



BART Metro: 2030 and Beyond

Summary Report

January 11, 2023



Study Purpose

- **Support Regional Growth:** Provide sustainable transit service that supports forecasted regional housing and job growth, aligned with regional equity and GHG reduction goals.
- **Increase Capacity and Improve Service:** Build on the current efforts to increase capacity and service (i.e., Core Capacity Program, Silicon Valley extension) to further enhance the customer experience, improve operational efficiency, and ensure financial stability.
- **Respond to evolving ridership trends:** Grow ridership and respond to new markets, including travel pattern changes related to the pandemic, emphasizing off-peak, weekend, and reverse commute trips.
- **Identify the necessary operational and capital improvements** to implementation.

Project Team

Funding Partners

- Caltrans (grantor)
- MTC (project applicant)

BART Project led by Strategic & Operations Planning

Consultant Support

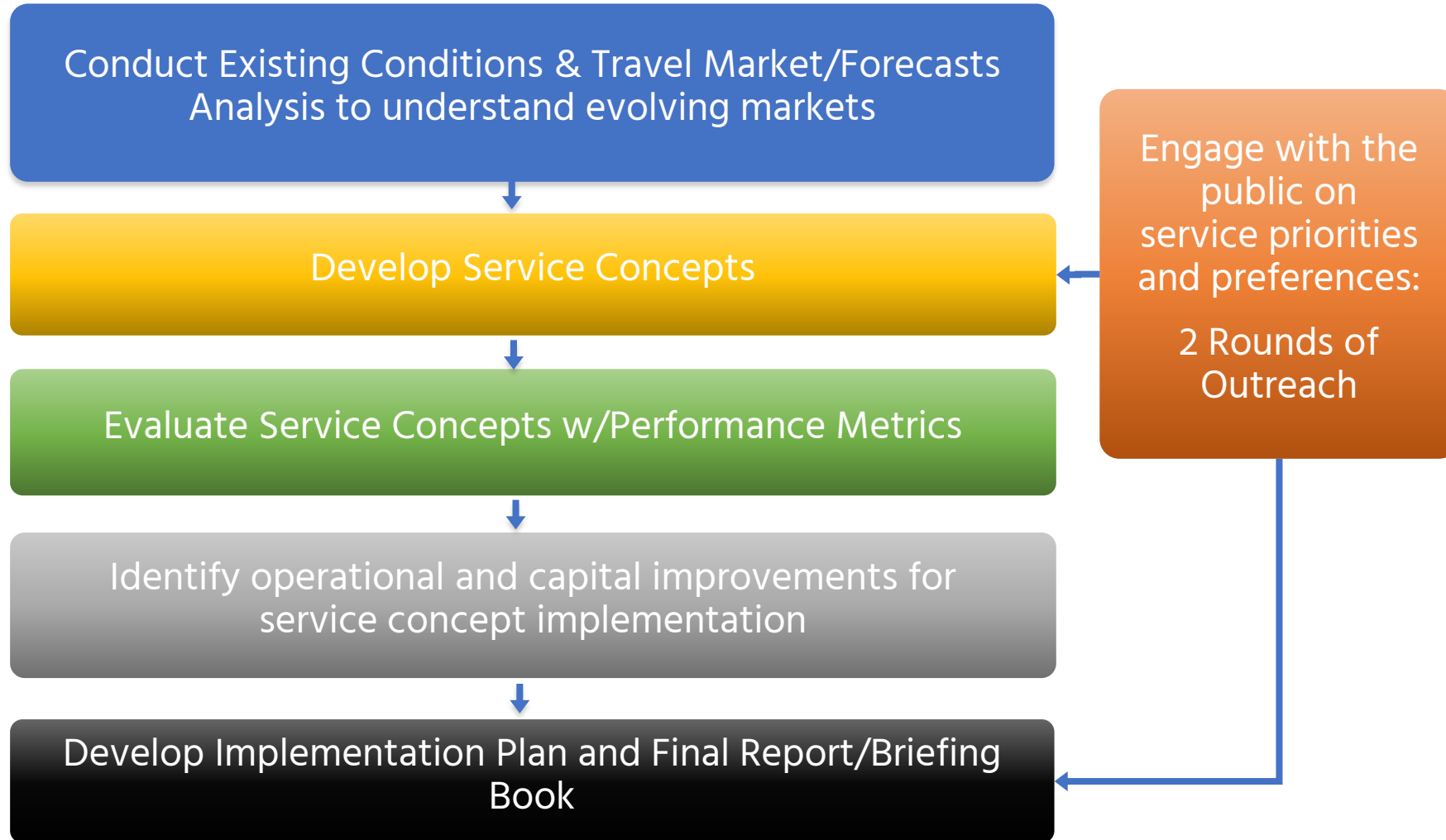
- Arup
- Connetics (now Nelson Nygaard)
- Civic Edge
- Hatch

