Technical Note

Project:	Hybrid Rail Study		
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Subject:	Capital Cost Estimate Memo		

1 Background and Purpose

The Double tracking cost estimate is a based on the preliminary 5% level of design. The following describes the methodology used to develop this cost estimate.

This report describes the development of capital cost estimates for infrastructure increase to accompany the Hybrid DMU vehicles. Rough order-of-magnitude capital cost estimates were developed for the following scenarios:

- Supplementing Existing Service between Pomona North and University of Redlands
- Limited bi-directional blended scenarios between El Monte and University of Redlands
  - 30-Minute service
  - 15-Minute service
- Limited bi-directional blended scenarios between Pomona North and University of Redlands
  - 30-Minute service
  - 15-Minute service
- Unconstrained scenarios between terminus station (El Monte, Pomona North, or Montclair) and University of Redlands
  - 30-minute service
  - 20-minute service
  - 15-minute service
- Ontario Airport Total (Escalated to 2018) Prepare from previous capital cost estimates

Each scenario includes an estimate of the probable cost of construction with appropriate increase in vehicles and new/modifications to the existing platforms. The cost estimate addresses double tracking route alignment, existing track shifts, infrastructure improvements and other system costs. The cost estimates will include appropriate design allowances, allocated and unallocated contingency mark-ups as individual line items. A Basis of Estimate Report explaining the scope, assumptions and limitations of the estimating process will accompany the cost estimate.

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2 Estimate Definition

In order to estimate project capital cost quantities, further conceptual engineering design development double tracking improvements and station modifications where necessary as part of the 15, 20 and 30-minute route planning scenarios.

3 Methodology

The format used for the estimate is the FTA Standard Cost Categories (SCC) for Major Capital Projects. The FTA SCC format presents the capital cost estimates in an industry-recognized format that considers all project components known to drive cost. The general cost categories applied in the FTA SCC template are as follows:

- 10 Guideway and Track Elements
- 20 Stations, Stops, Terminals, Intermodal
- 30 Support Facilities: Yards, Shops, Administration Buildings
- 40 Sitework and Special Conditions
- 50 Systems
- 60 Right-of-Way, Land, Existing Improvements
- 70 Vehicles
- 80 Professional Services
- 90 Unallocated Contingency
- 100 Finance Charges

For most cost items, the scope will be determined by an evaluation of the discrete construction items or activities that could reasonably be associated with that cost item based on a review of the planning drawings.

3.1 Quantities

Construction items and their related quantities are developed from design planning drawings and associated technical reports. Direct measurements from drawings and mathematical calculations are used in the estimate and the detail drawings and sections have been used to prepare quantities for significant construction items in the cost estimates. Some quantities were estimated by the use of allowances or other indirect means for items where there is not sufficient detail to perform a direct quantity take-off at the system planning level.

3.2 Cost Unit Prices

The cost estimate is developed using multiple resources, derived from historical bid data from completed projects and information obtained from similar transit projects. These projects include the Southwestern Yard (SW Yard) Facility, Crenshaw/LAX Transit Corridor and Regional Connector Transit Corridor. The cost estimate has also used the 2017 Metro planning-level estimates and other sources such as local vendors. Several other similar project cost estimates have also been used to provide further validation of the unit costs used in this estimate. In addition to this, the estimator's professional judgment has been used to allow for the specific type, location, size, and complexity. Unit prices were applied to the unit quantities identified for each cost item to produce an overall unit price for each element. Where cost items could not be estimated using quantities take from 5% design plans, an allowance cost was used to calculate a percentage of total construction cost.

After quantities were prepared for the cost data, they were added into the cost estimate alternative based on the Control Point of each double tracking alignment. This format related the cost directly to the conceptual alignment drawings and assists in summarizing costs, as well as in the analysis of various station and corridor improvements.

4 Estimate Assumptions

The following is a list of assumptions that have been applied to this cost estimate:

Assumptions:

- Unit costs are determined in Q2 2018 dollars and reflect conditions prevalent in the California region for work of this nature.
- All quantities are based on information provided by the most current conceptual design documents
- The cost of right of way have been estimate separately
- Operation and maintenance cost not included

5 Contingencies

Contingencies have been applied to the cost estimates in two ways. These include contingences allocated to individual cost categories (i.e. design allowances), as well as an overall unallocated contingency for the project. Contingency percentages have been calculated using recent cost estimating experience and taking into account the details specific to this project.

