Alameda Underpass
Conceptual Design Study
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ACKNOWLEDGEMENTS

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Appendices - under separate cover

A: Public Involvement Report
B: Drainage Summary
C: Initial Alternatives - Plans
D: Plate Girder Bridge Calculations and Layout
E: Retaining Wall Approach
F: Existing Retaining Wall Stability Checks
G: Soldier Pile Wall Design
H: Tangent Pile Wall Design
I: Soil Nail Wall Design
J: Refined Alternatives - EOPCC*
Executive Summary

Study Area
The study area focuses on the Alameda Avenue right-of-way between South Cherokee Street and South Santa Fe Drive; it includes the roadway, its parallel mixed use-path, the existing retaining walls and the two freight and light rail overpasses. Adjacent land use includes a mix of residential, commercial and industrial uses, with a significant amount of recent and in-progress redevelopment, including the 75-acre Broadway Park redevelopment.

Project Need and Goals
The Alameda Underpass presents a number of functional and experiential deficiencies along the study corridor. Foremost among these issues is the narrow width of the pedestrian/cyclist pathway and the condition of the existing retaining walls, which exhibit significant water damage and spalling. Local stakeholders express a strong desire for better connectivity to local destinations and regional trail infrastructure, as well as a need for better lighting and better intersection design to reduce modal conflict. Inadequate drainage above and within the corridor combines with roadway slope to create significant icing during winter months.

The goal of this study is to respond to these issues by establishing a comprehensive, multi-modal vision for the Alameda Underpass Area, and to help plan for the future, potentially phased implementation of those improvements.

Public Outreach
The study focused on an informal public involvement process. In place of more traditional open houses, the study set up staffed information booths at varied places and times around the study area, including grocery stores, the LRT station and youth sports tournaments.

Public outreach focused on understanding stakeholder priorities within the horizontally-constrained corridor. The results showed strong support for a path on both sides, and if a path could only be on one side, then on the north. The public favored stronger separation between pedestrians/cyclist and motorists, over stronger separation between pedestrians and cyclists.

Technical Parameters
The corridor’s most critical parameter is the structural interdependence of the existing underpass walls and the two rail bridges. These walls serve as abutments for both the freight and LRT bridges, so that any option that removes one or both walls must also reconstruct both rail bridges.

Neither rail service can be taken out of service for more than 8 – 12 hours, requiring both rail lines to be re-routed to reconstruct the bridges. These re-routes would require property acquisition on both sides of Alameda Avenue.

The study includes evaluation of alternatives which would relocate the underpass walls further from the existing roadway, as well as as potential alignments for a north-south, grade-separated pedestrian and cycle path over Alameda. On both sides of the roadway, existing walls are approximately 20 feet from City right-of-way boundary. Relative to the potential north-south path, the City does not own any property that could be used for this alignment, and coordination with adjacent property owners, including RTD, would be required.

Refined Alternatives
Options for enhanced pedestrian/cyclist facilities fit into three broad categories: cross the tracks at grade, cross above the tracks (an east-west bridge) or cross below the tracks. The first option was discarded due to unlikeliness of approval by the Public Utilities Commission. The second option was discarded due to bridge length and likely cost. Options within the last category looked at keeping both walls and bridges, moving one wall, and moving both walls.
Alternative 1A. Keeping both walls and bridges was considered a ‘base’ option that could provide immediate multi-modal safety enhancements such as refaced walls and enhanced lighting, but would not address the community’s larger concerns regarding connectivity and comfort. This option was estimated to cost approximately $5 million.

Alternative 9. Reconstructing and moving one wall (and bridges) was considered a conservative option that would respect adjacent property owner concerns on the south side of the roadway, provide a slightly widened pedestrian/cycle path on the north side and a minimal width sidewalk on the south side of the roadway. This option was estimated at approximately $52 million, excluding acquisition for railroad relocation.

Alternative 12. Reconstructing and moving both walls (and bridges) was considered a more extensive option that would provide widened pedestrian/cycle paths on both sides of the roadways. This option was estimated at approximately $64 million, excluding right-of-way acquisition for railroad relocation.

Preferred Alternative
Alternative 12, moving both walls and bridges, was judged to offer the best long-term enhancement to multi-modal connectivity and experience. The preferred option includes enhancement and expansion of east-west pedestrian/cyclist infrastructure, intersections improvements related to roadway alignment and pedestrian safety at both the Cherokee and Santa Fe intersections, a north-south pedestrian/cyclist trail and a grade-separated pedestrian/cyclist bridge across Alameda. Depending on funding and maintenance mechanism, the preferred alternative could also integrate a wide variety of horizontal and vertical urban design enhancements.