Technical Advisory Committee

Role: Provide technical input and help guide the study direction at key junctures

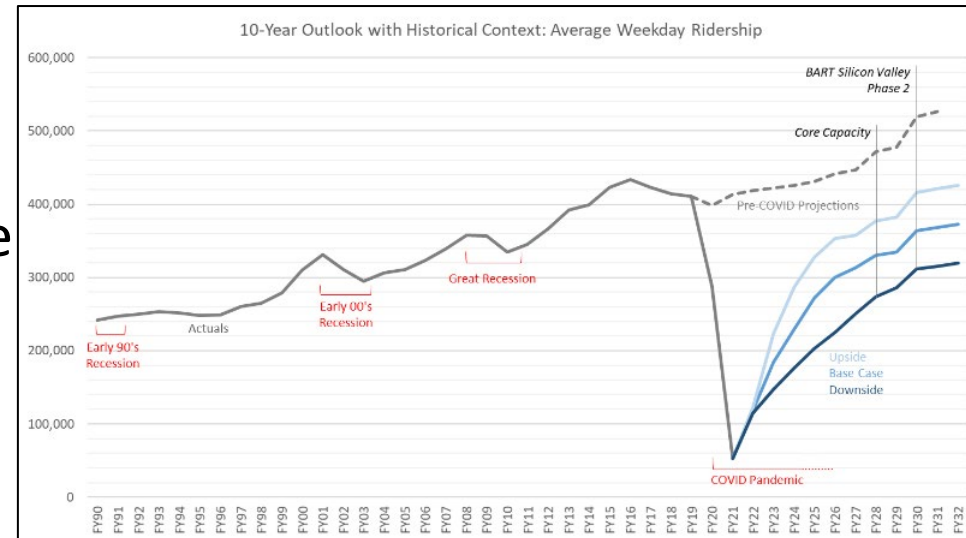
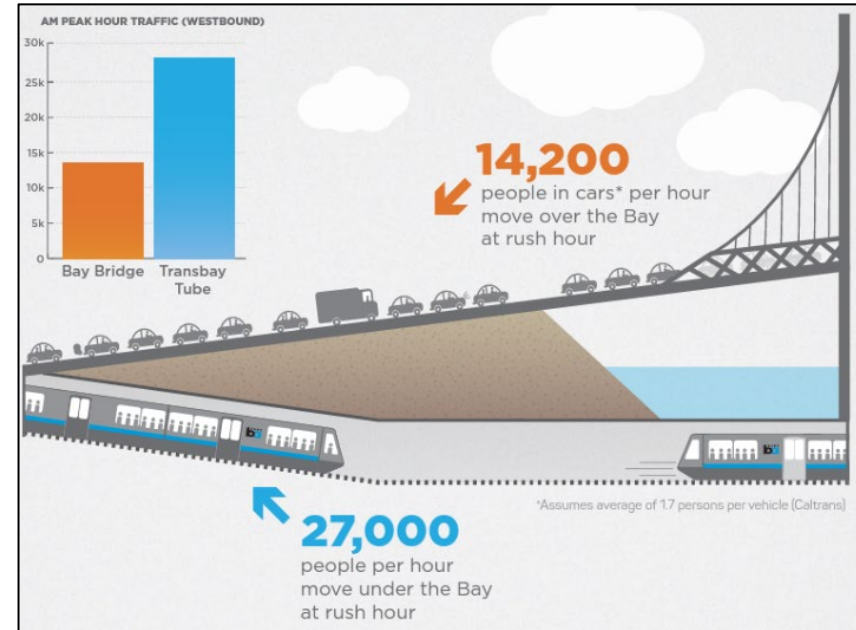
- Caltrans
- Metropolitan Transportation Commission
- Alameda County Transportation Commission
- Contra Costa Transportation Authority
- San Francisco County Transportation Authority
- Valley Transportation Authority
- City/County Association of Governments of San Mateo County (C/CAG)
- San Francisco Municipal Transportation Agency
- Capital Corridor
- SamTrans
- Caltrain
- AC Transit

