DRAFT MEMORANDUM

To: Joe Speaks, CH2M

From: Darin Smith and Matt Loftis

Subject: Secondary Costs Analysis for RAB Alternatives

Date: August 14, 2017

The Economics of Land Use

Working on a consultant team led by CH2M Hill, Economic & Planning Systems, Inc. (EPS) has prepared this memorandum to evaluate the potential implications of various rail alignments for the City of San Francisco's RAB study. This document is designed to help illustrate selected cost impacts associated with identified RAB alignments. The analysis contained herein does not take into consideration construction or operating costs of the various rail alignments, rather it quantifies costs associated with construction disruption, property loss, and changes in travel time. The three levels of impacts examined in this memo are explained further below:

- **Temporary Construction Disruption Costs:**
    - Impacts that street closures will have on aggregate travel times.
    - Loss of parking revenues associated with street closures.
- **Grade Separation Impacts:**
    - Impacts that various grade separation configurations will have on aggregate travel times.
    - Diminished property values associated with lost street frontage.
    - Lost bonding potential from diminished property tax proceeds.
- **Train Travel Time Impacts**
    - Value of potential time savings achieved through the Mission Bay alignment that would otherwise not be realized through the DTX or Pennsylvania alignments.

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Summary of Findings

1. ***Construction of the DTX "Cut and Cover" project is expected to last six to seven years and would result in significant disruption costs.*** Construction of this nature would require street closures of 12 city blocks for 6 months each. These closures would result in increased travel times for individuals moving to and from adjacent properties, as well as through the affected area. EPS estimates that this additional travel time would represent approximately $88 million in productivity losses over the construction period (in Year 2026 dollars). In addition to this, the City of San Francisco would lose out on another $720,000 in on-street parking revenue during this construction period.

2. ***There is considerable variation in vehicle travel times associated with grade separation scenarios for the DTX (Future with Surface Rail) and Pennsylvania Avenue alignments.*** A scenario in which 16th Street becomes an underpass beneath Caltrain and HSR at the current surface grade would perform the best from a vehicle travel time savings standpoint when compared to its alternatives, and even improves upon existing conditions. Alternatively, running HSR on the surface with the existing at-grade street configuration would result in substantial delays and productivity losses (see **Table 3**).

3. ***If the City elects to undergo a grade separation strategy that trenches intersections and allows HSR to run on the surface, some property owners will lose a portion of their site's accessibility and value.*** EPS estimates that in all, 57 such parcels would be affected by trenching along 16th Street, 7th Street, and Mission Bay Drive. The combined assessed property value loss for all of the affected parcels is estimated to total approximately $114 million. This diminished property value will decrease the City's bonding ability by approximately $8.3 million in 2026 dollars.

4. ***Due to differences in the physical characteristics and alignment of the rail alternatives, the Mission Bay alignment will generate rail travel time savings and associated productivity gains compared to the DTX or Pennsylvania Avenue alignments.*** It is estimated that the Mission Bay alignment will result in travel time savings of 0.35 minutes and 0.3 minutes for Caltrain and HSR respectively. With this time savings applied to millions of annual riders, the annual aggregate time savings is significant. Annually, EPS estimates that roughly 93,000 hours would be saved through the Mission Bay alignment compared to the DTX and Pennsylvania Avenue alignments. This represents an annual value of times savings of $1.6 million, and more than $80 million when applied to a period of 50 years (in 2026 dollars).

Temporary Construction Disruption Costs

This section of the memorandum seeks to quantify the costs associated with the nature and length of physical construction of high speed rail infrastructure. Information provided to EPS indicates that the construction of the DTX "Cut and Cover" project will occur over a duration of 7 years.[1] The construction will be phased and will affect each impacted city block for a period of six months. Furthermore, through conversations with the larger consulting team, EPS assumes that construction will begin in the year 2019 and will be complete in the year 2025.

This construction endeavor will result in the closure of existing streets and will therefore have measureable impacts on travel times. In particular, individuals that currently move through this project area will likely experience longer travel times as a result of street-closures. Travel time increases have an adverse effect on a region's economic output as delays impact productivity.

