LINK21

CONNECT NORTHERN CALIFORNIA

STRATEGIC PROGRAM PLAN

CHAPTER 14: TRAVEL DEMAND AND LAND USE

December 2022

Link21 is committed to ensuring that information is available in appropriate alternative formats to meet the requirements of persons with disabilities. If you require an alternative version of this file, please email link21dc@link21program.org.

Prepared By:
Link21 Program Management Consultants (PMC)

DRAFT - DELIBERATIVE

BART

CAPITOL CORRIDOR

INTENTIONALLY LEFT BLANK

ISSUE AND REVISION RECORD

REVISION	DATE	PREPARER(S)	PMC REVIEWER(S) / BART/CCJPA REVIEWER(S)	APPROVER / BART/CCJPA APPROVER	DESCRIPTION/ NOTES
0	11/23/2021	Steve Lavelle, Intueor	Steve Lavelle, Intueor	Steve Lavelle, Intueor	Working DRAFT submittal
		---			*No review requirement*
1.A	09/23/2022	Liliana Pereira, Smith Myung, Steer	Sudhish Verma, HNTB	Peter Gertler, HNTB	WPA.01-01 Working DRAFT submittal
	10/29/2022	---	Sadie Graham, Andrew Tang, BART	Sadie Graham, BART	WPA.01-01 Working DRAFT submittal review
1.B	12/16/2022	Liliana Pereira, Smith Myung, Steer	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/
2-PRGM-PH1-SPP_CH14_Travel_Demand_and_Land_Use-DRAFT_FINAL

INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

14. Travel Demand and Land Use 14-1
14.1. Purpose 14-1
14.2. Strategy 14-1
14.2.1. Phase 0: Program Definition and Phase 1: Project Identification 14-2
14.2.2. Phase 2: Project Selection 14-6
14.2.3. Phase 3: Project Delivery 14-7
14.3. Implementation 14-7
14.3.1. Technical Panels 14-7
14.3.2. Phase 1 Deliverables 14-8
14.3.3. Stage Gate 2 Support 14-9

TABLES

Table 14-1. Regional Dynamic Model Key Features 14-2
Table 14-2 Critical Features of the Refined Modeling Tool 14-4
Table 14-3. Link21 Refined TDLU Tool Key Features 14-5

INTENTIONALLY LEFT BLANK

ACRONYMS AND ABBREVIATIONS

ACRONYM/ABBREVIATION	DEFINITION
BART	San Francisco Bay Area Rapid Transit District
CCJPA	Capitol Corridor Joint Powers Authority
ABM	activity-based model
HOV	high-occupancy vehicle
ITS	Institute of Transportation Studies
MPO	metropolitan planning organization
MTC	Metropolitan Transportation Commission
PMC	Program Management Consultants
PMT	Program Management Team
RDM	Regional Dynamic Model
STOPS	Simplified Trips-on-Project Software
TM	travel model
UC	University of California
VMT	vehicle miles traveled

LINK21 PROGRAM TEAM NAMES

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

INTENTIONALLY LEFT BLANK

14. TRAVEL DEMAND AND LAND USE

14.1. Purpose

The Travel Demand and Land Use (TDLU) Team leads the management, development, and application of the modeling tools to support the evaluation and definition of project concepts for the Link21 Program (Link21).

The TDLU Team consists of staff involved in the development and application of the initial modeling tool; coordination with other Link21 delivery teams and leadership; and the development and application of a refined modeling tool that will ultimately be used to provide detailed ridership forecasts.

This chapter includes an overview of the Link21 TDLU strategy. It also details key deliverables for the TDLU Team and highlights the coordination between the TDLU and other Link21 delivery teams.

The purpose of Link21's TDLU strategy is to:

1. Develop and apply an initial modeling tool for screening concepts in the early rounds of Phase 1.
2. Develop a refined modeling tool that will be used to develop detailed ridership forecasts in the last round of Phase 1 and subsequent phases.
3. Provide and integrate the TDLU perspective required for the Business Case, Planning and Engineering (P&E), Engagement and Outreach, and Equity teams.