Study Approach



Existing Conditions

- Pre-pandemic Context:
 - 410k weekday daily ridership (2019); crowding in the peak hour peak direction
 - Forecasted substantial regional growth in households, jobs, and transit demand
- Current Context:
 - Weekday daily ridership 40% of pre-pandemic
 - “New Normal” of increased remote work - employees in the office fewer days/week



Problem Statement & Evaluation Approach

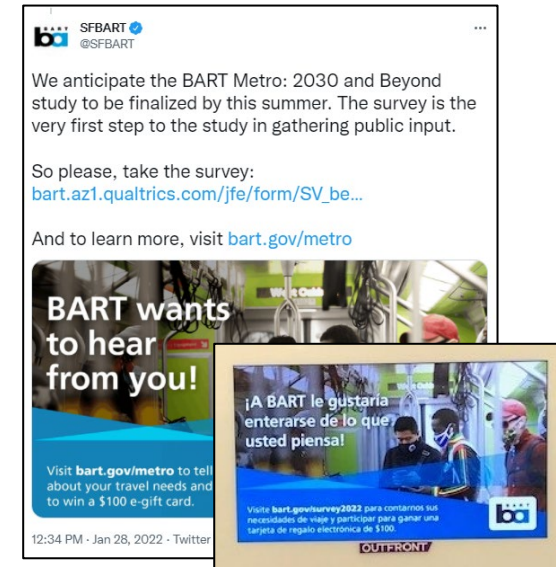
1. BART needs to respond to evolving ridership trends, particularly off-peak and non-transbay commute markets to support ridership recovery
 - Develop service concepts to serve evolving markets and evaluate concepts under a **COVID Recovery Scenario**: 415k daily ridership – “Upside”* (80% of 2030 forecast made pre-COVID)
2. BART needs to plan for the region’s future by increasing system capacity and identifying potential future constraints
 - Develop maximum capacity service concepts and evaluate concepts under a **Plan Bay Area (PBA) Growth Scenario**: 785k daily riders with more off-peak ridership and shifting ridership markets (proportionally fewer trips to DTSF and Oakland and more trips to other parts of SF, inner-East Bay, and Peninsula).

Given uncertainty, ridership scenarios represent points in a continuum of ridership growth and the service concepts and related improvements seek to improve how BART serves those scenarios in the future.

**Forecasted ridership outlook developed in Fall of 2022 represents an optimistic scenario; ridership projection has since been adjusted downward.*

Public Outreach Round 1

- Obtain feedback on travel needs, priorities, and potential service scenarios
- Online survey: 1/28/22 -2/22/22 (1,100 surveys completed)
 - Email sent to random sample of riders and CBOs
 - In-station promotion via electronic sign messaging
 - Social media push
- What we heard:
 - Riders prioritized service improvements based on frequency of ridership
 - Direct service is preferred when wait time is 10 minutes; more frequent with transfer preferred if direct service has 15-minute wait
 - Most respondents willing to wait up to 9 minutes to transfer
 - Transfer wait time most common reason for foregoing trips