Next Steps
The City of Denver is in the process of exploring and pursuing funding for design and construction of the recommended improvements. In addition, the City is coordinating with RTD relative to property acquisition or easement for the north-south path. Finally, potential urban design enhancements along the corridor would require an organization willing to take on long-term maintenance of these elements; no such organization, such as a Business Improvement District (BID) currently exists. Inclusion of these types of improvement would require formation of such an organization.
Study Area

The Alameda Corridor

The study area focuses on the Alameda Avenue right-of-way between South Cherokee Street and South Santa Fe Drive; it includes the roadway, its parallel mixed use-path, the existing retaining walls and the two freight and light rail overpasses. These east and west boundaries define the Alameda ‘underpass’; the roadway begins dropping immediately west of Cherokee, and comes back to grade at Santa Fe. Maximum height of the underpass walls is approximately 30 feet.

Land Use

Adjacent land use includes a mix of residential, commercial and industrial uses, with a significant amount of recent and in-progress redevelopment. Toward the Cherokee side of the corridor, a new multi-family apartment complex borders the north side of the corridor, and behind it, the historic single-family Baker residential neighborhood stretches north toward downtown.

Across the roadway, a pharmaceutical company directly borders the southern side of the corridor. Immediately south of this industrial use, Denizen apartment homes represents the first building in the 75-acre Broadway Park redevelopment. This project will increase existing development from 1.25 million square feet to approximately 10 million square feet of mixed-use, Transit-Oriented Development (TOD).

Moving west of the rail tracks, the corridor is bordered to the north by commercial warehouses and light industrial and to the south by undeveloped rail property, vacant land and a restaurant. West of Interstate 25 (I-25), Valverde and Athmar Park are the closest neighborhoods to that end of the study area.

Connectivity

Pedestrians and Cyclists

For non-motorized travel, Alameda intersects the Platte River Trail just east of I-25, providing long-distance connection to downtown Denver and the southern suburbs. On the western edge of the study area, Cherokee functions as the City’s designated bike route both north and south with a bike lane between Alameda and Virginia Avenue.

Transit - Light Rail Transit (LRT)

Alameda Station is approximately 2 blocks (0.2 mile) south of Alameda, and is serviced by LRT routes C, D, E, F and H. These routes split at Broadway Station, one station to the south, with routes C and D continuing south and routes E, F and H following I-25 alignment to the east and south. Broadway Station is a major bus transfer center as well as LRT stop.

Transit - Bus

Three bus routes run along this segment of Alameda - 3, 4, 33 - with closest stops just outside the study area to the east and west; one stop is located between Kalamath and Santa Fe, and another stop between Cherokee and Bannock.

The 3 ‘Alameda Avenue’ is a long-distance east-west route that runs from the Lakewood Federal Center in the west to Aurora Metro Center Station to the east. This route provides direct service to the Alameda LRT station by making a small loop south of Alameda, using Cherokee and Bannock.

Route 4 ‘Morrison Road’ is a shorter east-west route, terminating at the Alameda Station and using the same Cherokee/Bannock loop to return to the west. Route 33 ‘Platte Valley’ provides a rough north-south loop running on both sides of I-25 and between Alameda Station and the Auraria Campus on the edge of downtown.
The Alameda Underpass study area extends from Santa Fe Avenue on the west to Cherokee Street on the East.
Narrow width, poor separation from vehicles and spalling concrete walls on the north side of the Alameda Avenue underpass.

East-west bus service runs along Alameda itself, with the closest north-south buses running on Broadway (southbound) and Lincoln (northbound). Alameda Light Rail Station is approximately 2 blocks (0.2 mile) south of Alameda; pedestrians and cyclists must currently connect with the station on Cherokee.

**Freight**

Denver’s Consolidated Main Line (CML) crosses Alameda on an elevated, two-track rail bridge. Both Burlington Northern Santa Fe (BNSF) and Union Pacific Railroad (UPRR, or UP) railroads use these rails. According to a 2008 environmental study completed for development of Denver’s Union Station, in 2005 29 trains a day used the CML and this number is expected to increase to up to 44 trains a day in 2030.

**Vehicles**

Alameda Avenue is classified as an arterial; it has two lanes in each direction and offers on-off access to Interstate 25 (I-25) immediately east of the study corridor. Adjacent north-south arterials include Broadway (3 blocks to the east) and Federal Boulevard (1.5 miles to the west).

Steep ramping, acute intersection angle and lack of signage at the Alameda Avenue connection to the Platte River Trail.
Project Need

The City of Denver, in collaboration with local stakeholders, identified a number of functional and experiential deficiencies along the study corridor.

