,000.00	70,000
37	Electrical power for pump	1	LS	50,000.00	50,000
38					-
39	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
40	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
41					-
42	Parking Lot Restoration & Misc. Items:				-
43	Aggregate base, say 9"	1,131	CY	55.00	62,205
44	Asphalt concrete paving, say 6"	40,700	SF	4.00	162,800
45	Parking lot striping	40,700	SF	0.50	20,350
46	Tree & planting	1	LS	10,000.00	10,000
47	Parking lot lighting	2	EA	5,000.00	10,000
48	Parking lot stormwater drainage	40,700	SF	2.50	101,750
49	Allow for dewatering	1	LS	60,000.00	60,000
50	Traffic control/management	1	LS	200,000.00	200,000
51	Utilities relocation/protection, SFPUC, allowance	1	LS	81,000.00	81,000
52	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
53	Misc. & incidental work	1	LS	81,000.00	81,000
54					
55	**Direct Cost Subtotal**	406,890	CF	32.09	13,056,755
56	Add Markups:				
57	Contractor General Conditions and Requirements			10.00%	1,305,676

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	BEST BUY PARKING LOT					
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St					
58	Market Factor				0.00%	N/A
59	Construction or Contract Phasing Factor				0.00%	N/A
60	General Contractor Overhead and Profit				6.50%	933,558
61	Bonding and Insurance				2.50%	382,400
62	Design/Estimating Contingency				30.00%	4,703,517
63						
64	**Base Construction Cost (unescalated)**	406,890	CF		50.09	**20,381,906**
65	Construction Phase Contingency				10.00%	2,038,191
66						
67	**Total Construction Cost / Hardcost (Unescalated)**	406,890	CF		55.10	**22,420,097**
68						
69	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	10,795,277
70						
71	**Total Capital Project Cost**	406,890	CF		81.63	33,215,374
72	**In 2016 Dollars, Unescalated**			use		**33,220,000**
73						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	BEST BUY PARKING LOT				
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St				
74					
75	**B) Rectangular tank, 20 deep, 110 Lx185 W**				
76	Tank Construction:				
77	Remove asphalt paving	20,350	SF	2.00	40,700
78	Remove aggregate base, say 9" thick	565	CY	40.00	22,600
79	Remove trees & planting	1	LS	5,000.00	5,000
80	Temporary shoring	17,110	SF	25.00	427,750
81	Excavation	21,860	CY	25.00	546,500
82	Backfill from top of tank	3,010	CY	30.00	90,300
83	Haul-off and dispose excessive excavated	18,850	CY	20.00	377,000
84	Piles, say 12"x12"x75ft at one per 100 SF	204	EA	9,000.00	1,836,000
85	Base slab, 3 ft thick	20,350	SF	57.00	1,159,950
86	Perimeter wall, 2 ft thick	11,800	SF	63.00	743,400
87	Top slab, 2 ft thick	20,350	SF	61.00	1,241,350
88	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
89	Access ladder	2	EA	3,900.00	7,800
90	Pump	2	EA	45,000.00	90,000
91	Electrical power for pump	1	LS	50,000.00	50,000
92					-
93	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
94	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
95					-
96	Parking Lot Restoration & Misc. Items:				-
97	Aggregate base, say 9"	565	CY	55.00	31,075
98	Asphalt concrete paving, say 6"	20,350	SF	4.00	81,400
99	Parking lot striping	20,350	SF	0.50	10,175
100	Tree & planting	1	LS	15,000.00	15,000
101	Parking lot lighting	4	EA	5,000.00	20,000
102	Parking lot stormwater drainage	20,350	SF	2.50	50,875
103	Allow for dewatering	1	LS	60,000.00	60,000
104	Traffic control/management	1	LS	200,000.00	200,000
105	Utilities relocation/protection, SFPUC, allowance	1	LS	41,000.00	41,000
106	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
107	Misc. & incidental work	1	LS	41,000.00	41,000
108					
109	**Direct Cost Subtotal**	406,890	CF	20.87	8,490,335
110	Add Markups:				
111	Contractor General Conditions and Requirements			10.00%	849,034