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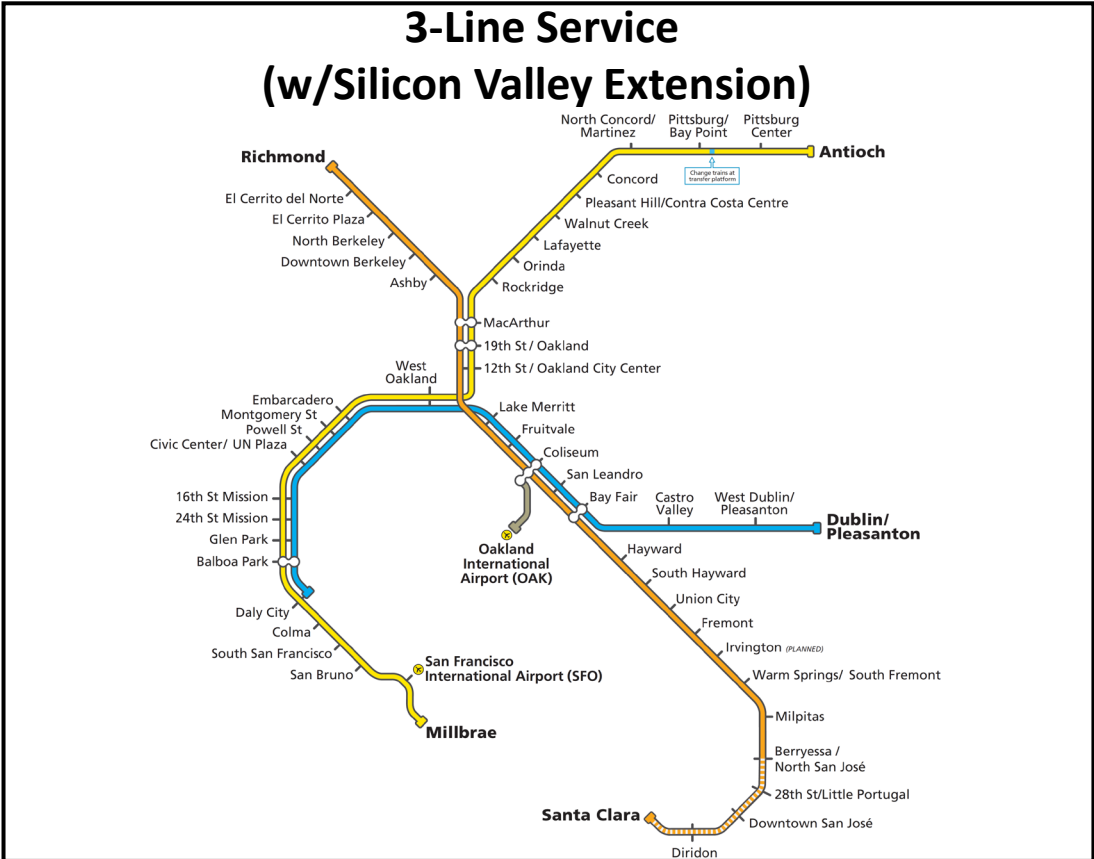
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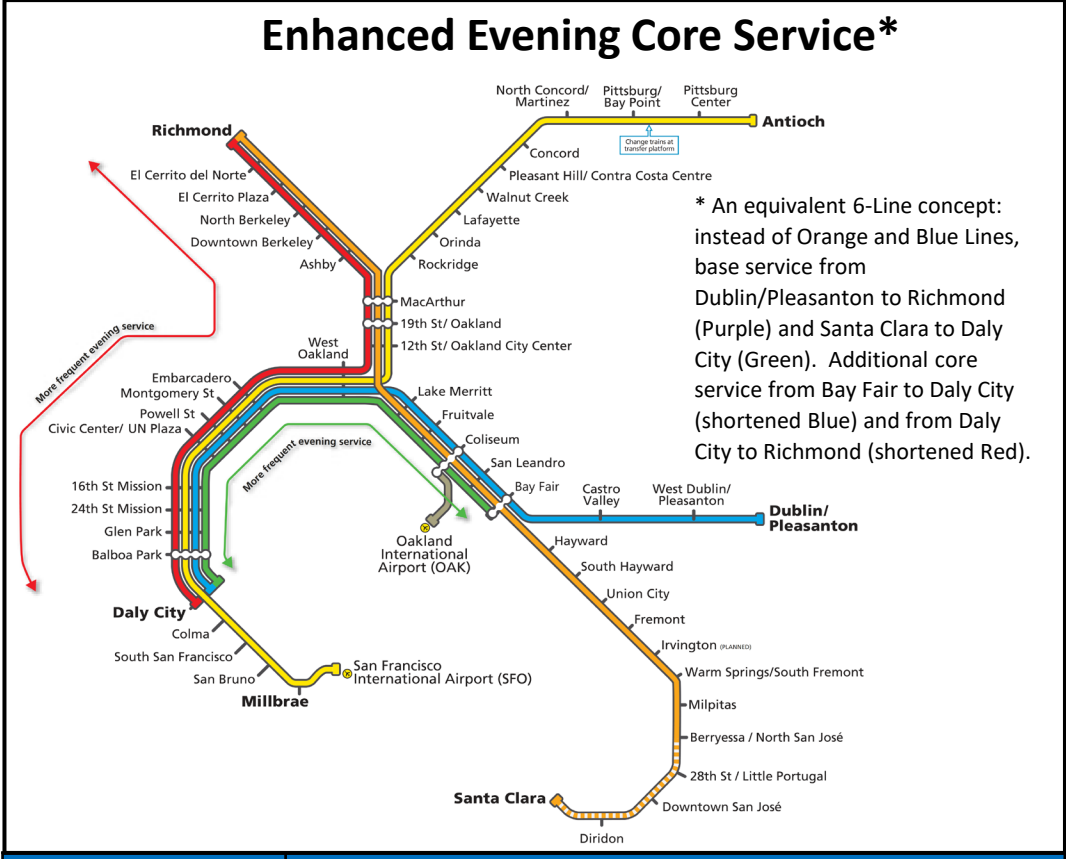
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Development of Off-peak/Evening Service Concepts



