LINK21

CONNECT NORTHERN CALIFORNIA

STRATEGIC PROGRAM PLAN

CHAPTER 12: PLANNING AND ENGINEERING

December 2022

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ISSUE AND REVISION RECORD

REVISION	DATE	PREPARER(S)	PMC REVIEWER(S) / BART/CCJPA REVIEWER(S)	APPROVER / BART/CCJPA APPROVER	DESCRIPTION/ NOTES
1.A	02/07/2020	Gay Knipper, HNTB	Gay Knipper, HNTB	Peter Gertler, HNTB	WPA.01 DRAFT submittal
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2.A	07/30/2020	Greg Oslund, HNTB	Gay Knipper, HNTB	Peter Gertler, HNTB	WPA.02 V1 DRAFT submittal
	08/25/2020	---	Camille Tsao, CCJPA	Sadie Graham, BART	WPA.02 V1 DRAFT submittal review
2.B	10/30/2020	Greg Oslund, HNTB	Gay Knipper, HNTB	Peter Gertler, HNTB	WPA.02 V1 DRAFT FINAL submittal
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3.A	04/16/2021	Greg Oslund, HNTB	Steve Lavelle, Intueor	Peter Gertler, HNTB	WPA.03 V2 Working DRAFT submittal
	05/13/2021	---	Sadie Graham, BART	Sadie Graham, BART	WPA.03 V2 Working DRAFT submittal review
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	08/13/2021	---	Sadie Graham, BART	Sadie Graham, BART	WPA.03 V2 DRAFT submittal review
3.C	11/30/2021	Greg Oslund, HNTB	Steve Lavelle, Intueor	Peter Gertler, HNTB	WPA.03 V2 DRAFT FINAL submittal
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5.B	12/16/2022	Chester Fung, HNTB	Sudhish Verma, HNTB	Peter Gertler, HNTB	WPA.01-01 DRAFT FINAL submittal
		---			*No review requirement*

SHAREPOINT PATH

Records Center/PRGM Record Center/WPA.01-01/SPP/
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ACRONYMS AND ABBREVIATIONS

ACRONYM/ABBREVIATION	DEFINITION
BART	San Francisco Bay Area Rapid Transit District
CCJPA	Capitol Corridor Joint Powers Authority
E&O	Engagement and Outreach
EMU	electric multiple unit
RTP	regional transportation plan
SPP	Strategic Program Plan

LINK21 PROGRAM TEAM NAMES

TEAM NAME	TEAM MEMBERS
Program Management Consultants (PMC)	The HNTB Team
Program Management Team (PMT)	BART/CCJPA + PMC
Consultants	Consultants supporting program identification/project selection
Link21 Team	PMT + Consultants

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12. PLANNING AND ENGINEERING

12.1. Purpose

The purpose of Link21's planning and engineering work is to develop potential concepts for a new transbay passenger rail crossing project (Crossing Project). The concepts are informed by prior technical studies, planning and engineering considerations, environmental constraints and opportunities, stakeholder and public engagement, and the business case evaluation.[1]

12.2. Strategy

The overall Link21 strategy is structured around the four development and delivery phases:

- Phase 0: Program Definition
- Phase 1: Project Identification
- Phase 2: Project Selection
- Phase 3: Project Delivery

Each phase has specific objectives, deliverables, and outcomes that support the Stage Gate Process.[2] The planning and engineering elements are summarized in the following sections.

