APPENDIX 6-A: HIGH-SPEED RAIL OPERATING AND MAINTENANCE COST FOR USE IN ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT PROJECT-LEVEL ANALYSIS

CALIFORNIA High-Speed Rail Authority

DATE: April 24, 2026

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SUBJECT: **High-Speed Rail Operating and Maintenance Cost for Use in EIR/EIS Project-Level Analysis**

This memorandum summarizes the assumptions used to estimate full system high-speed rail (HSR) operations and maintenance (O&M) costs in the *California High-Speed Rail Authority's 2026 Business Plan*[1]. For more information on the operations and maintenance cost model used for cost forecasting, please refer to the *Operations and Maintenance Cost Model Documentation*[2].

A variety of factors drive the cost forecasts, including but not limited to, service planning assumptions, station operations, maintenance facility operations, staffing and energy use. Allocated contingency costs are incorporated directly into each cost category, while unallocated contingency costs are forecasted separately within the overall O&M cost estimates. In total, 13 cost categories comprise total O&M costs that are described in detail in the *Operations and Maintenance Cost Model Documentation*:

1. Train operations
2. Bus Operations
3. Security
4. Dispatching
5. Maintenance of equipment
6. Maintenance of infrastructure
7. Station and train cleaning
8. Commercial
9. General and administrative
10. Insurance
11. Unallocated contingency
12. Margin
13. Capacity mark-up

The *California High-Speed Rail Authority's 2026 Business Plan* distinguishes between three operational scenarios as follows:
- Scenario 1 (Merced – Bakersfield); operational in 2033;
- Scenario 2 (SF – Bakersfield); operational in 2040; and
- Scenario 3 (SF – Anaheim); operational in 2040.

The service plan is a key driver of O&M cost forecasts as it determines the number of trainset miles, bus miles, trainsets, stations and maintenance facilities necessary to support system operations – all of which are inputs to the O&M cost model. The O&M cost forecasts in the *California High-Speed Rail Authority's 2026 Business Plan* rely on Scenario 3 (Phase 1, SF-Anaheim) system with key service planning assumptions outlined below:

- Scenario 3 has a reference year of 2040 and covers approximately 544 miles.
- Scenario 3 will serve 12 stations, including San Francisco, Millbrae, San Jose, Gilroy, Merced, Fresno, Kings/Tulare, Bakersfield, Palmdale, Burbank, Los Angeles, and Anaheim.

[1] Pending Board Approval as of 24 April 2026

[2] The technical document will be published after the adoption of the 2026 Business Plan.

- Scenario 3 includes 148 daily revenue service train runs, with varying stopping patterns between San Francisco and Anaheim, San Francisco and Fresno, Merced and Madera, Palmdale and Victor Valley, and additional trips in the Central Valley.

- Scenario 3 high-speed rail operations will include 30 trainsets including spares and 13.54 million annual trainset miles.

To support Scenario 3 high-speed rail service outlined above, total O&M costs include additional assumptions related to maintenance and train operations. The system will include one operations control center (OCC) and three terminal control facilities to manage dispatching. A heavy maintenance facility will be located in the Central Valley with two light maintenance facilities dispersed across the rest of the system, including one in Northern California along the Peninsula Corridor at Brisbane and one in southern California near Los Angeles. O&M will also include four maintenance of infrastructure facilities.

The O&M cost model assumes station staffing and operating costs are based on station size and the model differentiates among three station categories. San Francisco and Los Angeles represent the largest stations, and as a result, have the highest staffing level. Other terminal stations represent the mid-sized stations (e.g., San Jose) and intermediate stations (e.g., Palmdale) represent the smallest station category and have the lowest staffing levels. For more details on staffing assumptions and associated salaries, please refer to the *Operations and Maintenance Cost Model Documentation*.

Finally, energy costs were updated to $0.0859 per kilowatt-hour for Scenario 1 for year 2030, and $0.1145 per kilowatt-hour for Scenarios 2-3 (2025 dollars) for year 2040 based on the 2026 Business Plan. These energy costs are a key driver of train operations and station operating costs based on usage.

Table 1 below outlines medium (base-case) O&M cost forecasts and personnel forecasts by cost category. It is important to note that the cost model does not attempt to optimize operations to reduce costs but provides an achievable operating scenario that could be further improved by a private operator. Scenarios 1 and 2 reflect a different set of assumptions than those outlined above for Scenario 3 but are not covered further in this memorandum.

Table 1: Annual Operations and Maintenance Medium Case Cost Forecast ($2025 millions)

Cost Category	Scenario 1 MCD-BFD	Scenario 2 SF-BFD	Scenario 3 SF-ANA	Scenario 3 Personnel
Train Operations	$19	$64	$177	539
Bus Operations	$0	$97	$0	N/A
Security	$4	$17	$26	196
Dispatching	$5	$9	$13	56
Maintenance of Equipment	$19	$46	$106	227
Maintenance of Infrastructure	$28	$90	$105	326
Station and Train Cleaning	$7	$15	$23	N/A[3]
Commercial	$4	$19	$25	128
General and Administrative	$17	$79	$241	203
Insurance	$20	$41	$92	N/A
Unallocated Contingency	$0	$20	$34	N/A
Margin	$10	$50	$84	N/A
Capacity Mark-Up	$0	$0	$45[4]	N/A
Total Cost	**$133**	**$547**	**$971**	**1,675**

Note: Numbers may not add due to rounding

[3] Station and train turn cleaning costs were outsourced to third-party personnel

[4] The capacity mark-up reflects a contingency that accounts for instances in which projected demand exceeds available capacity under the Phase 1 scenario, particularly during peak periods and on higher-demand segments of the corridor.