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	BEST BUY PARKING LOT					
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St					
112	Market Factor				0.00%	N/A
113	Construction or Contract Phasing Factor				0.00%	N/A
114	General Contractor Overhead and Profit				6.50%	607,059
115	Bonding and Insurance				2.50%	248,661
116	Design/Estimating Contingency				30.00%	3,058,527
117						
118	**Base Construction Cost (unescalated)**	406,890	CF		32.57	**13,253,616**
119	Construction Phase Contingency				10.00%	1,325,362
120						
121	**Total Construction Cost / Hardcost (Unescalated)**	406,890	CF		35.83	**14,578,978**
122						
123	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	7,019,778
124						
125	**Total Capital Project Cost**	406,890	CF		53.08	21,598,756
126	**In 2016 Dollars, Unescalated**			use		**21,600,000**
127						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	BEST BUY PARKING LOT				
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St				
128					
129	**C) Silo tank, 75 deep x 88 dia**				
130	Tank Construction:				
131	Remove asphalt paving	9,025	SF	2.00	18,050
132	Remove aggregate base, say 9" thick	251	CY	40.00	10,040
133	Remove trees & planting		None		-
134	Slurry wall, say 2 ft thick x 84 ft deep	23,184	SF	89.00	2,063,376
135	Excavation	18,920	CY	30.00	567,600
136	Backfill from top of tank	1,340	CY	30.00	40,200
137	Haul-off and dispose excessive excavated	17,580	CY	20.00	351,600
138	Piles, say 12"x12"x150ft at one per 100 SF	90	EA	22,500.00	2,025,000
139	Base slab, 3 ft thick	9,025	SF	83.00	749,075
140	Perimeter wall, 2 ft thick	20,700	SF	96.00	1,987,200
141	Top slab, 2 ft thick	9,025	SF	66.00	595,650
142	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
143	Access ladder	2	EA	12,150.00	24,300
144	Pump	2	EA	100,000.00	200,000
145	Electrical power for pump	1	LS	50,000.00	50,000
146					-
147	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
148	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
149					-
150	Parking Lot Restoration & Misc. Items:				-
151	Aggregate base, say 9"	251	CY	55.00	13,805
152	Asphalt concrete paving, say 6"	9,025	SF	4.00	36,100
153	Parking lot striping	9,025	SF	0.50	4,513
154	Parking lot lighting		None		-
155	Parking lot stormwater drainage	9,025	SF	2.50	22,563
156	Allow for dewatering	1	LS	253,000.00	253,000
157	Traffic control/management	1	LS	100,000.00	100,000
158	Utilities relocation/protection, SFPUC, allowance	1	LS	18,000.00	18,000
159	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
160	Misc. & incidental work	1	LS	18,000.00	18,000
161					
162	**Direct Cost Subtotal**	456,030	CF	22.91	10,449,531
163	Add Markups:				
164	Contractor General Conditions and Requirements			10.00%	1,044,953

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	BEST BUY PARKING LOT					
	Located at parking lot bounded by 14th St, 13th St, Harrison St & Treat/Division St					
165	Market Factor				0.00%	N/A
166	Construction or Contract Phasing Factor				0.00%	N/A
167	General Contractor Overhead and Profit				6.50%	747,141
168	Bonding and Insurance				2.50%	306,041
169	Design/Estimating Contingency				30.00%	3,764,300
170						
171	**Base Construction Cost (unescalated)**	456,030	CF		35.77	**16,311,966**
172	Construction Phase Contingency				10.00%	1,631,197
173						
174	**Total Construction Cost / Hardcost (Unescalated)**	456,030	CF		39.35	**17,943,163**
175						
176	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	8,639,633
177						
178	**Total Capital Project Cost**	456,030	CF		58.29	26,582,796
179	**In 2016 Dollars, Unescalated**			use		**26,580,000**
180						

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	FOODS CO PARKING LOT				
	Located at parking lot bounded by 14th St, Shotwell St & Folsom St				
1	**Key Quantities/Assumed Dimensions**				
2	Cast in place reinforced concrete tank		LF		
3	Cover to top of tank		4.0		
4	Thickness of top slab		2.0		
5	Thickness of base slab		3.0		
6	Thickness of top wall		2.0		
7					
8		Plan Area	Depth	Perimeter	Volume
9		SF	LF	LF	CY
10	A) Rectangular tank, 10' deep - None				-
11	B) Rectangular tank, 20' deep, 159' Lx130' W	20,670	20.0	578	15,310
12	C) Silo tank, 75' deep x 88' dia	6,080	75.0	276	16,890
13					
14					
15	**Estimate Summary**	Base Construction Cost		Total Construction Cost	Total Capital Project Cost
16	A) Rectangular tank, 10' deep - None				
17	B) Rectangular tank, 20' deep, 159' Lx130' W	$13,350,000		$14,680,000	$21,760,000
18	C) Silo tank, 75' deep x 88' dia	$16,310,000		$17,940,000	$26,580,000
19					