Concept	Rationale
3-Line/20-minute	Return to pre-pandemic evening service

Concept	Rationale
Full 5-Line/30-minute	Direct service to the system's outer extents and higher core service
Full 6-Line/30-minute	Direct intra-East Bay service and with higher core service

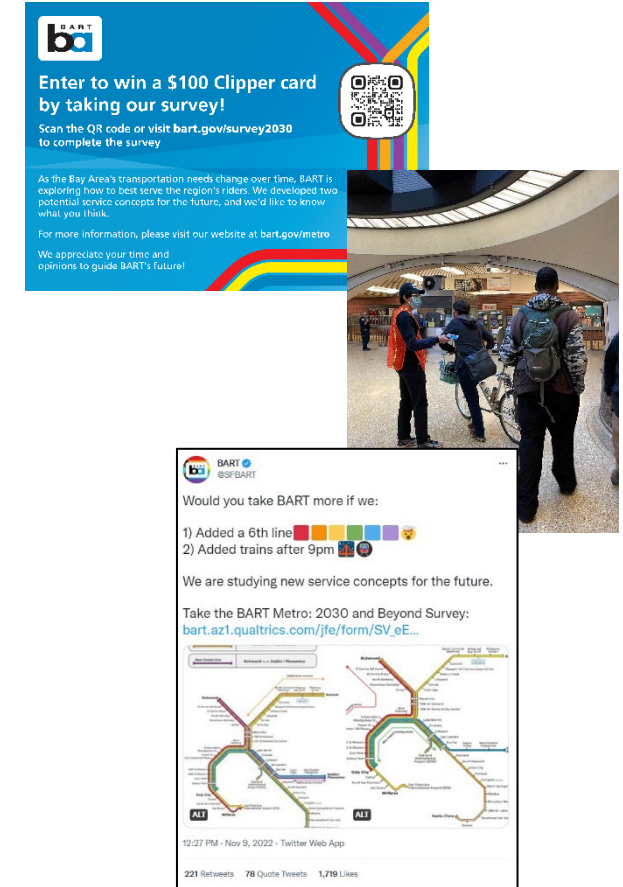


Concept	Rationale
Enhanced Core/ 20-minute	3-line/20-minute concept (w/overlaid service between Daly City & Richmond and between Daly City & Bay Fair every 20 minutes); targets higher ridership system core

* An equivalent 6-Line concept: instead of Orange and Blue Lines, base service from Dublin/Pleasanton to Richmond (Purple) and Santa Clara to Daly City (Green). Additional core service from Bay Fair to Daly City (shortened Blue) and from Daly City to Richmond (shortened Red).