12.2.1. Phase 0: Program Definition

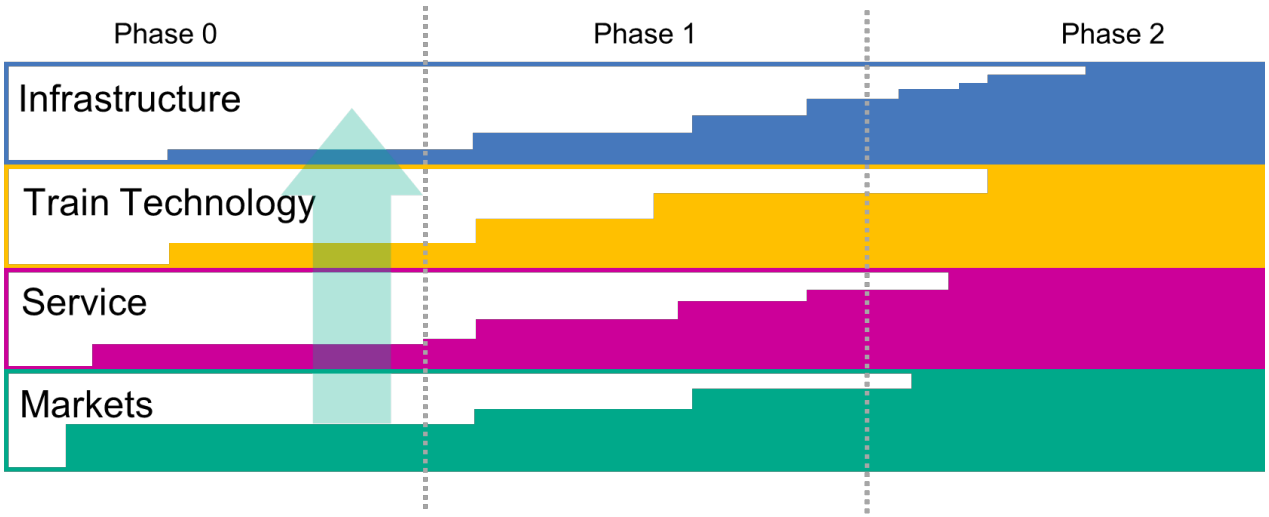
In Phase 0, Link21 considered and defined the fundamental aspects of the overall program. It took a megaregional and program-based view, exploring changes across the entire rail network for ones with the most promise for benefits – considering not just one project improvement, but multiple project improvements in multiple parts of the megaregional rail network that could work synergistically to provide optimal travel benefits.

The strategy was to define the program along four building blocks: markets to be served, train service to be provided, train technology to be deployed, and infrastructure to be delivered, as illustrated in **Figure 12-1**. The strategy focused first on *markets* (areas of high potential) and *service* (frequency, routes, and stopping patterns) then on *train technology* (train performance and traction power) and the required *infrastructure* (track, structures, power, etc.) needed to deliver the service as defined. Focusing early

[1] For more details on the Business Case, see Strategic Program Plan (SPP) Chapter 2.
[2] For more details on the Stage Gate Process, see the Master Timeline and Stage Gate Process foundational documents and SPP Chapter 5.

in the planning process on the "what" (markets and services) informed the requirements for the "how" (train technology and infrastructure).

Figure 12-1. Evolution of Link21's Building Blocks of Markets, Service, Train Technology, and Infrastructure (Phases 0 to 2)



The Phase 0 work began the process of adding information within each of the building blocks. The following phases will add successively more detail to the definitions (demonstrated by the addition of color in each phase).

MARKETS

To initiate the strategy for understanding travel markets, Link21 prepared a megaregional *Market Analysis Report*[3] in Phase 0 to identify potential markets with long-term, unmet demand and transbay unmet demand. That analysis informed identification of potential markets and corridors for rail service development, as well as exploration of potential rail service changes to capture those markets.

SERVICE

Link21 identified rail service improvement opportunities across the Northern California Megaregion (Megaregion). First, Link21 considered the types of passenger journeys (i.e., intercity vs. commuter vs. urban metro trips). Then, the Phase 0 market analysis identified the places in the Megaregion where unmet demand for those journeys might be most prevalent. Finally, Link21 identified the places along the rail network where service aspects, such as connectivity, level of train service, travel time, and reliability, could be improved, compared with today, to better serve those passenger journeys. Link21 will incorporate these service opportunities into the definitions of concepts in Phase 1, addressing train routing, frequency, travel speeds, and stopping patterns. We

[3] The Market Analysis Report documents can be found on the Link21 website in the Document Library.

will continue to coordinate with the state and align with the vision set forth in the *State Rail Plan* (next draft to be published in 2022).

TRAIN TECHNOLOGY

Link21 explored upcoming train vehicle technology advancements, in order to identify which technologies could support the rail service envision for Link21. For Regional Rail, the Phase 0 work focused on gathering information on advancements, such as electric multiple unit (EMU) vehicles, battery EMUs, and hydrogen EMUs, all with less pollution and better travel time performance than today's diesel locomotive Regional Rail trains. This is consistent with the state mandate to operate zero-emission rail vehicles by 2035. Link21 considered how the enhanced performance could translate to a Regional Rail service that can function similar to an urban metro service like the San Francisco Bay Area Rapid Transit District (BART), with closer station spacing and more service in denser areas, while also operating longer distance service as it does today. Link21 will use this information to shape the Phase 1 Crossing Project concepts.

BART is currently phasing in its "Fleet of the Future." It is unknown how BART vehicle technology will change in the future; however, it will likely remain electric-powered.