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	FOODS CO PARKING LOT				
	Located at parking lot bounded by 14th St, Shotwell St & Folsom St				
20					
21	**A) Rectangular tank, 10 deep - None**				
22					
23					
24	**B) Rectangular tank, 20 deep, 159 Lx130 W**				
25	Tank Construction:				
26	Remove asphalt paving	20,670	SF	2.00	41,340
27	Remove aggregate base, say 9" thick	574	CY	40.00	22,960
28	Remove trees & planting	1	LS	5,000.00	5,000
29	Temporary shoring	16,762	SF	25.00	419,050
30	Excavation	22,200	CY	25.00	555,000
31	Backfill from top of tank	3,060	CY	30.00	91,800
32	Haul-off and dispose excessive excavated	19,140	CY	20.00	382,800
33	Piles, say 12"x12"x75ft at one per 100 SF	207	EA	9,000.00	1,863,000
34	Base slab, 3 ft thick	20,670	SF	57.00	1,178,190
35	Perimeter wall, 2 ft thick	11,560	SF	63.00	728,280
36	Top slab, 2 ft thick	20,670	SF	61.00	1,260,870
37	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
38	Access ladder	2	EA	3,900.00	7,800
39	Pump	2	EA	45,000.00	90,000
40	Electrical power for pump	1	LS	50,000.00	50,000
41					-
42	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
43	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
44					-
45	Parking Lot Restoration & Misc. Items:				-
46	Aggregate base, say 9"	574	CY	55.00	31,570
47	Asphalt concrete paving, say 6"	20,670	SF	4.00	82,680
48	Parking lot striping	20,670	SF	0.50	10,335
49	Tree & planting	1	LS	15,000.00	15,000
50	Parking lot lighting	4	EA	5,000.00	20,000
51	Parking lot stormwater drainage	20,670	SF	2.50	51,675
52	Allow for dewatering	1	LS	61,000.00	61,000
53	Traffic control/management	1	LS	200,000.00	200,000
54	Utilities relocation/protection, SFPUC, allowance	1	LS	41,000.00	41,000
55	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
56	Misc. & incidental work	1	LS	41,000.00	41,000
57					

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	FOODS CO PARKING LOT					
	Located at parking lot bounded by 14th St, Shotwell St & Folsom St					
58	**Direct Cost Subtotal**	413,370	CF		20.69	8,551,810
59	Add Markups:					
60	Contractor General Conditions and Requirements				10.00%	855,181
61	Market Factor				0.00%	N/A
62	Construction or Contract Phasing Factor				0.00%	N/A
63	General Contractor Overhead and Profit				6.50%	611,454
64	Bonding and Insurance				2.50%	250,461
65	Design/Estimating Contingency				30.00%	3,080,672
66						
67	**Base Construction Cost (unescalated)**	413,370	CF		32.29	**13,349,578**
68	Construction Phase Contingency				10.00%	1,334,958
69						
70	**Total Construction Cost / Hardcost (Unescalated)**	413,370	CF		35.52	**14,684,536**
71						
72	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	7,070,604
73						
74	**Total Capital Project Cost**	413,370	CF		52.63	21,755,140
75	**In 2016 Dollars, Unescalated**			use		**21,760,000**
76						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	FOODS CO PARKING LOT				
	Located at parking lot bounded by 14th St, Shotwell St & Folsom St				
77					
78	**C) Silo tank, 75 deep x 88 dia**				
79	Tank Construction:				
80	Remove asphalt paving	9,025	SF	2.00	18,050
81	Remove aggregate base, say 9" thick	251	CY	40.00	10,040
82	Remove trees & planting		None		-
83	Slurry wall, say 2 ft thick x 84 ft deep	23,184	SF	89.00	2,063,376
84	Excavation	18,920	CY	30.00	567,600
85	Backfill from top of tank	1,340	CY	30.00	40,200
86	Haul-off and dispose excessive excavated	17,580	CY	20.00	351,600
87	Piles, say 12"x12"x150ft at one per 100 SF	90	EA	22,500.00	2,025,000
88	Base slab, 3 ft thick	9,025	SF	83.00	749,075
89	Perimeter wall, 2 ft thick	20,700	SF	96.00	1,987,200
90	Top slab, 2 ft thick	9,025	SF	66.00	595,650
91	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
92	Access ladder	2	EA	12,150.00	24,300
93	Pump	2	EA	100,000.00	200,000
94	Electrical power for pump	1	LS	50,000.00	50,000
95					-
96	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
97	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
98					-
99	Parking Lot Restoration & Misc. Items:				-
100	Aggregate base, say 9"	251	CY	55.00	13,805
101	Asphalt concrete paving, say 6"	9,025	SF	4.00	36,100
102	Parking lot striping	9,025	SF	0.50	4,513
103	Parking lot lighting		None		-
104	Parking lot stormwater drainage	9,025	SF	2.50	22,563
105	Allow for dewatering	1	LS	253,000.00	253,000
106	Traffic control/management	1	LS	100,000.00	100,000
107	Utilities relocation/protection, SFPUC, allowance	1	LS	18,000.00	18,000
108	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		
109	Misc. & incidental work	1	LS	18,000.00	18,000
110					
111	**Direct Cost Subtotal**	456,030	CF	22.91	10,449,531
112	Add Markups:				
113	Contractor General Conditions and Requirements			10.00%	1,044,953