Public Outreach Round 2
















- Strong enthusiasm to provide feedback on future service concepts and positive feedback on both new concepts
- Online survey: 11/9/22 -11/22/22 (5,864 surveys completed)
 - Same means as Round 1 + in-station flyer distribution at 6 stations
- What we heard:
 - Pluralities of respondents - both concepts serve their needs better than the existing service and would definitely or probably ride BART more often if implemented
 - Enhanced Evening Core more positive feedback than Enhanced East Bay.
 - Low-income, frequent riders and younger riders consistently more positive responses to both concepts
 - Riders who use BART between 4AM-6AM – Enhanced East Bay would better serve their need and lead to more ridership






Service Concept Technical Evaluation

Covid Recovery Demand: Daytime Service

Technical evaluation compares service concepts' *relative* performance using customer experience and operational metrics under the COVID Recovery Demand Scenario (415k daily riders)

Metric	Performance Indicators	Concept 1 5-line/12-minute	Concept 2 5-line/10-minute	Concept 3 6-line/12-minute
Regional Connectivity	<ul style="list-style-type: none"> Average trains per hour serving key regional transit hubs 			
Loading / Crowding	<ul style="list-style-type: none"> Percent of passenger hours above crowding threshold: 115 peak passengers per car Average and Max passengers per car at screen lines 			
Transfer Rate / Wait Time	<ul style="list-style-type: none"> Percent of trips that transfer Average Transfer Wait Time 	Highest transfer rate	Lowest transfer wait	Lowest transfer rate/highest transfer wait
Travel Time	<ul style="list-style-type: none"> Average Travel Time Average Preboarding Wait Time 			
Fleet Requirement	<ul style="list-style-type: none"> Within planned fleet of 1,200 cars 			
Resource Efficiency	<ul style="list-style-type: none"> Train hours Car hours Passenger hours per car hour* 			





















Relative Performance

-  Best Performing Service Concept
-  Neutral Performing Service Concept
-  Worst Performing Service Concept

Service Concept Technical Evaluation

Covid Recovery Demand: Off-peak/Evening Service

Technical evaluation compares service concepts' *relative* performance using customer experience and operational metrics under COVID Recovery Demand Scenario (415k daily riders)

Metric	Performance Indicators	3-Line/20-minute	Enhanced Core /20-minute	Full 5-Line Service /30-minute	Full 6-Line Service/30-minute
Regional Connectivity	<ul style="list-style-type: none"> Average trains per hour serving key regional transit hubs 				
Loading / Crowding	<ul style="list-style-type: none"> Percent of passenger hours above crowding threshold: 80 off-peak passengers per car Average and Max passengers per car at screen lines 				
Transfer Rate / Wait Time	<ul style="list-style-type: none"> Percent of trips that transfer Average Transfer Wait Time 	Highest transfer rate/wait time	Neutral performance	Lowest transfer wait time	Lowest transfer rate
Travel Time	<ul style="list-style-type: none"> Average Travel Time Average Preboarding Wait Time 				
Fleet Requirement	<ul style="list-style-type: none"> Within planned fleet of 1,200 cars 				
Resource Efficiency	<ul style="list-style-type: none"> Train hours Car hours Passenger hours per car hour* 				

Relative Performance



Best Performing Service Concept



Neutral Performing Service Concept



Worst Performing Service Concept

Service Concept Technical Evaluation

Covid Recovery Demand: Equity Analysis
















Comparison of customer experience metrics for passengers of color and low-income residents to remainder of the population:

- Passengers of color:
 - Experience slightly less crowding
 - Lower transfer rates in Concepts 1 (5-Line/12-minute) and 2 (5-Line/10-minute), and slightly higher transfer rates in Concept 3 (6-Line/8-minute)
 - Shorter pre-boarding wait time and average travel time across evening concepts
- Low-income residents:
 - Crowding consistent with rest of population
 - Higher transfer rate in AM and lower transfer rate in PM and evening
 - Lower average travel time and pre-boarding wait time




Service Concept Technical Evaluation

Plan Bay Area Growth Demand: Daytime Service

Technical evaluation compares service concepts' *relative* performance using customer experience and operational metrics under Plan Bay Area Growth Demand Scenario (785k daily riders)