INFRASTRUCTURE

Link21 compared the previously identified service opportunities against the existing rail network to identify potential infrastructure opportunities and constraints. For instance, Link21 recognized BART's Oakland Wye operations as an existing and future capacity constraint. Link21 BART crossing concepts will need to connect to existing BART lines without routing through the existing wye. For Regional Rail, passenger service allowed by current trackage rights agreements on the freight-owned rail corridors will constrain the level of train service able to reach and use a new crossing. This constraint points to the need for additional improvements as part of Regional Rail Crossing Project concepts to be developed in Phase 1.

12.2.2. Phase 1: Project Identification

The Phase 1 strategy entails first establishing the megaregional program context and the role that a new transbay passenger rail crossing of the San Francisco Bay would play within that context, then focusing on defining Crossing Project concepts.

The existing megaregional passenger rail network, along with future improvements already planned by others (including planning and funding agencies as well as individual rail operators), provides the context for Link21's Crossing Project concepts. That context demonstrates the critical role that such an improvement would play across the Megaregion. Link21 will document[4] this context and vision of the future network, which will reflect dramatic improvements in rail service and connectivity compared to the

[4] in a report to be determined

existing network. That future context will include improvements that are committed to in regional transportation plans (RTP), such as the Metropolitan Transportation Commission's *Plan Bay Area 2050*. It will also include additional improvements that were identified by others but were not committed to in RTPs and that have potential synergies with a new transbay passenger rail crossing. This will enable the benefits of Link21's Crossing Project concepts to extend throughout the Megaregion.

Against this megaregional rail context, Link21 will develop Crossing Project concepts. These concepts will include at least one new transbay passenger rail crossing using BART and Regional Rail technology, and Link21 will aim to define them such that new potential BART crossings would not conflict with new potential Regional Rail crossings, and vice versa. In addition to the crossing itself, the concepts will include other improvements that may be warranted to fully realize its benefits, such as to other segments of the rail network that trains would use to access the crossing. The concepts will also include improvements to benefit the other system, (i.e., a concept featuring a new BART crossing would also feature improvements to the Regional Rail network to further extend the benefits of the new crossing and vice versa). Link21 is defining the Crossing Project concepts based on information and input from the program's goals and objectives, business case evaluation, travel demand modeling, stakeholder and public input, and engineering feasibility considerations. The end goal of Phase 1 is to identify a project(s) to move forward to the next phase, including environmental documentation. Refer to Section 12.3.2 for more details.

12.2.3. Phase 2: Project Selection

Phase 2 will conduct more detailed planning and engineering studies, will identify project alternatives, and will prepare conceptual engineering drawings and cost estimates for each project alternative considered in the National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA) analysis. The final deliverable will be the preferred project alternative for advancement to Phase 3.

12.2.4. Phase 3: Project Delivery

Phase 3 will develop the project design from conceptual engineering to final engineering, and it will produce a set of plans, specifications, and estimates that are suitable for phasing, bidding, and constructing the project. At the conclusion of Phase 3, the project improvements will be ready for service.

12.3. Implementation

12.3.1. Phase 0

The Phase 0 work consisted of collecting and reviewing prior studies, conducting technical studies on specific background topics, and defining the improvements that Link21 may ultimately select later to be part of a Crossing Project concept. The Phase 0

work also resulted in technical input on Stage Gate 1 recommendations for BART and Capitol Corridor Joint Powers Authority (CCJPA) board approval.

Link21 began Phase 0 by reviewing prior studies from across the Megaregion, especially those identifying the need for additional connectivity and capacity across the San Francisco Bay and pointing toward potential BART and Regional Rail solutions. In particular, both MTC's *Plan Bay Area* and the *California State Rail Plan* describe a new rail crossing of the bay, which Link21 is a program to implement.

Link21 conducted technical studies on selected background topics deemed important to the definition of the concepts, including:

- *BART and Regional Rail Compatible Technologies:* Established criteria for technologies or systems that could be considered, advanced, and ultimately implemented as part of Link21. It concluded that, considering the overall planning context, feasible program and project alternatives will be compatible with and may be interlined with BART and Regional Rail systems.
- *Dual-Gauge Crossing Concept:* Explored the feasibility of a dual-gauge crossing as a potential means to accommodate both BART and Regional Rail in a single two-track crossing. It found the concept may not bring significant cost savings.
- *Connection to Existing BART in Downtown San Francisco:* Considered the feasibility of connecting a new BART bay crossing to the existing BART M-Line west of the Civic Center/UN Plaza Station. It found significant disruption to the existing transbay service for a substantial amount of time.
- *Rail Bridge Feasibility:* Explored the feasibility of crossing the bay with a BART or Regional Rail bridge. It found that while the concept may be technically possible, the impacts to the affected communities in San Francisco would be severe and likely unacceptable.
- *Underground Construction Challenges and Considerations:* Explored the implications and requirements of two potential construction methods that might be employed for the new transbay passenger rail crossing: immersed tube tunnel (ITT) and Tunnel Boring Machine (TBM) methods.
- *Extended (24-hour) BART Service and Maintenance Considerations:* Identified opportunities, constraints, and other factors pertinent to future 24-hour service for the BART system after construction of the Crossing Project.
- *Megaproject Delivery:* Assessed common delivery challenges and lessons learned from megaprojects that are comparable to Link21. It was based on first-hand experience and a review of similar megaprojects in the United States and abroad, addressing two categories of challenges: 1) those impacting the cost and schedule of the project, and 2) those related to governance and accountability.
- *Sea Level Rise:* Conducted a preliminary analysis of its potential effects on locations where Link21 may propose infrastructure and considered sea level rise policy

questions to inform future work, acknowledging that adaptation efforts will advance in parallel to Link21 and anticipating that Link21 will participate with those efforts to achieve resiliency for the program and the community overall.

These studies helped to clarify the range of possibility for Crossing Project concepts and uncovered some of the constraints the concepts will need to conform to.

The final work within Phase 0 explored ideas for program concepts using the market analysis information that was developed and considering the rail service that could best serve that demand and the infrastructure improvements that would be needed in order to operate that service. The ideas included BART and Regional Rail in the crossing, other improvements to the BART and Regional Rail systems, and a far-ranging geography of improvements from ones near the crossing to ones much further away. These improvements, including rail service and infrastructure ideas, would serve as the basis for developing Crossing Project concepts in Phase 1.

At the conclusion of Phase 0, Link21 documented the planning and engineering work in the *Phase 0 Planning and Engineering Technical Summary Report*, which served as the starting point for the development and evaluation of the program concepts in Phase 1.

12.3.2. Phase 1 Concept Development

Phase 1 focuses on defining concepts for a potential new transbay passenger rail crossing using BART and Regional Rail technology. Link21 will develop concepts through multiple rounds of development, analysis, evaluation, and refinement that will be documented in a series of products, including a concept development report.

In an initial Exploratory Round, Link21 will define multiple Crossing Project ”tests“ and additional associated rail improvements beyond the crossing. This step also entails generating performance metrics and using those metrics as inputs to the business case evaluation[5] to inform the development of concepts in Round 1. Using the business case approach and incorporating results from the Travel Demand and Land Use Initial Tool,[6] this round will test the benefits of combining crossing options and additional improvements in various ways to begin identifying promising combinations.

In Round 1, Link21 will evaluate concepts representing the most promising combinations of Crossing Project options and associated improvements. The business case evaluation results of the previously developed exploratory concepts, as well as input from stakeholders and the public as gathered through the Link21 Engagement and Outreach (E&O) work,[7] will inform development of Round 1 concepts. The process will target creating a small number of Regional Rail crossing concepts and BART crossing

[5] For more information on the Business Case, refer to SPP Chapter 2.
[6] For more information on the Travel Demand and Land Use Initial Tool, refer to SPP Chapter 14.
[7] For more information on the E&O Team’s work, refer to SPP Chapter 11.

concepts for Round 1 and generate performance metrics for the business case evaluation.

In Round 2, Link21 will use the business case evaluation results from Round 1 to develop a refined set of Crossing Project concepts. There may be fewer Round 2 concepts than Round 1 concepts depending on the results of the Round 1 evaluation, although both BART and Regional Rail crossings will still be represented. This step will also entail generating performance metrics for the Round 2 evaluation.

After the Round 2 evaluation and additional feedback from the E&O Team's work, the final planning and engineering deliverable of this phase will be two Crossing Project concepts: the best-performing BART crossing and the best-performing Regional Rail crossing. They will be selected from the Round 2 concepts and include any refinements as identified by the business case evaluation.

12.3.3. Stage Gate 2 Support

Phase 1 will conclude with a significant decision point referred to as Stage Gate 2. The Stage Gate 2 report will include a description of the project concepts developed by the Link21 Team, and it will be refined in three successive rounds of concept evaluation. At a minimum, it is anticipated that the evaluation process will identify the best performing Regional Rail Crossing Project and the best performing BART Crossing Project in preparation for Stage Gate 2. The Stage Gate 2 decision will recommend that at least one project concept is advanced to Phase 2.