Table 1 below summarizes these travel time impacts by project year and monetizes the value of lost time. The annual travel time delay inputs for this analysis were provided by Fehr & Peers. It is important to note that the travel time delays shown are derived from estimating the number of trips to destinations on the affected streets, and are not representative of any aggregated system-wide travel delays. That being said, this approach is conservative in nature and the reality is that additional system-wide delays will likely occur. This analysis is consistent with the framework laid out by the United States Department of Transportation for monetizing travel time savings or losses. As planned, disruption associated with the DTX "Cut and Cover" project is estimated to result in a loss of approximately $65.5 million, or $88 million in year-2026 dollars. .

Table 1 DTX Cut and Cover Construction Travel Time Impacts

Construction Year	Calendar Year	Annual Delay Time (Hrs)			Cost of Delayed Time		
		Business *4.6%*	Personal *95.4%*	Total	Business *$24.90/ hr*	Personal *$12.90/ hr*	Total
1	2019	30,736	637,446	668,182	-$765,336	-$8,223,049	-$8,988,384
2	2020	31,155	646,118	677,273	-$775,748	-$8,334,928	-$9,110,676
3	2021	31,573	654,791	686,364	-$786,161	-$8,446,807	-$9,232,969
4	2022	31,991	663,464	695,455	-$796,574	-$8,558,687	-$9,355,261
5	2023	32,409	672,136	704,545	-$806,986	-$8,670,553	-$9,477,539
6	2024	32,827	680,809	713,636	-$817,399	-$8,782,433	-$9,599,831
7	2025	33,245	689,482	722,727	-$827,812	-$8,894,312	-$9,722,124
Total (2016$)		**223,936**	**4,644,246**	**4,868,182**	**-$5,576,016**	**-$59,910,769**	**-$65,486,784**
Total (2026$)					**-$7,493,699**	**-$80,515,063**	**-$88,008,762**

Sources: CH2M Hill, Fehr and Peers; US Department of Transportation; Economic & Plannings Systems.

[1] EPS is not estimating potential travel time delays from construction of the Mission Bay alignment. The deep tunneling nature of the Mission Bay alignment will likely have significantly less impact on surface disruption.

In addition to increased travel times, road closures associated with the DTX "Cut and Cover" project will diminish parking revenues that are currently being captured by the City of San Francisco. In total, 12 blocks will need to be closed for a period of 6 months each during DTX "Cut and Cover" construction. These blocks are currently home to metered on-street parking spaces that accrue parking revenue to the City of San Francisco. Data provided to EPS indicates that, on average, each block generates approximately $10,000 in parking meter revenue per month. **Table 2** quantifies the loss of parking revenue that will be experienced during this construction period.

Table 2 Lost Parking Revenue

Construction Year	Blocks Closed	Length of Closure (months)	Lost revenue per block month	Annual Lost Parking Revenue
1	2	6	$10,000	-$120,000
2	2	6	$10,000	-$120,000
3	2	6	$10,000	-$120,000
4	2	6	$10,000	-$120,000
5	2	6	$10,000	-$120,000
6	2	6	$10,000	-$120,000
Total				**-$720,000**

Source: San Francisco Planning Department; Economic & Planning Systems

This analysis does not estimate any loss of property value resulting from temporary construction disruptions. The construction period is temporary, consisting of six months per city block and would have no real impact on a property's inherent value. However, property value diminution is taken into consideration if a parcel experiences any persisting loss of street frontage due to grade separations. This component of the analysis is discussed in the following section of the memorandum and is summarized on **Table 4**.

Grade Separation Impacts

Similar to the disruption costs described above, grade separation will have measurable economic implications on both local transportation and land values. At present, trains regularly disrupt traffic flow at at-grade crossings. With train traffic increasing through diminished Caltrain headways and the introduction of high speed rail, the number of automobiles being delayed would be expected to increase after project buildout and further contribute to time and productivity loss within San Francisco if there continue to be at-grade crossings. Alternatively, new grade separations would allow traffic to move freely even with trains present, and would represent an improvement over existing conditions. The vehicle travel time changes associated with each alternative have been contrasted with existing conditions and are shown on **Table 3**.

In order to calculate travel time impacts, Fehr & Peers provided EPS with average daily automobile delays corresponding to the possible future scenarios. Approximate daily automobile delay was given in hours for each alternative for the year 2030. Additionally, delay time was provided for the year 2016 under the existing configuration without electrification or HSR. EPS assumed that no travel times savings differences would be achieved until the infrastructure project is complete in the year 2026. After infrastructure buildout, the growth in average daily delay time has been extrapolated linearly to account for expected general population and trip generation growth.

