SANDAG

Purple Line Conceptual Planning Study

EXECUTIVE SUMMARY

DECEMBER 2024

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Contents

Executive Summary

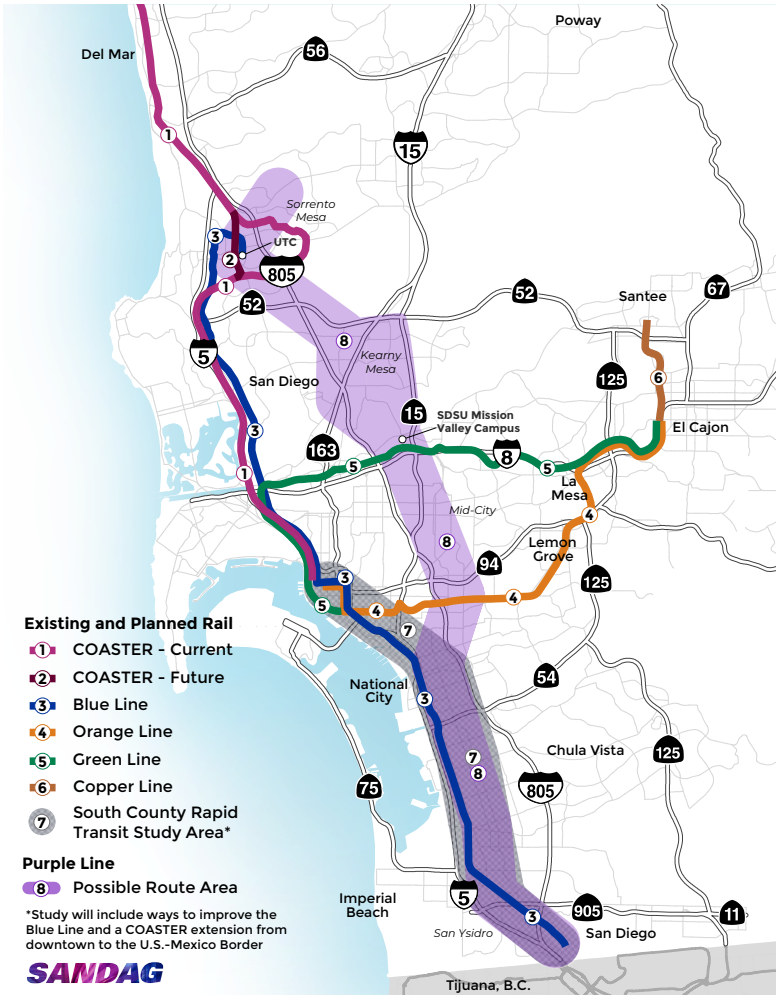
Project Introduction

The Purple Line is envisioned as a high-capacity transit line from San Ysidro to Sorrento Mesa via Chula Vista, National City, City Heights, Mission Valley, Kearny Mesa, and University City. The idea for the Purple Line comes from many years of community advocacy and planning, which are documented in the San Diego Association of Governments' (SANDAG) *2021 Regional Plan* and *South Bay to Sorrento Comprehensive Multimodal Corridor Plan*.

By connecting several densely populated communities as well as multiple major employment centers, the Purple Line would provide high-capacity, reliable, and equitable transit service to residents, employees, and visitors throughout San Diego and South Bay. The Purple Line would directly serve several social equity focus populations, connecting residents to jobs, education, healthcare, and other community resources. It would also connect to the three principal Trolley lines, COASTER commuter rail, and dozens of *Rapid* and local bus routes.

This *Purple Line Conceptual Planning Study* evaluates the potential of constructing and operating high-capacity rail service in the northern portion of the corridor between the City of National City and Sorrento Mesa in the City of San Diego. While there are many modes that could provide high-capacity transit service, this study is the first dedicated solely to evaluating this regionally significant project as a heavy rail transit line.[1] The Purple Line corridor is presented in Figure 1, reflecting both the northern segment that is the focus of this study and the southern segment that will be evaluated as part of a separate study.

Figure 1. Project Study Area



Projects of similar scope and scale as the Purple Line require the dedicated efforts of many people and agencies to come to fruition. This report provides an overview of the process and anticipated timeline the Purple Line will need to advance through before it can open for revenue service.