5.1 Allocated Contingency

A 15 to 20 percent allocated contingency has been used for unknown or undeveloped costs for each item description.

5.2 Unallocated Contingency

A 25 percent unallocated contingency has been applied to the estimate to account for unanticipated costs, refinements in the design as it progresses through the design phases of the project, and to account for the potential for future changes.

6 Professional Services

Professional service costs are calculated as a percentage of the total construction costs. The following percentages have been applied to each category:

- EIR/EIS Planning 2 percent
- Preliminary Engineering 3 percent
- Final Design Services 6 percent
- Project Management for Design & Construction 7 percent
- Construction Administration & Management 4 percent
- Professional Liability & Other Non- Construction Insurance 0.5 percent
- Legal, Permits, Legal Fees, Agencies, Cities etc. 2 percent
- Surveys, Testing, Investigation & Inspection 1 percent
- Flagging 4 percent
- Start-Up 2 percent

7 Escalation

No provision has been made for escalation to the proposed year of construction, or life of the construction contract (an allowance for escalation could be applied using 3% per year).

8 Vehicles

The cost of the DMU Stadler Flirt vehicles is dependent on the service patterns and headways on the route and will also be procured separately from double tracking corridor improvements. For these reasons, they have been estimated separately.

The DMU Stadler vehicles are typically six-axle, double-ended and articulated multiple unit operation in trains up to three cars in length with the Diesel engine in the middle. The Stadler vehicles could operate at speeds of up to 80 miles per hour (mph).

The vehicles would be configured with a driver’s cab at either end, and would have equal performance in both directions. The most robust operating scenario is 15-minute headways per line and would require a maximum of 16 cars to accommodate anticipated demand (assuming three-car trains), three cars are included as spares. A number of sources have been used to confirm the costs of a Stadler Flirt DMU vehicles including a 10% contingency for spare parts.

Table 8-1: Summary of Vehicle Cost Estimate

Model Run	Total Vehicles	Vehicles Needed (3 RPRP)	Unit Price	Sub Total	Contingency	Spare Parts	Total
Univ of Redland to El Monte 30 minutes	9	6	$7,449,000	$44,694,000	10%	14%	$55,197,090
Univ of Redland to El Monte 20 minutes	11	8	$7,449,000	$59,592,000	10%	14%	$73,596,120
Univ of Redland to El Monte 15 minutes	16	13	$7,449,000	$96,837,000	10%	14%	$119,593,695
Univ of Redland to Montclair 30 minutes	5	2	$7,449,000	$14,898,000	10%	14%	$18,399,030
Univ of Redland to Montclair 20 minutes	7	4	$7,449,000	$29,796,004	10%	14%	$36,798,065
Univ of Redland to Montclair 15 minutes	9	6	$7,449,000	$44,694,000	10%	14%	$55,197,090
Univ of Redland to Pomona 30 minutes	5	2	$7,449,000	$14,898,000	10%	14%	$18,399,030
Univ of Redland to Pomona 20 minutes	7	4	$7,449,000	$29,796,004	10%	14%	$36,798,065
Univ of Redland to Pomona 15 minutes	9	6	$7,449,000	$44,694,000	10%	14%	$55,197,090

9 Maintenance facility Cost

The maintenance facility cost was estimated using a similar approach, using the conceptual layout plans for a maximum maintenance footprint of up to 15 Stadler Flirt diesel multiple units optimized to provide the facilities required. The facility was designed to a given space and assumes available land take is not an issue. A separate Estimate report explaining the scope, assumptions and limitations was produced, accompany the cost estimate.

Table 9-1: Maintenance Facility Cost

Segment	Total
DMU Maintenance Facility (Includes ROW Costs)	$131,598,717

10 Rail Access to Ontario Airport

The cost estimate presented in the 2014$ Ontario Airport Rail Access Study, was used to compile the cost estimate for services running onto Ontario Airport. The capital cost estimate for this connection was $776 million escalated at 3% a year to 2108 dollars to $869 million and utilized option A-4 DMU alternative.