14.2. Strategy

Link21 is a highly complex and long-term effort that will require TDLU support for travel demand and land use forecasting through at least Phase 2 of program development. The strategy for TDLU reflects the requirements of Link21 during various phases of the program. The overall Link21 TDLU strategy is structured around the four delivery phases as follows:

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

14.2.1. Phase 0: Program Definition and Phase 1: Project Identification

The TDLU strategy acknowledges that travel models are highly complex tools that require a long lead time for development. Therefore, the TDLU Team has designed different tools to inform the development of each phase according to each one's specific needs and the decisions that need to be made. Thus, direct oversight and management is critical to ensure that model development and application adheres to Link21's overall schedule and continuously meets the needs of the changing program. The goal of the TDLU strategy is to provide reliable data from the modeling tools to other delivery teams. These data will be used as evidence to inform decisions for investment in Link21.

INITIAL MODELING TOOL: REGIONAL DYNAMIC MODEL

The TDLU Team has developed an initial modeling tool. It is based on Steer's Regional Dynamic Model (RDM), which is a transportation and land use model that simulates how an urban area evolves over time with an emphasis on how transportation, land use, population, and employment interact. The RDM is an aggregate model with the 21-county Northern California Megaregion (Megaregion) represented by 300+ zones. It is being used in preliminary screening and to inform project concept development in Phase 1. **Table 14-1** provides a summary of the initial TDLU modeling tool's key features.

Table 14-1. Regional Dynamic Model Key Features

MODEL FEATURES	DESCRIPTION
Geographic Coverage	21-county Megaregion
Zones	306 internal zones covering the 21-county Megaregion and 7 external zones covering the rest of California
Networks	Strategic highway network and rail network
Model Years	2015 Base Year and 2050 Forecast Year
Time Periods	AM Peak Period (6 – 10 am)
Trip Purposes	Home-based Work (HBW), Home-based Other (HBO)
Mode Choice	Auto, Rail (heavy rail and commuter rail), Other transit (bus, light rail transit [LRT], and ferry), and Non-motorized (walking and bicycling)
Input Data Sources	Metropolitan planning organization (MPO) data, American Community Survey, public transportation schedules, sources provided by the San Francisco Bay Area Rapid Transit District (BART) and other transit operators, and publicly available or acquired data.

MODEL FEATURES	DESCRIPTION
Model Output	Incremental performance of concepts against the 2050 baseline (*Plan Bay Area 2050* and other MPO adopted plans without a project under Link21) and between concepts of: ridership, travel times, and other accessibility metrics that are used for the business case evaluation.

TDLU Support

For Link21, the initial modeling tool is used to inform the performance of concepts in two discrete stages based on an evaluation conducted by the Business Case Team. The two stages are the Exploratory Phase and Round 1, in which the concepts will be compared against the 2050 baseline and against each other. A short list will progress to Round 2 where the refined modeling tool will be used.

The TDLU Team coordinates with the P&E Team to ensure the Phase 1 concepts are specified correctly for input into the initial model. This step normally involves iterative feedback between the P&E and TDLU Teams as it reviews the assumptions used in the concepts. The TDLU Team produces results to inform the P&E Team's design of project concepts. This is an important data exchange where the TDLU Team communicates the features and the limitations based on the aggregate characteristics of the initial modeling tool.

The TDLU Team also works closely with the Business Case Team in defining the performance metrics and in processing the raw model output. This step provides another level of quality assurance/quality control (QA/QC), and it informs the evaluation and insights related to each project concept.

REFINED MODELING TOOL: LINK21 REFINED TDLU MODEL

During Phase 0, the PMC TDLU Team reached out to researchers to solicit their expertise on the features that should be included in the refined modeling tool that is expected to provide detailed ridership forecasts for Link21. Researchers at the Institute of Transportation Studies (ITS) University of California (UC), Davis identified *critical, important,* and *optional* features for the refined modeling tool.[1] **Table 14-2** includes a summary of the "critical" features, which are defined as features that a model needs to include.