Metric	Performance Indicators	Concept 2 5-Line/10-minute	Concept 3 6-Line/12 minute	Concept 4 6-Line/8-minute
Regional Connectivity	<ul style="list-style-type: none"> Average trains per hour serving key regional transit hubs 			
Loading / Crowding	<ul style="list-style-type: none"> Percent of passenger hours above crowding threshold: 115 peak passengers per car Average and Max passengers per car at screen lines 			
Transfer Rate / Wait Time	<ul style="list-style-type: none"> Percent of trips that transfer Average Transfer Wait Time 	Lowest transfer wait	Lowest transfer rate/highest transfer wait	Highest transfer rate
Travel Time	<ul style="list-style-type: none"> Average Travel Time Average Preboarding Wait Time 			
Fleet Requirement	<ul style="list-style-type: none"> Within planned fleet of 1,200 cars 			
Resource Efficiency	<ul style="list-style-type: none"> Train hours Car hours Passenger hours per car hour* 			

Relative Performance





-  Best Performing Service Concept
-  Neutral Performing Service Concept
-  Worst Performing Service Concept

* Passenger demand is assumed to be fixed across all service concepts in each scenario and is reflected in the technical evaluation results.




Service Concept Technical Evaluation

Plan Bay Area Growth Demand: Off-peak/Evening Service

Technical evaluation compares service concepts' *relative* performance using customer experience and operational metrics under Plan Bay Area Growth Demand Scenario (785k daily riders)

Metric*	Performance Indicators	Enhanced Core /20-minute	Full 5-Line Service/30-minute
Loading / Crowding	<ul style="list-style-type: none"> Percent of passenger hours above crowding threshold: 80 off-peak passengers per car Average and Max passengers per car at screen lines 		
Transfer Rate / Wait Time	<ul style="list-style-type: none"> Percent of trips that transfer Average Transfer Wait Time 	Lower transfer rate/higher transfer wait time	Higher transfer rate/Lower transfer wait time
Travel Time	<ul style="list-style-type: none"> Average Travel Time Average Preboarding Wait Time 		

Relative Performance

-  Best Performing Service Concept
-  Neutral Performing Service Concept
-  Worst Performing Service Concept

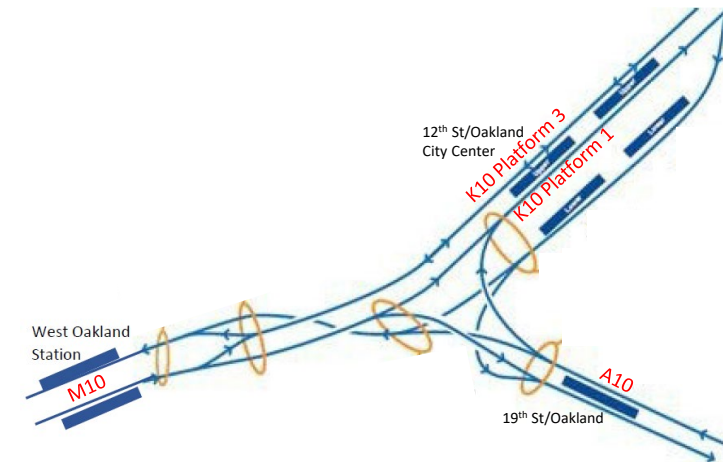
- Service characteristics do not change between scenarios: regional connectivity and operational metrics same as COVID Recovery demand
- Passenger hour/car hour change with higher demand: Full 5-Line service concept slightly more efficient

Service Concept Technical Evaluation

Reliability and Resiliency Analysis

Conducted Simulation test system reliability and resiliency:

- Daytime Concept 1 (5-Line/12-mins) and the Concept 4 (6-Line/8-mins) as “book ends” for range of results:
 - Delay Analysis: Concept 4 additional minute over Concept 1 due to ends of the lines functioning at or above capacity
 - Delay Recovery Time: Simulated 10-minute dwell time for a single train at A10, M10, and K10:
 - Recovery duration are equivalent (20~24 mins) at M10 and K10 Platform 3 (trains from San Francisco)
 - Concept 4 has much higher recovery time at two locations:
 - 37 mins vs 25 mins at A10
 - 31 mins vs 16 mins at K10 Platform 1
- Simulation of E Line transfer platform (single track constraint) showed can't accommodate Concept 4 (6-Line/8-mins) but can accommodate Concept 3 (6-Line/12-mins)