Unlike construction disruption impacts, travel time delays will be ongoing and will persist, and increase, for the duration of the planned infrastructure. To represent these ongoing costs, EPS has estimated the travel time implications for each alternative over a period of 50 years after HSR service begins. Each alternative is benchmarked against the projected travel time impacts of the existing configuration without high speed rail. Unsurprisingly, the existing configuration with high speed rail and at-grade crossings is the only alternative that will experience travel time increases above and beyond the baseline conditions. This is due to the greater frequency of train movements through the study area and the increasing events of at-grade rail crossings.

Please note that these comparisons account only for the differences between potential configurations of Caltrain and HSR through either the DTX or Pennsylvania Avenue alignment. The findings shown below do not account for any time savings that could presumably be achieved through the Mission Bay alignment, which may eliminate existing at-grade crossings and associated delays.

Table 3 Grade Separation Travel Time Impacts

Calendar Year	Daily Travel Time Delay (hours)[1]				Annual Travel Time Costs[2]			
	Existing At-Grade Crossings without HSR	Existing At-Grade Crossing with HR	16th St. Underpass Below Rail At-Grade	Rail Underground with 16th St. At-Grade	Existing At-Grade Crossings without HSR	Existing At-Grade Crossing with HR	16th St. Underpass Below Rail At-Grade	Rail Underground with 16th St. At-Grade
2026	1,036	1,243	621	746	$3,482,589	$4,179,107	$2,089,554	$2,507,464
2027	1,089	1,307	654	784	$3,662,723	$4,395,268	$2,197,634	$2,637,161
2028	1,143	1,371	686	823	$3,842,857	$4,611,429	$2,305,714	$2,766,857
2029	1,196	1,436	718	861	$4,022,991	$4,827,589	$2,413,795	$2,896,554
2030	1,250	1,500	750	900	$4,203,125	$5,043,750	$2,521,875	$3,026,250
2031	1,304	1,564	782	939	$4,383,259	$5,259,911	$2,629,955	$3,155,946
2032	1,357	1,629	814	977	$4,563,393	$5,476,071	$2,738,036	$3,285,643
2033	1,411	1,693	846	1,016	$4,743,527	$5,692,232	$2,846,116	$3,415,339
2034	1,464	1,757	879	1,054	$4,923,661	$5,908,393	$2,954,196	$3,545,036
2035	1,518	1,821	911	1,093	$5,103,795	$6,124,554	$3,062,277	$3,674,732
2036	1,571	1,886	943	1,131	$5,283,929	$6,340,714	$3,170,357	$3,804,429
2037	1,625	1,950	975	1,170	$5,464,063	$6,556,875	$3,278,438	$3,934,125
2038	1,679	2,014	1,007	1,209	$5,644,196	$6,773,036	$3,386,518	$4,063,821
2039	1,732	2,079	1,039	1,247	$5,824,330	$6,989,196	$3,494,598	$4,193,518
2040	1,786	2,143	1,071	1,286	$6,004,464	$7,205,357	$3,602,679	$4,323,214
2041	1,839	2,207	1,104	1,324	$6,184,598	$7,421,518	$3,710,759	$4,452,911
2042	1,893	2,271	1,136	1,363	$6,364,732	$7,637,679	$3,818,839	$4,582,607
2043	1,946	2,336	1,168	1,401	$6,544,866	$7,853,839	$3,926,920	$4,712,304
2044	2,000	2,400	1,200	1,440	$6,725,000	$8,070,000	$4,035,000	$4,842,000
2045	2,054	2,464	1,232	1,479	$6,905,134	$8,286,161	$4,143,080	$4,971,696
2046	2,107	2,529	1,264	1,517	$7,085,268	$8,502,321	$4,251,161	$5,101,393
2047	2,161	2,593	1,296	1,556	$7,265,402	$8,718,482	$4,359,241	$5,231,089
2048	2,214	2,657	1,329	1,594	$7,445,536	$8,934,643	$4,467,321	$5,360,786
2049	2,268	2,721	1,361	1,633	$7,625,670	$9,150,804	$4,575,402	$5,490,482
2050	2,321	2,786	1,393	1,671	$7,805,804	$9,366,964	$4,683,482	$5,620,179
2051	2,375	2,850	1,425	1,710	$7,985,938	$9,583,125	$4,791,563	$5,749,875
2052	2,429	2,914	1,457	1,749	$8,166,071	$9,799,286	$4,899,643	$5,879,571
2053	2,482	2,979	1,489	1,787	$8,346,205	$10,015,446	$5,007,723	$6,009,268
2054	2,536	3,043	1,521	1,826	$8,526,339	$10,231,607	$5,115,804	$6,138,964
2055	2,589	3,107	1,554	1,864	$8,706,473	$10,447,768	$5,223,884	$6,268,661
2056	2,643	3,171	1,586	1,903	$8,886,607	$10,663,929	$5,331,964	$6,398,357
2057	2,696	3,236	1,618	1,941	$9,066,741	$10,880,089	$5,440,045	$6,528,054
2058	2,750	3,300	1,650	1,980	$9,246,875	$11,096,250	$5,548,125	$6,657,750
2059	2,804	3,364	1,682	2,019	$9,427,009	$11,312,411	$5,656,205	$6,787,446
2060	2,857	3,429	1,714	2,057	$9,607,143	$11,528,571	$5,764,286	$6,917,143
2061	2,911	3,493	1,746	2,096	$9,787,277	$11,744,732	$5,872,366	$7,046,839
2062	2,964	3,557	1,779	2,134	$9,967,411	$11,960,893	$5,980,446	$7,176,536
2063	3,018	3,621	1,811	2,173	$10,147,545	$12,177,054	$6,088,527	$7,306,232
2064	3,071	3,686	1,843	2,211	$10,327,679	$12,393,214	$6,196,607	$7,435,929
2065	3,125	3,750	1,875	2,250	$10,507,813	$12,609,375	$6,304,688	$7,565,625
2066	3,179	3,814	1,907	2,289	$10,687,946	$12,825,536	$6,412,768	$7,695,321
2067	3,232	3,879	1,939	2,327	$10,868,080	$13,041,696	$6,520,848	$7,825,018
2068	3,286	3,943	1,971	2,366	$11,048,214	$13,257,857	$6,628,929	$7,954,714
2069	3,339	4,007	2,004	2,404	$11,228,348	$13,474,018	$6,737,009	$8,084,411
2070	3,393	4,071	2,036	2,443	$11,408,482	$13,690,179	$6,845,089	$8,214,107
2071	3,446	4,136	2,068	2,481	$11,588,616	$13,906,339	$6,953,170	$8,343,804
2072	3,500	4,200	2,100	2,520	$11,768,750	$14,122,500	$7,061,250	$8,473,500
2073	3,554	4,264	2,132	2,559	$11,948,884	$14,338,661	$7,169,330	$8,603,196
2074	3,607	4,329	2,164	2,597	$12,129,018	$14,554,821	$7,277,411	$8,732,893
2075	3,661	4,393	2,196	2,636	$12,309,152	$14,770,982	$7,385,491	$8,862,589
Total 2026 - 2075 (in 2016$)					**$394,793,527**	**$473,752,232**	**$236,876,116**	**$284,251,339**
Total 2026 - 2075 (in 2026$)					**$530,569,487**	**$636,683,385**	**$318,341,692**	**$382,010,031**
Savings Compared to Existing At-Grade without HSR						**-$106,113,897**	**$212,227,795**	**$148,559,456**