As with all model forecasting, risks and uncertainties exist in model inputs and assumptions. For example, salaries or energy costs in 2040 may be lower or higher than those assumed in the model. The *California High-Speed Rail Authority's 2026 Business Plan* O&M forecasts include a Monte Carlo simulation to capture these risks and uncertainties by creating a forecast range with associated probabilities of occurrence. A high O&M cost forecast was developed to reflect the results of these Monte Carlo simulations. For more details on the O&M risk analysis methodology, please refer to the *Operations and Maintenance Cost Model Documentation*.

The limitation of the methodology used for the O&M risk analysis is that it does not provide high-cost scenarios for individual cost categories but instead identifies only total O&M high-scenario forecasts. As a result, to estimate high scenario costs by cost category, medium cost category forecasts are multiplied by the percentage increase of total O&M costs from the medium to high scenario. In other words, if total high scenario costs are approximately 9-10% higher than total medium costs, each cost category is multiplied by a factor between 1.09 and 1.10 to estimate high scenario costs by category.

Table 2 below outlines high-scenario O&M costs.

Table 2: Annual Operations and Maintenance High Scenario Cost Forecast ($2025 millions)

Cost Category	Scenario 1 M2B	Scenario 2 V2V	Scenario 3 Phase 1
Train Operations	$21	$70	$194
Bus Operations	$0	$107	$0
Security	$4	$18	$29
Dispatching	$5	$10	$14
Maintenance of Equipment	$20	$50	$116
Maintenance of Infrastructure	$31	$99	$115
Station and Train Cleaning	$8	$16	$25
Commercial	$4	$21	$27
General and Administrative	$19	$86	$263
Insurance	$22	$45	$100
Unallocated Contingency	$0	$22	$37
Margin	$11	$54	$92
Capacity Mark-Up	$0	$0	$49
Total Cost	**$146**	**$598**	**$1,062**

Note: Numbers may not add due to rounding

For planning, engineering, and design purposes, the 544-mile Scenario 3 HSR system has been divided into ten geographic sections. None of the sections would operate independently, and any cost values associated with individual sections are not intended to represent the cost to operate and maintain those sections as standalone systems; rather, geographic sections operate as part of an integrated system. However, to assist the regional teams in their evaluation of environmental impacts associated with future construction and operation of individual HSR projects, total O&M costs have been allocated to each geographic section on a proportional mileage basis.

O&M costs in 2025 dollars are apportioned to each geographic section based on the system-wide average total cost per route-mile. Track mileage used for this allocation may differ slightly from the track mileage used in the O&M cost model, which is based on specified segments of single and double track mileage rather than aggregated milepost distances.

Table 3 below outlines the cost per route mile by year and scenario.

Table 3: Cost per Route Mile ($2025 millions)

Cost Category	Year	Approx. Route Miles	Low O&M	Medium O&M	High O&M
Scenario 1 (MCD - BFD)	2030	171	$0.75	$0.78	$0.85
Scenario 2 (SF-BFD)	2040	324	$1.63	$1.69	$1.85
Scenario 3 (SF-ANA)	2040	544	$1.72	$1.78	$1.95

O&M costs by geographic segment are distributed in Table 4 below and are estimated by multiplying the cost per route-mile in Table 3 by the approximate route miles in each geographic section. Approximately 54 route-miles were allocated to the Palmdale-Victor Valley segment based on revenue train service operations on the High Desert corridor.

Table 4: Annual Operations and Maintenance Costs by Geographic Segment ($2025 millions)

Cost Category	Approx. Route Miles	2030 Scenario 1 Medium	2030 Scenario 1 High	2040 Scenario 2 Medium	2040 Scenario 2 High	2040 Scenario 3 Medium	2040 Scenario 3 High
San Francisco (4th and King)-San Jose	47	$0	$0	$79	$87	$84	$92
San Jose - Merced Wye Junction	105	$0	$0	$178	$195	$188	$206
Merced - Madera	42	$33	$36	$71	$78	$75	$82
Madera - Fresno	18	$14	$15	$30	$33	$32	$35
Fresno-Bakersfield	111	$86	$94	$187	$205	$198	$217
Bakersfield-Palmdale	82	$0	$0	$0	$0	$146	$160
Palmdale-Burbank	39	$0	$0	$0	$0	$70	$77
Palmdale-Victor Valley	54	$0	$0	$0	$0	$96	$105
Burbank-Los Angeles	14	$0	$0	$0	$0	$25	$27
Los Angeles-Anaheim	31	$0	$0	$0	$0	$55	$61

Note: Numbers may not add due to rounding