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT		UNIT COST	TOTAL $
	FOODS CO PARKING LOT					
	Located at parking lot bounded by 14th St, Shotwell St & Folsom St					
114	Market Factor				0.00%	N/A
115	Construction or Contract Phasing Factor				0.00%	N/A
116	General Contractor Overhead and Profit				6.50%	747,141
117	Bonding and Insurance				2.50%	306,041
118	Design/Estimating Contingency				30.00%	3,764,300
119						
120	**Base Construction Cost (unescalated)**	456,030	CF		35.77	**16,311,966**
121	Construction Phase Contingency				10.00%	1,631,197
122						
123	**Total Construction Cost / Hardcost (Unescalated)**	456,030	CF		39.35	**17,943,163**
124						
125	**Add for Project Softcost/Delivery Cost Allowance**				48.15%	8,639,633
126						
127	**Total Capital Project Cost**	456,030	CF		58.29	26,582,796
128	**In 2016 Dollars, Unescalated**			use		**26,580,000**
129						

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	OFFICE MAX PARKING LOT				
	Located at parking lot bounded by 14th St, Transport St, 13th St & Harrison St				
1	**Key Quantities/Assumed Dimensions**				
2	Cast in place reinforced concrete tank		LF		
3	Cover to top of tank		4.0		
4	Thickness of top slab		2.0		
5	Thickness of base slab		3.0		
6	Thickness of top wall		2.0		
7					
8		Plan Area	Depth	Perimeter	Volume
9		SF	LF	LF	CY
10	A) Rectangular tank, 10' deep - None				-
11	B) Rectangular tank, 20' deep - None				-
12	C) Silo tank, 75' deep x 88' dia	6,080	75.0	276	16,890
13					
14					
15	**Estimate Summary**	Base Construction Cost		Total Construction Cost	Total Capital Project Cost
16	A) Rectangular tank, 10' deep - None				
17	B) Rectangular tank, 20' deep - None				
18	C) Silo tank, 75' deep x 88' dia	$16,310,000		$17,940,000	$26,580,000
19					

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SSIP PROGRAM **Date: 7/25/2016**

FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS By: ML/FL

PRE-PLANNING LEVEL (AACE CLASS 5) PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	OFFICE MAX PARKING LOT				
	Located at parking lot bounded by 14th St, Transport St, 13th St & Harrison St				
20					
21	**A) Rectangular tank, 10 deep - None**				
22					
23	**B) Rectangular tank, 20 deep - None**				
24					
25					
26	**C) Silo tank, 75 deep x 88 dia**				
27	Tank Construction:				
28	Remove asphalt paving	9,025	SF	2.00	18,050
29	Remove aggregate base, say 9" thick	251	CY	40.00	10,040
30	Remove trees & planting		None		-
31	Slurry wall, say 2 ft thick x 84 ft deep	23,184	SF	89.00	2,063,376
32	Excavation	18,920	CY	30.00	567,600
33	Backfill from top of tank	1,340	CY	30.00	40,200
34	Haul-off and dispose excessive excavated	17,580	CY	20.00	351,600
35	Piles, say 12"x12"x150ft at one per 100 SF	90	EA	22,500.00	2,025,000
36	Base slab, 3 ft thick	9,025	SF	83.00	749,075
37	Perimeter wall, 2 ft thick	20,700	SF	96.00	1,987,200
38	Top slab, 2 ft thick	9,025	SF	66.00	595,650
39	Manhole, 6 ft dia x 5 ft deep, with frame & cover	2	EA	15,000.00	30,000
40	Access ladder	2	EA	12,150.00	24,300
41	Pump	2	EA	100,000.00	200,000
42	Electrical power for pump	1	LS	50,000.00	50,000
43					-
44	Flow structure at 14th/Folsom: 18' wide x 5 ft tall 132 ft long with 4 ft cover	132	LF	8,680.00	1,145,760
45	Discharge Pipe: 12" dia x 300 ft long	300	LF	419.00	125,700
46					-
47	Parking Lot Restoration & Misc. Items:				-
48	Aggregate base, say 9"	251	CY	55.00	13,805
49	Asphalt concrete paving, say 6"	9,025	SF	4.00	36,100
50	Parking lot striping	9,025	SF	0.50	4,513
51	Parking lot lighting		None		-
52	Parking lot stormwater drainage	9,025	SF	2.50	22,563
53	Allow for dewatering	1	LS	253,000.00	253,000
54	Traffic control/management	1	LS	100,000.00	100,000
55	Utilities relocation/protection, SFPUC, allowance	1	LS	18,000.00	18,000
56	Utilities relocation/protection, PG&E, AT&T and other private companies		NIC		