[1] Fehr & Peers provided daily automobile delay estimates for the years 2016 and 2030. EPS has extrapolated this delay time linearly to adjust for future delays associated with additional vehicular traffic over time.
[2] EPS is using the US DOT standard for monetized value of time of $13.45 per hour. This is a blended figure that includes both personal and business travel. Additionally, EPS is using an annualization factor of 250 days per year, consistent with other ongoing studies in San Francisco.

Sources: Fehr & Peers; US Department of Transportation; Economic & Planning Systems.

As demonstrated in the previous table, a grade separation in which 16th Street is converted to an underpass beneath rail tracks at the current grade would enjoy the greatest travel time benefits of any of the identified alternatives. However, for this alternative to function effectively, the City has indicated that reconfigurations would be required to both 16th Street and 7th Street. The Department of Public Works and the Planning Department have indicated that 7th Street would be depressed in a "trench" from roughly Brannan Street on the north to Hubbell Street on the south, before returning to the current grade level as it crosses over 16th Street. To achieve a grade separation at 7th and 16th, 16th Street would itself be depressed in a trench from roughly Wisconsin Street to 4th Street. A trenching project of this nature would result in significant loss of street frontage for many property owners within the study area. The reduction of street frontage would likely be detrimental to property values as it would reduce a parcel's accessibility.

