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RESPONSE TO XCAP COMMENTS

1. **What are the main cost drivers for each alternative? How can we drive the prices down? For example, what would it take to get the price of the trench down to $300M?**

   The main cost drivers vary for each alternative. Below is the highest construction cost item for each alternative.

   - Meadow Charleston Trench - Retaining Wall & Groundwater Cutoff Wall construction cost is $127M of the total construction cost of $505.6M
   - Meadow Charleston Hybrid - Trackwork (permanent and shoofly) is $20M of the total construction cost of $103.6M
   - Meadow Charleston Viaduct - Structural cost is $176M of the total construction cost of $259M
   - Meadow Charleston Underpass - Retaining Wall & Groundwater Cutoff Wall construction cost is $26M of the total construction cost of $157M

   It is highly unlikely that the Meadow-Charleston construction costs for the trench could be reduced to $300M.

2. **What assumptions, if changed, would significantly lower costs and or reduce complexity? For example, the tracks can't clear Adobe creek in a trench even at 2% grade due to the vertical curvature needed for freight trains. If freight trains could reduce operating speeds from 50mph to 35 mph, would that offer the design flexibility needed to clear Adobe creek?**

   The Design Criteria established by the project has been coordinated and accepted by both Caltrain and the City. Caltrain has indicated that any changes to the design criteria would need to follow a standard procedure for design variances. In addition, Caltrain stated, "Any changes to Caltrain's standards must be considered in a way that is careful, deliberate and fully and fairly weighs both the benefits and consequences; and should be undertaken on a system-wide basis." Thus, at this planning level stage, alternatives should be evaluated based on the approved Design Criteria as the approval of a design variance would be a lengthy process involving further technical studies at the next phase of design.

3. **What other technical assumptions, if loosened would provide significant design flexibility, or reduce costs, or cut construction time, etc. In other words, what would AECOM suggest we ask Caltrain to think about in order to address the issues identified for each of the alternatives.**

The key questions regarding Caltrain's design standards such as maximum grades, vertical clearance, freight operations, shooflies, right of way, etc. have been previously posed to Caltrain. Caltrain has responded (see the following link for the detailed response).

https://connectingpaloalto.com/wp-content/uploads/2019/07/Caltrain-Grade-Separation-responses.pdf.

Further technical studies would be required for any design variances considered. Thus, at this planning level stage, alternatives should be evaluated based on the approved Design Criteria since the approval of a design variance would be a lengthy process involving further technical studies.

4. **In the presentation, a cost per linear foot metric seems to indicate that the price of Palo Alto's trench is much higher than other similar projects. Why?**

The San Gabriel Trench Project took 6 years to complete (2012 to 2018). The construction cost was $174.1M. Escalating this from the award of construction contract date of 2012 to 2018 (2018 is the base year for developing construction cost estimates for the Meadow Charleston Trench project) at 3% equates to nearly $208M. The total cost for construction for the Meadow Charleston Trench was estimated between $458M and $550M. The following items help explain the $250M cost differential:

- The bids for the San Gabriel Trench took place in early 2012 when bids were highly competitive, the construction industry was still feeling the impacts of the recession (see article here), and overall costs were low. This article notes that the engineer's estimate was $266.8M, but the winning bid came in at only $172.6M; a difference of $94M. Comparing the estimated construction cost of $266.8M, using escalation factors stated above, the escalated construction cost estimates for the San Gabriel trench in 2018 would be nearly $319M. Therefore, the difference in estimated construction costs is between $139M to $231M
- A single shoofly track within the existing right of way was needed for the project. As a result, no additional demolition and reconstruction of the existing roadway, intersections and traffic signals was necessary to accommodate the shoofly construction.
- The San Gabriel Trench Project did not include electrified tracks for temporary or permanent conditions.

- The San Gabriel Trench Project also did not have commuter rail and its associated train control infrastructure to be reconfigured and replaced.
- The project only included the construction of a single permanent track.
- Based on our preliminary findings, it appears that a groundwater cutoff wall was not required. Aside from the elimination of the cutoff wall itself, this results in:
    - Groundwater pumping not required
    - Lower unit cost of excavation
- Only one pump station was required for the project, whereas three separate pump stations will be needed for the Meadow Charleston Trench (for the trench itself, one at Barron Creek and one at Adobe Creek). Based upon the initial review, it appears that the bisection location for the San Gabriel Trench and the two creeks (Alhambra Wash & Rubio Wash) are at either end of the trench where the top of rail elevation is close to existing. Whereas, the Meadow Charleston Trench would bisect both creeks completely, requiring a pump station and backup generators at each creek location.
- The unit prices, in general, are likely higher for a construction project in Palo Alto than in San Gabriel.