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SSIP PROGRAM
FOLSOM STORMWATER IMPROVEMENT - DETENTION TANKS
PRE-PLANNING LEVEL (AACE CLASS 5)

Date: 7/25/2016
By: ML/FL
PMC Team

ALL IN 2016 DOLLARS

ITEM	WORK ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL $
	OFFICE MAX PARKING LOT				
	Located at parking lot bounded by 14th St, Transport St, 13th St & Harrison St				
57	Misc. & incidental work	1	LS	18,000.00	18,000
58					
59	**Direct Cost Subtotal**	456,030	CF	22.91	10,449,531
60	Add Markups:				
61	Contractor General Conditions and Requirements			10.00%	1,044,953
62	Market Factor			0.00%	N/A
63	Construction or Contract Phasing Factor			0.00%	N/A
64	General Contractor Overhead and Profit			6.50%	747,141
65	Bonding and Insurance			2.50%	306,041
66	Design/Estimating Contingency			30.00%	3,764,300
67					
68	**Base Construction Cost (unescalated)**	456,030	CF	35.77	**16,311,966**
69	Construction Phase Contingency			10.00%	1,631,197
70					
71	**Total Construction Cost / Hardcost (Unescalated)**	456,030	CF	39.35	**17,943,163**
72					
73	**Add for Project Softcost/Delivery Cost Allowance**			48.15%	8,639,633
74					
75	**Total Capital Project Cost**	456,030	CF	58.29	26,582,796
76	**In 2016 Dollars, Unescalated**			use	**26,580,000**
77					

Appendix J

Triple Bottom Line Analysis

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TBL Evaluation for the Folsom Area Stormwater Improvement Project

PURPOSE OF TBL EVALUATION:

As part of meeting its Levels of Service (LOS), the SFPUC Wastewater Enterprise (WWE) evaluates proposed projects and alternatives for Triple Bottom Line (TBL) performance.

The TBL Assessment Model is a decision-support tool created for the Citywide Sewer System Improvement Program (SSIP). TBL evaluation facilitates the selection of SSIP projects and project alternatives that generate the highest value in terms of environmental improvement, social benefit, and economic gain relative to established criteria.

The primary objectives for the TBL evaluation process are to:

- Inform and support the analytical process to develop and arrive at a preferred alternative by considering social and environmental components in the process alongside performance and financial considerations.
- Provide decision-making support for SFPUC project leaders.
- Increase project selection transparency.
- Facilitate the assessment of a project's actual TBL outcomes relative to predicted outcomes.

When evaluating proposed project alternatives, the model uses a rules-based system to rank each criterion across each alternative to assess financial, social and environmental impacts. Two or more alternatives may receive the same ranking in a specific criterion. The sections below describe the TBL performance of four proposed alternatives for the Folsom Area Stormwater Improvement Project.

PROJECT DESCRIPTION:

The purpose of this project is to address flooding in the 17th and Folsom neighborhood under the current Sewer System Improvement Program (SSIP) level of service (LOS).

Properties in this area have been subject to stormwater inundation during moderate to heavy storms. The Folsom area does not meet the SSIP defined LOS to manage stormwater from a statistically derived LOS storm (5-year 3-hour storm with 1.3 inches of rainfall). Potentially, lower-lying properties in the area can experience over a foot of flooding during rain events, which could result in health and safety issues, as well as property damage.

To address these issues and meet the LOS, the project team developed four families of sub-alternatives (A, B, C and D), the first three are based on conveyance solutions, and the fourth is based on storage solution. Each sub-alternatives within the same family is a variation of the same solution. After comparing sub-alternatives within each family, the project team selected four best sub-alternatives, one per family, to more thoroughly compare against one another.