While forecasting the exact diminution of property value that would result from this trenching project is impossible, EPS has developed a conservative methodology to estimate the general order of magnitude of lost property value. This methodology is based on two primary principles: 1) there is a relationship between the percentage of lost street frontage and the corresponding reduction in property value, and 2) any given site will maintain its inherent land value regardless of frontage lost. That being said, EPS assumes that the percent of street frontage lost is directly proportional to the percent of property value diminution. Furthermore, EPS is using a conservative assumption that even if a parcel loses its entire street frontage and associated access points, it can still be sold to an adjacent land owner for a potential expansion or redevelopment project, thus maintaining its land value. For example, a property that has an assessed value of $20 million, split evenly between "land value" and "improvement value" ($10 million each) and suffering a 50 percent reduction in street frontage is assumed to have a new value of $15 million ($10 million land value remains plus 50 percent of the $10 million improvement value). **Table 4** illustrates that a future trenching project of this magnitude would result in approximately $114 million of diminished property value. **Figure 1** provides a visual representation of the affected parcels that are aggregated in the table below.

Table 4 Diminished Property Value from Trenching Project

Percent of Frontage Lost	# of Parcels	Aggregated Loss of Value
0-24%	33	-$26,276,577
25-49%	9	-$37,060,400
50-74%	12	-$50,225,058
75-100%	3	-$365,958
Total	**57**	**-$113,927,993**

Source: San Francisco Department of Public Works; Economic & Planning Systems

Figure 1 Parcels Impacted by Trenching Project

The reduction in property value that would be experienced through the grade separation trenching project would adversely impact the City's available bonding potential as the City would lose access to critical tax revenues from which a bond could be repaid. EPS estimates this lost bonding potential at approximately $8.3 million in Year 2026 dollars – the timeframe used by CH2M Hill and the City to estimate RAB construction costs.

Table 5 Lost Bonding Potential from Diminished Property Values

Item	Value
2021 Property Loss Associated with Trenching	-$113,927,993
Lost Annual Property Tax General Fund Share[1]	-$634,351
Lost Bonding Potential 2016$[2]	**-$6,343,511**
Lost Bonding Potential 2026$	**-$8,276,843**

[1] Assuming 55.68 percent of the 1 percent annual tax levy to the City's General Fund.
[2] According to City sources, bonding potential is equal to 10 times that of annual revenue.

Future Train Travel Time Savings

Due to differences in track curves, vertical changes, and other factors, the alternative rail alignments have different implications for the pace at which trains can reach their destinations. These train speed differences can be critical in HSR achieving its planned trip duration from San Francisco to Los Angeles, and also can mean significant value for its riders. According to CH2M Hill, there is no difference between the travel time savings for Caltrain or HSR between the DTX and Pennsylvania alignments. However, the Mission Bay alignment would achieve modest time savings per trip when compared to its alternatives.

Table 6 below documents the calculations of annual time savings for the Mission Bay alignment and monetizes this time based on USDOT standards. EPS estimates this monetary value of time savings to be $1.2 million annually in 2016 dollars. This figure is shown as a positive value as it represents the time savings associated with the Mission Bay alternative. Alternatively, this figure could be looked at as an opportunity cost for either the DTX or Pennsylvania alignments. When valued in 2026 dollars over a 50-year period, the travel time savings of the Mission Bay alignment is approximately $81.8 million.

Table 6 Mission Bay Train Travel Time Savings

Item	Caltrain	HSR	Total
Travel Time Savings (minutes per trip)	0.35	0.30	
Daily Riders at Buildout	31,500	35,460	66,960
Annual Riders at Buildout[1]	7,875,000	8,865,000	16,740,000
Annual Time Savings (Hrs)	45,938	44,325	90,263
Annual Value of Time Savings (2016$)[2]	**$619,697**	**$597,944**	**$1,217,641**
Annual Value of Time Savings (2026$)	**$832,821**	**$803,587**	**$1,636,408**
Value over 50 Years (in 2026$)	**$41,641,039**	**$40,179,354**	**$81,820,393**

[1] Reflects annualization factor of 250 day per year, consistent with other ongoing studies in San Francisco
[2] Based on the US DOT standard for monetized value of time of $13.45 per hour

Sources: CH2M Hill; US DOT; Economic & Planning Systems