[1] Circella, G., Sun, R., Le, T.V, Soza-Parra, J., Qian, X., Bunch, D., & Jaller, M. (2022). Travel Demand Modeling Methodology Recommendations for the Link21 Program. *UC Davis: 3 Revolutions Future Mobility Program*. Retrieved from https://escholarship.org/uc/item/43t98653.

Table 14-2 Critical Features of the Refined Modeling Tool

PROPOSED CRITERIA	COMMENTS
Timeline	▫ Core model should be developed in 18 months.
Geographical Considerations	▫ Model should be able to evaluate long- and medium-scale trips. ▫ Model zone system should have a level of detail appropriate to model local characteristics of the urban areas and access/egress from public transportation stations. ▫ Model should represent the Megaregion.
Rail Service Modeling	▫ Need for explicit representation of transit rail network and services provided.
Service Integration Modeling	▫ Ability to model both longer-distance and regional trips, including intermodal trips connecting from one service to another.
Travel Time	▫ Travel time should be included in the utility functions for various steps of demand modeling. ▫ Model needs enough spatial detail to capture travel time between major centers and transportation hubs.
Travel Cost	▫ Ability to model the impacts of travel cost for transit and auto.
Service Frequency	▫ Account for frequency of service.
Crowding	▫ Account for crowding and capacity constraints.
Future Land Use	▫ Model should have the ability to consider different land use scenarios.
Transit Ridership	▫ Ability to model ridership and evaluate trips between major centers.
Mode Choice Modeling	▫ Ability to model mode choice/mode share, including competitiveness between auto and rail.
Vehicle Miles Traveled (VMT) Estimation	▫ Ability to estimate VMT impacts (by mode and time of day).
Impact of New Communication Technologies	▫ Ability to model the impacts of telecommuting.

Based on the researchers' recommendations, the TDLU Team is developing the Link21 refined travel demand model using the Metropolitan Transportation Commission's (MTC) travel model (TM) 1.5 activity-based model (ABM) as its basis. ABMs are the state-of-practice in travel demand models for larger MPOs. Instead of aggregate estimates of zonal population, ABMs use a synthetic population where each person is synthesized, and their activity patterns are simulated during an average weekday. Compared to trip-based travel models, ABMs are more realistic in their representation of trip-making with mandatory and discretionary travel, long-term choice models

(e.g., work and school location choice), tour-level models (coordinated daily activity patterns), and trip level models.

The Link21 refined TDLU model system also includes a land use model. A regional economic model, called REMI, is used to forecast jobs and population at the county level. A land use allocation model is implemented in MapCraft and is similar to Bay Area UrbanSim (BAUS), which allocates county-level population and employment estimates to the zones based on a simulated market interaction. The land use model will be used to evaluate the effects of Link21 concepts on land use relative to MTC's adopted plan (*Plan Bay Area 2050*).

The Link21 refined TDLU model will address most of the "critical" features identified by the researchers at ITS-UC Davis. One critical feature that was modified is geographic coverage. The Link21 refined travel demand model covers the 9-county Bay Area (MTC) Region rather than the entire Megaregion. This change was made because Link21 no longer needed to evaluate wider 21-county program concepts and needed to only evaluate project concepts focused on the new transbay passenger rail crossing and its associated improvements. Megaregional benefits or impacts associated with the project concepts will be assessed using a combination of the initial and refined TDLU models. **Table 14-3** provides key features for the Link21 refined modeling tool. Since the refined TDLU tool is still under development, some values are subject to change.

Table 14-3. Link21 Refined TDLU Tool Key Features

MODEL FEATURES	DESCRIPTIONS
Geographic Coverage	9-county Bay Area (MTC) Region
Zones	3,330 internal zones covering the Bay Area and 21 external zones covering the rest of California
Networks	Highway network, rail network, and non-motorized network
Model Years	2015 Base Year; 2040 and 2050 Forecast Years
Time Periods	Five total: early AM, AM peak, midday, PM peak, evening
Activity Purposes	Work, university, high school, grade school, escorting, other maintenance, social/recreation, eat out, other discretionary
Tour and Trip Mode Choice	Auto, high occupancy vehicle (HOV) 2, HOV3+, transit-walk, transit-drive, transit kiss-n-ride, non-motorized
Input Data Sources[2]	MPO data, American Community Survey, public transportation schedules, transit on-board surveys, traffic counts, transit ridership data, park-n-ride utilization, household travel diaries/surveys, parcel level land use data

[2] Please see TDLU's *Data Collection Plan* for a comprehensive list of data sources.