Summary of Stakeholder Coordination and Outreach

The Purple Line has gained community support along its corridor since its introduction in SANDAG's *2021 Regional Plan* and evaluation during the *South Bay to Sorrento Comprehensive Multimodal Corridor Plan*. This *Purple Line Conceptual Planning Study* marks the first step towards making it a major transit project.

Public participation and stakeholder engagement are crucial for future phases. Stakeholder engagement during this phase of the Purple Line included coordinating with community-based organizations along the corridor and establishing a Project Development Team.

1 The Federal Transit Administration defines heavy rail as an electric railway with the capacity for a heavy volume of traffic. It is characterized by high-speed and rapid acceleration passenger rail cars operating as single- or multi-car trains on fixed rails separated from other vehicular and pedestrian traffic with sophisticated signaling and high-platform loading. Typical metros, such as the LA Metro, and subway systems are examples of this.

Four community-based organizations along the Purple Line corridor — Environmental Health Coalition, City Heights Community Development Corporation, Urban Collaborative Project, and SBCS — supported public engagement through the following activities:

- Provided feedback on project messaging and materials.
- Hosted two pop-up events each targeting the communities they serve.
- Promoted engagement opportunities to their members, ally organizations, and other contacts via email, social media, and word of mouth.
- Reported on participation and promotional reach for engagement opportunities.

The Project Development Team included staff from relevant municipalities, transit and transportation agencies, and other partners. Project Development Team meetings were convened at targeted periods during this study to communicate study progress and solicit input on findings. Outcomes helped inform alignment development and potential station and operations and maintenance facility locations, and the team helped identify additional multimodal connections or land use development opportunities.

Public Meeting and Survey Findings

The public meeting input and survey responses revealed the following:

- Over 60 percent of respondents live in the corridor. Approximately 35 to 55 percent of respondents work, shop, or recreate in the corridor.
- The most visited areas include UTC, Kearny Mesa, National City, Chula Vista, and SDSU Mission Valley.
- Most people either drive or take transit to places within the study area. Others either walk, bike, or use rideshare services (e.g., Uber, Lyft).
- Over 90 percent of respondents use public transit at least a few times a year. Over 25 percent use transit daily or almost daily.

Purple Line Concepts

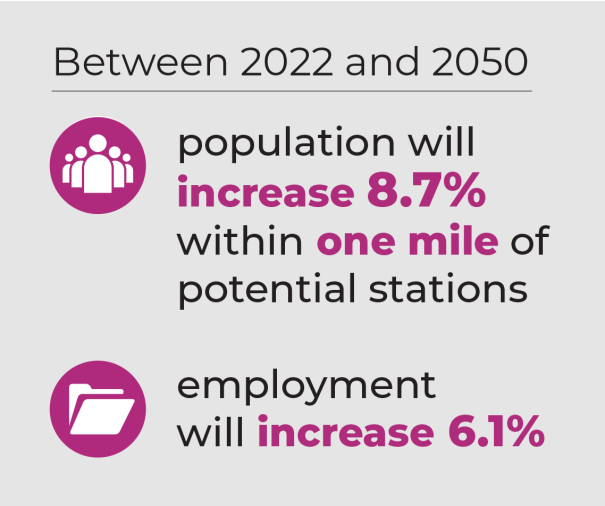
Stations

Station identification is an essential early step in the planning process and when establishing planning and design parameters. Preliminary station locations were identified as part of the *2021 Regional Plan and South Bay to Sorrento Comprehensive Multimodal Corridor Plan* planning processes. These were informed by residential and employment activity, planned land use, and public and stakeholder input. Projected growth within one mile of potential stations is presented in Figure 2.

This *Purple Line Conceptual Planning Study* refined these locations through coordination among the Project Development Team. Stations were chosen based on their proximity to residential and commercial development, transit connections, ridership potential, and ability to advance regional sustainability and equity goals. Station locations helped inform the development of planning and design parameters.

Some stations were removed or added, including the removal of Birdland Station and the addition of alternate station locations in Kearny Mesa, Sorrento Mesa, and SDSU Mission Valley. Further planning to finalize station locations will occur in the next phase of the planning process.