Alternative A included only one option, which had been developed under the Central Bayside Sewer Improvement Project (CBSIP) studies. For B-alternatives, a first group of sub-alternatives was discarded as requiring additional effort without providing extra benefits. The remaining sub-alternatives were narrowed down by discarding options scoring low in terms of constructability. Finally, the team selected the best sub-alternative based on a rating exercise that accounted for environment, community, operation and maintenance, site availability, tie-in complexity, geotechnical and constructability, costs, and schedule. For C-alternatives, a first sub-alternative was discarded as too costly and the remaining two were consolidated into one, as they were very similar. For D-

alternatives, sub-alternatives were first narrowed from four to two based on minimum freeboard requirement for nodes, and then from two to one based on constructability. The following TBL evaluation compares the four best sub-alternatives, hereafter referred to simply as "the alternatives".

ALTERNATIVES:

- Alternative A1 - Connector Tunnel with CBSIP, connecting to the proposed Channel Tunnel (as part of CBSIP) at Indiana St.
    - 6,450 LF of 9.5' tunnel with other minor projects from 17th/Harrison to 17th/Carolina through Jackson playground, and from Mariposa/Arkansas to Mariposa/Indiana
- Alternative B1 - Connector Tunnel w/o CBSIP – Alameda, connecting to Channel Transport/Storage Box near 7th/Berry Streets
    - 4,200 LF of 12' tunnel with other minor projects from Treat/Alameda to Carolina/Alameda to 7th/Berry
- Alternative C1 - Division Box Sewer Expansion, running along Division Street and ending at Channel Transport/Storage Box
    - Expand 4,100 LF of Division Street Sewer with other minor projects from 16th/Treat to Division/Treat to 7th/Berry
- Alternative D4 - Distributed Storage with Minor Components
    - Two storage tanks (2.3 MG and 3.0 MG) with other minor projects at various option sites centered around 14th/Folsom and 17th/Folsom

FINANCIAL CRITERIA

The two criteria in the financial category are Capital Costs (construction and project soft costs) and Other Costs (O&M and R&R). For these two criteria, the proposed alternatives are ranked relative to the average of the alternatives.

In terms of capital cost, taking into account necessary permanent easement acquisition costs, all alternatives received a neutral ranking because their costs fall within 30% of the mean. The costs of easement acquisition, for two distinct properties in the case of alternative D4, which would include real estate valuation, impact to businesses, and loss of goodwill, is significantly higher for alternative D4 than any of the other three alternatives. Alternative C1 is the only alternative that does not require any easement acquisition.

In terms of other costs, alternative B1 and C1 received a neutral ranking as their costs fall within 30% of the mean, alternative A1 received a negative ranking because its cost is more than 130% of the mean, and alternative D4 received a significantly positive ranking because its cost is less than 30% of the mean.

If a proposed project alternative falls within 30% of the average, then it receives a neutral ranking. If it falls from 30% to 60% below or above the average, then it receives a positive or negative ranking, respectively. Proposed project alternatives below or above 60% of average, receive a significantly positive or negative ranking, respectively.

SOCIAL CRITERIA

SUMMARY:

The four proposed alternatives perform similarly for most social criteria that evaluate impacts to San Francisco's communities. The proposed alternatives rank positively for system resilience and employment, and scored neutrally for ratepayer affordability, bicycle and pedestrian environment, recreation and open space, cultural resources, odors, noise and worker safety. By contrast, alternatives scored differently for construction impact, for which alternative C1 (Division St Box Sewer Expansion) received a significantly negative ranking as opposed to the other three alternatives which received a negative ranking.

PERFORMANCE

S1 – The System Resilience criterion serves as a check on a project's ability to meet level of service standards under specified extreme event conditions. All four proposed alternatives receive a positive ranking for the System Resilience criterion. This is because all project alternatives manage the LOS storm.

S2 - The Ratepayer Affordability criterion is tied directly to the financial criteria, but evaluates the social impact of costs by comparing Annualized Life Cycle Cost (Annualized LCA), namely the combination of Capital and Other Costs ultimately passed on to the ratepayer. In this case, all proposed alternatives received a neutral ranking since their Annualized LCAs fall within 30% of the mean. It is worth noting that alternative A1 and D4 end up receiving a neutral score even if for the Other Costs criterion they score negative and significantly positive respectively. Because Capital Costs are very high relative to Other Costs, they end up weighing much more in the combination of the two. Since the difference in the Capital Costs are minor, thereby resulting in all alternatives receiving a neutral score, then they all end up receiving a neutral score also for the way in which they are passed on to rate payers.

S3 - All four alternatives received a positive ranking for the Employment criterion. This is due to average employment richness (i.e., the number of full time equivalent (FTE) units generated per $1 million of project cost for both one-time construction and ongoing O&M expenses). Project alternatives with similar job richness or job creation will receive similar rankings.