The alignment A-4 was starts at Rancho Cucamonga Metrolink Station and travels west along the south side of the San Gabriel Subdivision (San Bernardino Metrolink Line), turning south onto Deer Creek/Cucamonga Creek alignment to serve the Ontario Airport terminals along Terminal Way. The A-4 alternative only provided one connection from the east and from the ridership modelling a new connection to the West was proposed, including additional cost items of new rail, crossovers, signaling and utility relocation costs, etc. Table 10-1 summarizes the capital cost estimate for DMU services to the airport:

Table 10-1: Cost of Rail Access to Ontario Airport

Segment	Total
Ontario Airport Total (Escalated to 2018)	$881,408,785

11 Platform Improvements

As a result of introducing DMU vehicles on the existing infrastructure, the Metrolink stations would need improvements necessary to meet the minimum DMU passenger requirements for ADA level boarding and able boded stepping distances.

A capital cost improvement was prepared to include cost improvements to associated with each station required a 15” high mini-high platform and existing upgrades to existing min-highs, canopies, Lighting, Drainage etc. Table 11-1 summarizes the improvement costs estimate for each station:

Table 11-1: Legacy Platform Modification Costs

Station Name	Mile Post (MP)	Total
El Monte	12.6	$75,344
Baldwin Park	18.9	$208,978
Covina	23.0	$390,935
Pomona North	30.9	$203,611
Claremont	33.1	$90,721
Montclair	34.3	$152,596
Upland	37.1	$247,752
Rancho Cucamonga	42.1	$239,314
Fontana	49.1	$174,065
Rialto	52.9	$162,598
San Bernardino	56.4	$183,334

12 Capital Cost Estimate Summaries

Table 12-1: Double Track Improvement Cost Summary

Control Point	Begin MP	End MP	Total
EL Monte Turnback Track	12.5	12.6	$10,106,177.92
CP Ramona to CP Amar	13.0	16.6	$443,948.48
CP Amar to CP Irwin	16.6	20.4	$46,980,464.68
CP Irwin to CP Barranca	20.4	23.4	$7,603,294.13
CP Barranca to CP Lone Hill	23.4	26.5	$54,600,854.69
CP Lone Hill to CP White (previous study)	*26.5*	*30.4*	*$71,600,000.00*
CP White to CP Vista	30.4	34.0	$18,296,830.66
CP Vista to Upland	34.0	37.1	$14,656,202.45
Upland to CP Rochester	37.1	42.4	$19,636,600.51
CP Rochester to CP Nolan	42.4	45.5	$22,458,839.50
CP Nolan to CP Lilac	45.5	52.4	$37,350,740.18
CP Lilac to CP San Bern Jct	52.4	55.3	$17,174,296.08
CP San Bern Jct to CP Redlands Uni	55.3	66.5	$72,466,133.85

Table 12-2: Operating Scenario Capital Cost Detail

Double Tracking Segments, Vehicles, and Platforms Mods	Begin MP	End MP	30 Minute Blended	30 Minute Unconstrained	20 Minute Blended	15 Minute Blended
EL Monte Turnback Track	12.5	12.6	$0.00	$0.00	$0	$10,106,178
CP Ramona to CP Amar	13.0	16.6	$0.00	$0.00	$443,948	$443,948.48
CP Amar to CP Irwin	16.6	20.4	$0.00	$0.00	$46,980,465	$46,980,465
CP Irwin to CP Barranca	20.4	23.4	$0.00	$0.00	$0	$7,603,294
CP Barranca to CP Lone Hill	23.4	26.5	$0.00	$0.00	$54,600,855	$54,600,855
CP Lone Hill to CP White	26.5	30.4	$80,192,000	$80,192,000	$80,192,000	$80,192,000
CP White to CP Vista	30.4	34.0	$0.00	$0.00	$0	$18,296,831
CP Vista to Upland	34.0	37.1	$0.00	$0.00	$14,656,202	$14,656,202
Upland to CP Rochester	37.1	42.4	$0.00	$0.00	$0	$19,636,601
CP Rochester to CP Nolan	42.4	45.5	$0.00	$22,458,840	$22,458,840	$22,458,840
CP Nolan to CP Lilac	45.5	52.4	$0.00	$0.00	$0	$37,350,740
CP Lilac to CP San Bern Jct	52.4	55.3	$0.00	$0.00	$0	$17,174,296
CP San Bern Jct to CP Redlands Uni	55.3	66.5	$0.00	$0.00	$0	$72,466,134
Vehicle Cost El Monte to Redlands Univ	12.6	66.5	$55,197,090	$55,197,090	$73,596,120	$119,593,695
Vehicle Cost Pomona to Redlands Univ	30.9	66.5	$18,399,030	$18,399,030	$36,798,065	$55,197,090
Vehicle Cost Montclair to Redlands Univ	34.3	66.5	$18,399,030	$18,399,030	$36,798,065	$55,197,090
Min High Platforms - El Monte to San Bernardino	12.6	66.5	$2,129,247	$2,129,247	$2,129,247	$2,129,247
Min High Platforms - Pomona to San Bernardino	30.9	66.5	$1,453,990	$1,453,990	$1,453,990	$1,453,990
Min High Platforms - Montclair to San Bernardino	34.3	66.5	$1,159,659	$1,159,659	$1,159,659	$1,159,659