Figure 2. Projected Growth by 2050



The stations evaluated in this study include the following:

- National City Station Option A (8th Street Trolley Station)
- National City Station Option B (Highland Avenue/Plaza Boulevard)
- Euclid Avenue Trolley Station
- City Heights Station Option A (University Avenue)
- City Heights Station Option B (El Cajon Boulevard)
- SDSU Mission Valley Station Option A (Stadium Station)
- SDSU Mission Valley Station Option B (near I-15)
- Kearny Mesa Station Option A (Ruffin Road/Clairemont Mesa Boulevard)
- Kearny Mesa Station Option B (Convoy Street/Clairemont Mesa Boulevard)
- UTC Transit Center Station
- Sorrento Mesa Station Option A (Barnes Canyon Road)
- Sorrento Mesa Station Option B (Mira Mesa Boulevard)

Figure 3 demonstrates these potential station locations and alignment concepts.

Figure 3. Potential Purple Line Stations and Alignment Configurations

Alignments

Alignment concepts were developed to connect preliminarily identified stations using the planning and design parameters described in the Planning and Design Parameters section. The concepts were evaluated to determine how well each one would help achieve the goal of fast service from National City to Sorrento Mesa. Such a goal would require (1) concepts that follow the most direct line between stations as possible and (2) significant portions of the route to be underground.

One full alignment from the City of National City to Sorrento Mesa in the City of San Diego was developed. A series of alignment segments were also developed along the corridor that could be combined with the full alignment and/or other segments to create an alternative alignment. The effectiveness of each alternative would need to be evaluated in future studies.

Operations and Maintenance Facilities

An operations and maintenance facility is needed to store and conduct various types of maintenance on train sets. Potential operations and maintenance facility sites were selected based on one or more of the following: (1) zoning of the site, (2) ownership of the site, (3) proximity to the corridor, (4) topography of the site, and (5) size and shape of the site.

Alignment Concept and Station Analysis

Alignment concepts and station and support facility locations were used to (1) identify minimum operable segments, (2) develop preliminary ridership projections, (3) estimate capital costs, and (4) evaluate development potential and multimodal connections within proximity of identified station locations. It is important to note that alignment concepts and potential station and support facility locations are subject to change as the Purple Line advances through project development, a process that will include stakeholder and public input.

Minimum Operable Segments

Projects of the scope and scale of the Purple Line are not typically built as one large single undertaking. Instead, sponsor agencies generally start by developing a section of the corridor, known as the minimum operable segment. It is important that the minimum operable segment have independent utility to be competitive for funding and provide benefit as a standalone project should future phases be delayed.

Different minimum operable segments were identified and evaluated to determine whether they could provide viable service along a portion of the Purple Line. Based on existing and projected population and employment density, the location of employment centers, and traffic patterns, three minimum operable segments were identified:

- **Minimum Operable Segment 1: National City to SDSU Mission Valley Campus (9.1 miles)**
  Ridership modeling showed relatively strong demand among the stations between National City and SDSU Mission Valley. As such, this minimum operable segment was identified. It tests the effect of not providing direct service to key employment centers in Kearny Mesa, UTC, and Sorrento Mesa.
- **Minimum Operable Segment 2: National City to UTC Transit Center Station (19.3 miles)**
  This minimum operable segment assesses the effect of not providing direct service to Sorrento Mesa.
- **Minimum Operable Segment 3: Euclid Avenue to UTC Transit Center Station (15.6 miles)**
  This minimum operable segment assesses the effect of not providing direct service to National City, the Blue Line Trolley in the South Bay, or Sorrento Mesa. This minimum operable segment would allow the most flexibility for future planning efforts that would evaluate how the Los Angeles-San Diego-San Luis Obispo corridor could be extended to San Ysidro, and how that service could complement and connect to Blue Line and/or Purple Line service between National City and the Mexican border.

Projected ridership on each minimum operable segment is summarized in Table 1. During subsequent phases of Purple Line development, these minimum operable segment options may be further refined to reflect the findings from the alternatives analysis and associated environmental studies. At the completion of project development, a preferred minimum operable segment will be chosen to enter final design.