MODEL FEATURES	DESCRIPTIONS
Travel Demand Model Output[3]	Simulated population, ABM outputs, trip file, travel model, purpose of travel, highway volumes and speeds, transit ridership, VMT and vehicle hours traveled (VHT), measures of congestion, etc.
Land Use Model Output[4]	Change in location, scale, mix and value of development and land uses; change in location, scale, mix, and value of displaced land uses; change in location of job spaces; change in housing units; change in location and types of inclusionary affordable units

TDLU Support

TDLU tasks during Phase 1 will involve the development and application of the refined TDLU model system. The TDLU Team will also coordinate with the P&E Team for the inputs needed for the refined TDLU model system. For the travel demand model, detailed service concepts will be provided with data on station locations, service frequencies by time-of-day, and rail travel times. The TDLU Team may also be involved in helping to develop a narrative that explains the model results for each alternative that is evaluated.

For the land use model, the TDLU Team will liaise with the Land Use Strategy Team to help identify impacted areas from Link21 concepts and develop transit-oriented development (TOD) policy attributes, such as inclusionary housing requirements, on-site parking requirements, density, and height bonuses that will be used in future year scenario development.

The TDLU Team informs several metrics designed by the Business Case Team. Both teams coordinate to produce the metrics, check for reasonableness, and interpret model results.

14.2.2. Phase 2: Project Selection

TDLU support during Phase 2 may include providing enhancements to the refined TDLU model system. This may be related to improving performance of some aspect of the model system or incorporating features that are necessary to support the more detailed evaluations in Phase 2. The TDLU Team may also consider the development of a Simplified Trips-on-Project Software (STOPS) model to evaluate a preferred project. STOPS is the Federal Transit Administration's (FTA) travel demand modeling software that is recommended for sponsors of the Capital Investment Grants (CIG) Program.

The TDLU Team will work with the P&E, Environmental, and Business Case teams to evaluate the selected alternatives in Phase 2. The development of ridership forecasts

[3] Please see TDLU's *Model Methodology Report* for a complete list of output from the travel demand models.
[4] Please see TDLU's *Model Methodology Report* for a comprehensive list of output from the land use models.

under the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) will require a comprehensive analysis of project-related impacts.

14.2.3. Phase 3: Project Delivery

The TDLU Team will coordinate with the other service categories (Engagement and Outreach, Environmental, and P&E), and they will liaise with the TDLU Consultant if additional analyses using the refined modeling tools are needed.

14.3. Implementation

During Phase 1, the TDLU Team finalized calibration and validation for the initial modeling tool for the base year 2015. The model calibration parameters were applied to the horizon year model of 2050. The 2050 RDM was tested to confirm that future year model results were reasonable and ready for evaluating Link21 concepts. The TDLU Team provided support and information for the development of concepts for Round 1 during the exploratory phase as part of the evaluation methodology that was established by the Business Case Team.

For the refined modeling tool, the TDLU Team involved in model development will review the interim model calibration/validation results, review deliverables, and track work tasks against a master schedule. They will also be coordinating with the other service categories. Similar to the data required for the inputs for the initial modeling tool, the TDLU Team will rely on the P&E Team for the detailed definition of service concepts and on the Land Use Strategy Team for land-use-related inputs needed for the land use model. In evaluating concepts, the TDLU Team will use a baseline scenario that includes future rail service assumed in the MPO's adopted regional transportation plans (RTP), which would exclude any projects under Link21. In the base evaluation, project performance will be evaluated by comparing with the baseline. A different reference scenario, referred to as the megaregion program, will also be developed. That scenario assumes future megaregional rail service assumptions going beyond adopted MPO plans, based on the *State Rail Plan* and existing aspirational plans (e.g., *Capitol Corridor Vision Plan*, *Caltrain Long-Range Service Vision*, *ConnectSF*, etc.). Some modifications will need to be made as the refined modeling tool only includes MTC's 9-county region. For the sensitivity test evaluation, project performance will be evaluated by comparing it with the megaregion program scenario.