Although not related to the construction cost, flagging for the M/C Trench was estimated at $35.4M (7% of the construction estimate), which is likely much higher than the cost for flagging on a freight-only line. This also contributes to a higher overall cost when compared to the San Gabriel Trench Project.

5. What is the cost per linear foot for each of the alternatives (Trench, tunnel, hybrid, viaduct and Underpass)?

The costs presented in the fact sheets were extracted to develop the table to calculate the per-unit costs as requested by the XCAP. For the total costs, all costs associated with roadway, railroad, and other structures, right-of-way and utility relocation, support, and escalation were considered. However, for the construction cost determination, the costs associated with support and escalation were not considered in the calculations. Please note that the project costs for all alternatives were based on the 2018 year estimates. In addition, these costs should be considered cautiously as per linear feet cost may be deceptive of the total costs for each alternative given the unique physical characteristics of project, such as soil conditions, utilities, and mitigation requirements, etc. See Exhibit A for Details.

6. For the underpass designs, is it feasible to raise the tracks by 1-2 feet? If so, how could that improve the underpass design, particularly for the slope of the bike/ped path and the functioning of the Park Avenue intersection.

Yes, it is feasible to raise the tracks. In general, for Meadow Charleston Underpass Alternative, the raising the tracks by 2 feet will allow either:

- The grades for the ped/bike path to be slightly lower. At Charleston, it would lower the grade 1% from 5% to 4%.
- The Park Avenue intersection would be raised the same amount (2 feet), resulting in a flatter grade for Park Ave; from 9-12% to approximately 7-9%.

7. **Has Caltrain approved the "swinging" of the tracks in a viaduct alternative from its current location to the East side of the ROW? How is this design affected by given Caltrain's Rail Corridor Use Plan indicating they don't want to encumber land that might be needed for 4 tracks?**

   From a rail alignment perspective, if the design criteria is met, (minimum spiral and tangent lengths of the reversing curves, for example), then this is a non-issue for Caltrain. From a rail corridor use policy, additional track(s) in the future would require a new/parallel viaduct regardless of the alignment of the tracks. However, this has not been discussed in detail with Caltrain.

8. **An XCAP member is interested in understanding the light planes that would result from the Viaduct design. Given the alternative is at 5% engineering, what is the margin of error in feet regarding the exact East/West position of the Viaduct.**

   For the interest of evaluation at this level of design, the location of the viaduct and/or the track alignment for any alternative, is generally very accurate. However, the design typically will go through changes in the subsequent phases of the project as the design is refined and additional information is acquired. In general, minor changes/refinements of the project geometry are common and should be anticipated. Also, light planes could be considered as part of the environmental process.

EXHIBIT A

Meadow Charleston - Low End Cost Estimates

Alternative	Length Calculations	Length (LF)	Roadway & RR Cost ($Millions)	Structure Costs ($Millions)	Right of Way & Utilities ($Millions)	Support Cost ($Millions)	Escalation Cost ($Millions)	Construction Cost = Roadway & RR + Structure + ROW + Utilities ($Millions)	Construction Cost/LF ($Thousands)	Total Cost (All Items) ($Millions)	Total Cost/LF ($Thousands)
Tunnel*	Sta 230- Sta 335	10,500	764	0	5	236	212	769	73.2	1217	115.90
Trench	Sta 175 - Sta 115	6,000	450	8	26	166	150	484	80.7	800	133.33
Viaduct	Sta 180 - Sta 105	7,500	72	155	18	80	75	245	32.7	400	53.33
Hybrid	Sta 170 - Sta 120	5,000	84	10	26	35	35	120	24.0	190	38.00
Underpass			124	18	80	54	64	222	NA	340	NA

Meadow Charleston - High End Cost Estimates

Alternative	Length Calculations	Length (LF)	Roadway & RR Cost ($Millions)	Structure Costs ($Millions)	Right of Way & Utilities ($Millions)	Support Cost ($Millions)	Escalation Cost ($Millions)	Construction Cost = Roadway & RR + Structure + ROW + Utilities ($Millions)	Construction Cost/LF ($Thousands)	Total Cost (All Items) ($Millions)	Total Cost/LF ($Thousands)
Tunnel*	Sta 230- Sta 335	10,500	1146	0	10	353	318	1156	110.1	1827	174.00
Trench	Sta 175 - Sta 115	6,000	540	10	28	194	178	578	96.3	950	158.33
Viaduct	Sta 180 - Sta 105	7,500	90	194	22	100	94	306	40.8	500	66.67
Hybrid	Sta 170 - Sta 120	5,000	102	12	32	42	42	146	29.2	230	46.00
Underpass			152	22	98	70	78	272	NA	420	NA

* Tunnel costs are for South Palo Alto Tunnel with Passenger and Freight