S4 – All four alternatives received a neutral ranking for the Bicycle and Pedestrian Environment criterion. This is because none of the four alternatives proposed changes to the bicycle and pedestrian environment.

S5 – All four alternatives received a neutral ranking for the Recreation and Open Space Amenities criterion. One of the reasons for this ranking is that none of the four alternatives is predicted to alter the dimensions, add, subtract or improve recreation areas.

S6 - All four alternatives receive a neutral ranking on the Cultural Resources criterion. A GIS query shows that there are no known cultural artifacts or high incidence of finding cultural artifacts in the project boundary for any of the four alternatives that would be under threat of disturbance from project implementation. Another reason for this ranking is that none of the alternatives includes a budget for cultural education elements or for historically/culturally-referential design elements.

S7 – All four alternatives received a neutral ranking for the Odors criterion. None of the alternatives is projected to reduce odors through collection or treatment improvement.

S8 – None of the Alternatives will increase or reduce noise produced from sewer system operations. As a result, all the alternatives receive a neutral ranking for the Noise criteria.

S9 – Does not apply to collection system projects.

S10 – The Construction Impacts criterion measures the net impact resulting from negative and positive effects of construction. In particular, noise and traffic are accounted for as negative effects of construction whereas coordination with other projects is accounted for as positive. In this case, alternative A1, B1 and D4 received a negative ranking whereas alternative C1 received a significantly negative ranking. The reason for alternative C1 receiving a lower rank is that this alternative would entail closing traffic lanes on an arterial (negative impact in terms of traffic), and because it would require using noisy construction equipment in an area officially designated as Quiet Zone (negative impact in terms of traffic). According to the City's Envista database, all four alternatives have a potential for coordination. However, after review none was selected for coordination by the project team (although it was not specified what projects it would be possible coordinate with). As such, project coordination efforts did not build toward the overall construction impact criterion.

S11 – All alternatives receive a neutral ranking for Worker Safety. However, there are a number of minor differences across projects. During operation and maintenance of alternative C1, Division Street Box Sewer Expansion, workers will be exposed to traffic on a high-injury corridor, as opposed to alternative A1 and B1, where workers will be exposed but the roadway is not a high-injury corridor. For alternative D4, workers will not be exposed to any traffic.

ENVIRONMENTAL CRITERIA

SUMMARY:

In terms of environmental criteria, which evaluate impacts to San Francisco's natural and environmental resources, all four alternatives received the same ranking. In particular all proposed alternatives ranked positively for Water Quality and Natural Resource Inputs, and neutrally for Climate, Air Quality, Water Use, and Habitat. In particular, while alternative D4 contributes to greenhouse gas emissions (from pumping) its impact in terms of air quality is comparable to the other alternatives.

CRITERIA PERFORMANCE

E1 – All proposed alternatives receive a neutral ranking for the Climate criterion. Although alternative D4 generates greenhouse gasses due to the presence of a pump, the change in emissions is not significant enough to change its ranking from neutral to negative (i.e., less than 1 million tons of CO_2 equivalent increase or decrease).

E2 - None of the alternatives will reduce or increase the emission of local air pollutants during project operations. As a result, the alternatives all receive a neutral ranking for the Air Quality criterion.

E3 - All four alternatives receive a positive ranking for the Water Quality criterion. However, there are some minor differences across project alternatives. In particular, alternative A1 is predicted to reduce CSD events by two for a typical year, whereas alternatives B1, C1 and D4 reduce volumes but not frequency.

E4 - None of the alternatives will change water demand nor create any new landscaping that may require irrigation during drought years. As a result, all the alternatives received a neutral ranking for the Water Use criterion.

E5 - None of the alternatives will increase or reduce natural habitat because the alternatives all involve underground improvements or above ground improvements on locations with no existing habitat. Any excavation will be repaired by restoring the above-ground features to prior project conditions. As a result, all the alternatives received a neutral ranking for the Habitat criterion.