Table 12-3: Operating Scenario Capital Cost Summaries

Double Tracking Segments, Vehicles, and Platforms Mods	Begin MP	End MP	30 Minute Blended	30 Minute Unconstrained	20 Minute Blended	15 Minute Blended
El Monte to Univ Redland Totals	12.6	66.5	$137,518,337	$159,977,177	$295,057,677	$523,689,325
Pomona to Univ Redland Totals	30.9	66.5	$19,853,020	$42,311,860	$75,367,097	$258,690,724
Montclair to Univ Redland Totals	34.3	66.5	$19,558,689	$42,017,528	$75,072,766	$240,099,561
Ontario Airport Total (Escalated to 2018)						$881,408,785
DMU Maintenance Facility (Including ROW)						$131,598,717

A. Appendices

A.1 El Monte Turn Back Track

El Monte to Alhambra sub division

The high cost items are provided below:

- New bridge Construction
- Track and turnouts
- Train Control and Signals

Category	Description	Cost
10	Double Track Guideway & Track Elements	$5,202,251
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$0
40	Site work & Special Conditions	$445,549
50	Systems	$689,609
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	Not Included
80	Professional Services	$1,747,533
90	Unallocated Contingency	$2,021,236
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$10,106,178**

Total Estimated Cost: **$10.1 Million**

A.2 CP Ramona to CP Amar (MP 13.0 – MP 16.6)

San Gabriel Flyover

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.3 CP Amar to CP Irwin (MP 16.6 – MP 20.4)

Baldwin Park Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.4 CP Irwin to CP Barranca (MP 20.4 – MP 23.4)

Covina Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.5 CP Barranca to CP White (MP 23.4 – MP 30.3)

Fairgrounds Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.6 CP White to CP Vista (MP 30.3 – MP 34.0)

Pomona North Station, Claremont Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.7 CP Vista to CP Archibald (MP 34.0 – MP 40.2)

Montclair Station, Upland Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.8 CP Archibald to CP Nolan (MP 40.2 – MP 44.5)

Rancho Cucamonga Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.9 CP Nolan to CP Lilac (MP 44.5 – MP 52.4)

CA Speedway Station, Fontana Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**

A.10 CP Lilac to CP San Bernardino Jct (MP 52.4 – MP 56.2)

Rialto Station, San Bernardino Station

Category	Description	Cost
10	Double Track Guideway & Track Elements	$3,58,009
20	Stations, Stops, Terminals, Intermodal	$0
30	Support Facilities: Yards, Shops, Admin. Bldgs	$29,935,860
40	Site work & Special Conditions	$3,114,500
50	Systems	$11,198,218
60	Row, Land, Existing Improvements	Not Included
70	Vehicles (10% spare parts)	See Separate Estimate
80	Professional Services	$13,144,061
90	Unallocated Contingency	$18,282,194
100	Finance Charges	$0
	Total Project Cost (10 to 100)	**$79,222,843**

Total Estimated Cost: **$79 Million**