Recommended Improvements

Applicable Projects	Existing Needs	Service Concepts Implementation				Project Benefits	
		Baseline Service Concept 1 (5-Line/12-Minute)	Service Concept 2 (5- Line/10-Minute)	6-Line Service (Concepts 3 & 4)	Enhanced Core	Efficiency & Reliability	Capacity Projects
Fleet of the Future Maintenance Facility: Vehicle Overhaul Shop	X	X	X	X	x	Primary	Secondary
Hayward Yard M&E Building	X	X	X	X	X	Primary	Secondary
Existing Daly City Terminal Zone Facility Upgrades	X	X	X	X	X		Primary
Augment E Line Fleet	X	X	X	X		Secondary	Primary
Increase West Bay Storage Capacity	X	X	X	X		Secondary	Primary
W-Line Tail Track Extension	X	X	X	X		Secondary	Primary
Intrusion Control	X					Primary	
Colma Turn Back/Terminal Zone Upgrade		X	X	X		Secondary	Primary
Dublin Tail Track Extension		X	X	X		Secondary	Primary
Contra Costa County Storage Capacity			X	X			Primary
Additional breakroom/supervisor towers at Bay Fair and/or MacArthur)				X	X	Secondary	Primary
E Line improvements (car storage and maintenance facilities) and transfer platform reconfiguration				X		Secondary	Primary
E Line electrification						Primary	
Richmond Crossover						Primary	Secondary
'A' Line Siding south of Oakland Yard						Primary	Secondary
Oakland 3rd Track (Wye-West Oakland)						Primary	Secondary
Additional Bay Fair Track/Platform					X	Primary	Secondary
Fleet of the Future: Additional Vehicles Beyond Planned Fleet			X	X		Secondary	Primary
Richmond breakroom/supervisor tower for Richmond Crossover						Primary	
Richmond Yard Storage Track Extension			X	X		Secondary	Primary

Next Steps to Implement Service Concepts

The following would be required for implementation of service concepts to support ridership recovery in the mid- to long-term:

- Simulation of operations at Santa Clara terminal
- Evaluation of storage capacity on the C Line
- Study West Bay storage opportunities; coordinate evaluation with Link21
- Further simulation of Daly City as a turnback for service concepts
 - Consider projects needed for Colma as turnback alternative
- Evaluation of additional traction power and staffing/facility needs
- Simulation of E Line capacity to meet different service concepts
- 6-Line Service Concept Next Steps:
 - Service Plan refinement to address train spacing and terminal capacity issues
 - Further evaluation of storage capacity on the L line
- Enhanced Core Service Next Steps :
 - Simulation of operations at Bay Fair
 - Evaluation of staffing implications of turning trains at Bay Fair

Key Findings

- **Positive interest on new service concepts for the future that address evolving ridership trends**
- **Crowding:** Minimal under COVID recovery scenario but persists in Plan Bay Area Growth scenario even with maximum service concepts; concept refinement and additional train cars may address crowding outside Transbay only
- **Transfers vs. direct service:** 6-Line service provides more direct services than the 5-line service but has train spacing challenges and slightly longer preboarding and transfer wait time; modeled transfers indicate time savings more than requirement
- **What do riders want?** frequent riders want increase in peak service and infrequent riders want mid-day or weekend increase; generally, people willing to wait 9 minutes to transfer, would wait up to 10 minutes for a direct train, otherwise willing to transfer; positive feedback for Enhanced Core service and (to a lesser degree) Enhance East Bay (6-Line service)
- **Additional resources required:**
 - High fixed cost results in lower marginal cost per car hour across alternatives
 - Concepts estimated to be 13-34% more annual operating cost than Fiscal Year 2022 budget
 - Operational staffing required estimated to be 15-43% more than Fiscal Year 2022 budget
 - 6-Line/8-mins and 5-Line/10-mins require more than planned FOTF fleet, all other concepts can be implemented with planned fleet
- **Context of uncertainty** – CBTC enabled services were evaluated in this study, BART may consider evaluation of concepts with lower levels of service given current ridership trends
- **Identified improvements:** supportive for service concepts, to advance in CIP and districtwide Capital Project Prioritization