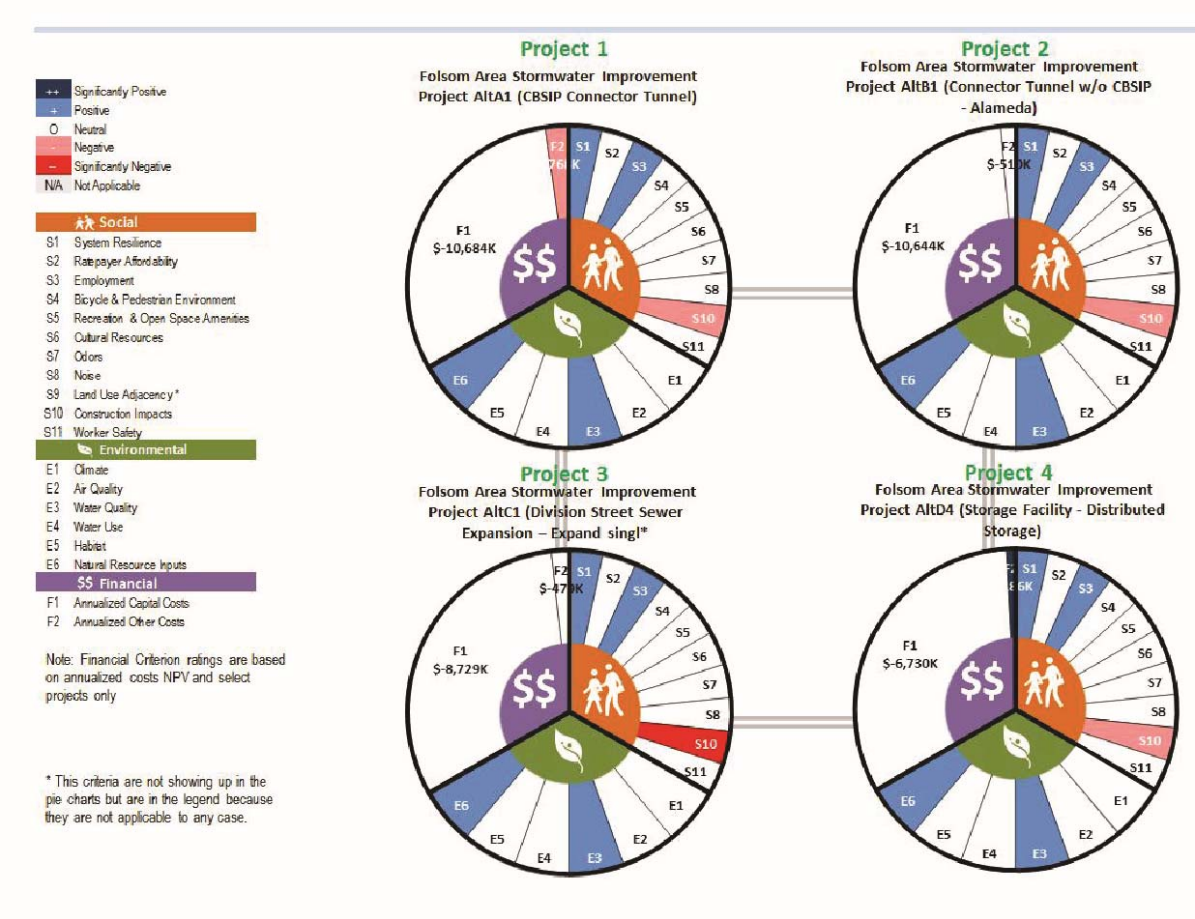
E6 – Only applies to new construction of occupied buildings, projects with resource conservation plans, or projects that result in toxic site remediation/clean up. At the current stage of planning, none of these are expected.

CONCLUSION

For the financial category, all four of the proposed alternatives, A1, B1, C1 and D4 are comparable in Capital Costs – all alternatives received a neutral ranking– but they are not in Other Costs – alternative A1 is negative, alternatives B1 and C1 are neutral, and alternative D4 is significantly positive. For the social category, the alternatives performed the same in all criteria with the exception of the Construction Impact criterion, for which alternative C1 received a significantly negative ranking and the others a negative ranking. Finally, for the environmental category, all four alternatives scored the same relative to one another.

Given the differences between project are limited to only two criteria, from a TBL perspective the preferred alternatives are D4 and B1 in order of preference. However, these two alternatives only differ in the Other Costs criterion, which represents a relatively small share of the project. Furthermore, alternative D4 would entail very high acquisition challenges and would preclude any future development of the land. Moreover, because conveyance projects are designed to have more freeboard than storage projects, Alternative B1 has the benefit of better performance under higher recurrence-interval storms and higher reduction in combined sewer discharge volume.

Figure 1: TBL Project Comparison



Alternative A1 - Connector Tunnel with CBSIP - **Project 1 in figure**
Alternative B1 - Connector Tunnel w/o CBSIP – Alameda - **Project 2 in figure**
Alternative C1 - Division Box Sewer Expansion - **Project 3 in figure**
Alternative D4 - Distributed Storage with Minor Components - **Project 4 in figure**