Planning and Design Parameters

A key goal of this *Purple Line Conceptual Planning Study* is to determine the feasibility of constructing and operating the Purple Line using technology that allows for faster service than the current light rail system in San Diego County. As such, the following planning and design parameters were identified to guide the development of Purple Line route alignment concepts, potential ridership, capital costs, and system requirements. These parameters could be refined in future phases of study.

Planning Parameters

Design Speed
A target maximum design speed of 85 miles per hour (mph) with an 80-mph maximum operating speed was assumed. A design speed of 85 mph was selected based on identified average station spacing, curvatures along the alignment, and diminishing returns that a faster technology would offer because the vehicles would not be able to reach these speeds for numerous segments of the alignment.

Vehicle Technology
The higher-speed requirement would most likely be met by using a heavy rail transit or metro system powered by a third rail. An example of heavy rail is LA Metro, as presented in Figure 4.

Figure 4. LA Metro Heavy Rail

Source: KTLA, 2024

Alignment Plan and Profile Development
All guideway alignment and station profiles assumed full grade separation with no at-grade vehicle or pedestrian crossings. Building on the identified station locations, horizontal and vertical alignments were developed with adequate sections of straight track near stations.

Headways
This *Purple Line Conceptual Planning Study* assumes the Purple Line would be designed for 10-minute headways, as noted in the *2021 Regional Plan*. However, further development of the Purple Line may determine different headways — the time interval between train arrivals — are appropriate. Headways will influence the number of vehicles, land area required for an operations and maintenance facility, and ridership.

Design Parameters

Underground Guideways and Tunneling
For this study, twin-bore tunnels are assumed with a nominal 20-foot outer diameter. This would be sufficient to fit an emergency walkway, third rail, and the dynamic envelope of the vehicle. Track centers would be about 45 feet apart, allowing for a 30-foot-wide center platform at aerial and underground stations.

Aerial Guideways
Aerial guideways would be 35 feet wide to support the tracks, third rails, emergency walkways, and a signal and communication system. Tracks would mostly have a 15-foot-wide separation, with a 45 foot-wide separation at stations to accommodate a 30-foot-wide platform.

Station Requirements
Platforms for aerial stations are assumed to be 450 feet long, and a mezzanine level would be needed for stations in the median of major streets. Underground station boxes are assumed to be 1,000 feet long by 60 feet wide to accommodate 450-foot-long stations, constructed by cut and cover at a depth of between 35 feet and 110 feet. Station entrances would be constructed at grade with escalators, elevators, and stairs providing access to the station concourse and platform.

Each station is assumed to include double crossovers — track sections that allow trains to cross from one track to another. Terminal stations are assumed to have two double crossovers.

Storage Tracks
Storage tracks are assumed to be provided beyond the terminal station double crossovers. They are designed to be 500 feet long.

Traction Power
A third rail power transmission system would likely be used for this transit line. It is assumed that each station would have a substation and others would be sited between stations at a spacing of approximately 5,000 feet. Substations would also be required at the operations and maintenance facility and potentially along the lead track connecting to it.

Engineering Summary

This study confirms the engineering feasibility of underground and aerial guideway and station concepts based on known information. Some concepts may be determined to have a fatal flaw in subsequent phases of study. Coordination and outreach with the public, community groups, stakeholders, and agency partners during the next phase of project development will help determine how the identified concepts can effectively serve regional goals and community needs.

Ridership Summary

To model potential ridership, alignment concepts were grouped into a series of scenarios that were coded into the Federal Transit Administration's Simplified Trips-on-Project Software model. Existing transit ridership and regional growth forecasts developed for San Diego County are just a few of the model inputs. These scenarios tested how well the Purple Line would perform under the full alignment concept, with the addition or omission of select stations, or with a change in operating speed. Based on the estimates developed for this study, between 23,200 and 25,800 passengers could be expected to use the full Purple Line alignment between National City and Sorrento Mesa each day in 2050. Table 1 demonstrates ridership estimates for 2029 for the full alignment and the three minimum operable segments.