One important aspect of implementation for TDLU is the use of quarterly technical panel meetings to critically review model development. The technical panel's involvement helps create more robust modeling tools, and, ultimately, more confidence in the ridership forecasts that will be used by all the Link21 service categories.

14.3.1. Technical Panels

The role of the technical panels is to provide expert recommendations and guidance to TDLU Team in developing and applying the travel demand and land use models for

Link21. The panels are essential to Link21 because they provide credibility to the modeling tools and the forecasts produced by them.

For the initial modeling tool, the TDLU Team has been conducting both internal and external technical panels to review scoping, calibration, and validation of model results for the base year of 2015 and the reasonableness of forecasts for the horizon year 2050. The internal technical panel is made up of Program Management Team (PMT)[5] and agency staff, and it serves as a vehicle to socialize the initial modeling tool with a non-modeling audience. The external technical panel is composed of transportation planners around the Megaregion.

For the refined modeling tool, the PMC manages the internal and external TDLU panels. The main differences between the panels for the initial and refined modeling tools are the composition of the members and the use of a panel liaison on the external panel, which reflects the complexity of the refined modeling tool. The external technical panel also includes federal agency representation, MPO representation from outside of California, and two leading academics in transportation modeling. Their involvement provides a level of scrutiny that will contribute to the Link21 refined modeling tool that uses best practices and that is reliable enough to make detailed forecasts of project-level ridership.

14.3.2. Phase 1 Deliverables

PHASE 1 INITIAL TOOL TDLU REPORT

The TDLU Team will prepare a *Phase 1 Initial Tool TDLU Report*. This report will document model scope, development, calibration, validation, and it will also include the outputs available at the time.

COMPARISON OF POSSIBLE APPROACHES

For the refined modeling tool, the TDLU Team developed the *Comparison of Possible Approaches* report. This document reviews and recommends candidate travel demand and land use models for Link21. The review includes tools that are already in use within the region and tools used in other major urban areas in the United States. The report evaluates each tool's feasibility using criteria from Link21's High-Level Model Objectives and Detailed Model Performance Objectives that includes recommendations for the Link21 travel demand and land use models. The report served as the TDLU Consultant's justification for selecting MTC TM1.5 as the basis for the Link21 refined travel demand model.

[5] BART/Capitol Corridor Joint Powers Authority (CCJPA) and PMC

EQUITY MODELING MEMO

The TDLU Team prepared an *Equity Modeling Memo* that provides a comprehensive review of how equity concerns have been addressed in other large-scale travel demand and land use models. The report considers data-driven analyses and presents a proposal for how to approach incorporating equity concerns into the refined TDLU model system for Link21. Although the TDLU Consultant has yet to finalize all the details of how equity will be incorporated in the refined modeling tool, it provides an outline of their approach.

DATA COLLECTION PLAN

The TDLU Team's *Data Collection Plan* documents the plan for collecting data needed to support base year model development, calibration, validation, and testing as well as forecast year data to support model application. This includes a combination of information from previous phases of Link21, information from external data sources, and new primary and/or passive data collection. The data will be regularly updated and maintained, as needed, to ensure up-to-date information through the development of a data management system.

MODEL METHODOLOGY REPORT

The TDLU Team's *Model Methodology Report* presents the methodology underlying the refined travel demand and land use model system. The detailed report covers the model structure, rationale for addressing the model objectives, and inputs and outputs.

14.3.3. Stage Gate 2 Support

Stage Gate 2 will be the decision point that concludes Phase 1. As part of Stage Gate 2's documentation, the program will demonstrate it has conducted a robust development and evaluation process to recommend project(s) to advance. Although it is currently assumed that the TDLU Team will not provide direct documentation for Stage Gate 2, their modeling of concepts will be a key input to the evaluation and to the Preliminary Business Case, which will feature prominently in Stage Gate 2 documentation.