Table 1. 2029 Ridership Estimates for the Full Alignment and Minimum Operable Segments

Purple Line Ridership by Scenario (2029)				
Total Scenario Ridership	**Full Alignment**	**Minimum Operable Segment 1: National City to SDSU Mission Valley Campus**	**Minimum Operable Segment 2: National City to UTC Transit Center Station**	**Minimum Operable Segment 3: Euclid Avenue Trolley Station to UTC Transit Center Station**
Total Ridership	**25,700 - 29,100**	**15,800 - 18,600**	**26,100 - 28,800**	**14,500 - 16,800**

While land use plans allow for notable population and employment growth near potential Purple Line stations, the latest regional growth forecast developed for San Diego County projects minimal growth both regionwide and within proximity to these potential station areas as presented in Figure 2. This, coupled with other significant transit investment planned for the Purple Line corridor, may collectively limit the Purple Line ridership projected in this study. These phenomena are likely why Purple Line ridership for the full alignment is forecasted to be higher in 2029 than in 2050. Further analysis is required to determine how these elements may influence the overall effectiveness and utilization of the Purple Line.

It is important to note that there are significant transit investments planned between National City and San Ysidro, including an extension of the Purple Line to San Ysidro via Chula Vista. A more comprehensive understanding of potential Purple Line ridership south of National City is critical to understanding overall Purple Line feasibility and performance.

Cost Estimate Summary

Cost estimates were prepared for two concepts that would serve all stations (except only one station each in Sorrento Mesa and City Heights): one that would be primarily in a tunnel and another that would include aerial guideways where feasible. The total cost of the project would range from about $20,700 million (aerial guideways where feasible) to $27,170 million (primarily in a tunnel). A summary of capital costs is provided in Table 2. Costs (both capital and operations and maintenance) should be developed and compared for the Purple Line as a variety of transit modes (e.g., light rail) as part of an Alternatives Analysis.

Table 2. Capital Cost Estimates for Lower and Higher Cost Alignment Concepts

Item	Projected Capital Cost (millions)*	
	Lower Cost (Aerial + Tunnel)	**Higher Cost (Tunnel)**
Revenue Service Guideway and Stations	$18,720	$23,410
Operations/Maintenance Facility and Lead Track	$1,350	$3,130
Vehicles	$630	$630
Total	**$20,700**	**$27,170**

* Costs are in 2024 dollars and do not include the cost of real estate, finance charges for the project, or escalation to year-of-expenditure costs. These additional costs will be developed in future phases of project development when a detailed project schedule, financing plan, and right-of-way limits have been identified.

Conclusion

The study has determined that a high-speed, high-capacity transit service is possible in the Purple Line corridor. As the Purple Line advances, further work needs to be done to balance cost, performance, and other priorities to determine the appropriate service type and other characteristics (e.g., aerial or below grade, station locations, etc.). When determining which alignment concepts are advanced for further analysis, tradeoffs and key takeaways should be considered for both the aerial and tunnel concepts identified to date. Many decisions related to mode, potential alignments, termini, station locations, and vertical configurations will need to be resolved pending additional engineering analysis, environmental considerations, and community and stakeholder input.

Project Implementation Process

This *Purple Line Conceptual Planning Study* is the initial step of a complex process by which major transit capital investments are conceived, vetted through studies of alternatives, environmentally cleared, designed, financed, constructed, and eventually opened for revenue service.

After conceptual planning, the next step of Project Planning, usually referred to as an Alternatives Analysis, is where the Purpose of and Need for a project and the general study corridor limits are identified. Through multiple rounds of development and screening, alternatives are evaluated at progressively greater levels of detail leading to the selection of a Locally Preferred Alternative. Following the conclusion of initial planning and the Alternatives Analysis, the project advances through environmental review and approval.

Once the Locally Preferred Alternative is cleared through the federal and state environmental processes and preliminary engineering is complete, the projects would enter the engineering and design phase. This phase includes decisions about project phasing and delivery methods, the development of baseline budgets, and the completion of final design.

The final stage is the actual construction of the project and all testing required to open for revenue service.

Major multibillion dollar rail transit projects are high-risk, complex undertakings involving numerous parties and varied interests. The entire process typically takes roughly 15 to 20 years for projects that are 8-15 miles long. An example timeline is presented in Figure 5. Minimum operable segments identified at this time and which will require further analysis range from 9.1 miles to 19.3 miles. The full alignments for which capital costs were developed are both more than 22 miles.

Figure 5. Example Implementation Timeline