Pedestrians & Cycles

- Narrow path width
- Proximity to vehicular traffic
- Inadequate lighting
- Unsafe intersections / Modal conflict / free right turn at Santa Fe
- Connectivity to surrounding land uses and infrastructure

Alameda Avenue offers a single sidewalk on the north side of the roadway; approximately 7.4 feet in width at its widest, this facility falls below the City’s 8-foot minimum width for a shared-use sidewalk as defined in Denver Moves Bikes (2011). The path directly abuts the underpass retaining wall and is separated from traffic by a Type 7 barrier (aka ‘jersey barrier’); while this condition meets City standards, stakeholders report feeling inadequately buffered and protected from adjacent vehicular traffic. Although cyclists are legally allowed to ride within and occupy the full width of a regular traffic lane, the volume and speed of the roadway discourages most cyclists from exercising this option.

Non-motorized users also noted high need for more and/or better functioning lighting; the sidewalk is currently lit by wall-mounted fixtures, in various states of function or repair. The underpass walls exhibit considerable water damage and spalling, posing a safety risk to both sidewalk and roadway users.

At the study area’s western edge, the intersection with Santa Fe is particularly challenging for cyclists and pedestrians: a 95-foot crossing with no median refuge and a vehicular ‘free right’ turn onto northbound Santa Fe Drive represent two of the most difficult conditions. Further west and just outside of the study area – but still critical connections to regional systems - the sidewalk segment between southbound Santa Fe and the I-25 off-ramp is confusing (although potential corrected in concurrent CDOT Planning and Environmental Linkages (PEL) plans). One block further, ramp grade and connection to the South Platte River Trail is poorly signed and non-ADA compliant.
Motorized Vehicles

- Constrained lane widths for buses and commercial vehicles
- Inadequate drainage / Alameda waterfall
- Roadway slope and icing

In addition to the modal conflicts and spalling issues identified in the preceding section, vehicle travel is also compromised by winter icing on the grade immediately west of Cherokee. In period of rain or heavy snowmelt, water ponds in the area south of Alameda between the two rail bridges. This water can overtop the adjacent retaining walls and create the so-called ‘Alameda Waterfall’ into the eastbound travel lane. Finally, bus and commercial drivers note it is not uncommon to scraper mirrors on the southern wall.

Study Goal

The goal of this study is to respond to the issues above by establishing a comprehensive, multi-modal vision for the Alameda Underpass Area, and to help plan for the implementation of those improvements. The project identifies benefits and challenges of various ways the City might address the corridor’s identified needs, and vets those options with very preliminary conceptual (5%) design. The study tests the technical feasibility and potential phasing of a ‘short list’ of three options, and recommends a preferred vision.

Although the City’s 2017 Elevate Denver Bond Program allocated $7 million for the Alameda Avenue Underpass Rehabilitation Project, these funds were specifically excluded as a project constraint. Depending upon availability and timing of additional funding resources, these bond funds may be to build a portion of the recommended vision – a Phase 1 or Early Action suite of improvements – or may be used for transitional improvements to stabilize the corridor and improve safety until funding for the ultimate vision can be secured. In the latter case, it is anticipated that the majority of GO Bond improvements would be removed when the ultimate vision is built.
Process

The study followed a three-step alternative evaluation process that identified eight broad alternatives, narrowed that list to three alternatives, then identified a single preferred vision. Initial alternatives sought to quickly evaluate a diversity of approaches to non-motorized mobility, including overpass, underpass, and at-grade crossing of the existing rail lines.

Concurrent public input established very clear direction and identified a small group of alternatives most closely aligned with stakeholder priorities. All three of these alternatives were costed to provide a rough order-of-magnitude comparison among the three options.

Finally, a preferred alternative was selected and further refined to determine recommended construction methods and phasing.

Public Outreach

The study focused on an informal, low-commitment / high-visibility public involvement process. In place of more traditional open houses, which often pose time or location constraints to attendance, the study went to ‘meet people where they are’ by setting up staffed information booths at varied places and times around the study area, including grocery stores, the LRT station and youth sports tournaments. Locations included:

- Alameda LRT Station (2 events)
- West Bar Val Wood Park (youth football tournament)
- Broadway Park Redevelopment site (vacant storefront)
- Visionworks
- Ace Hardware
- Natural Grocers
- Denver Distillery
- Dailey Park

The study sent a bi-lingual, informational postcard about the project and various ways to get information and provide input to approximately 4500 residential and business addressed through the Baker, Valverde and Athmar park areas. These cards directed stakeholders to the project website for a list of events and project information, and provided a unique #ConnectAlameda hashtag for social media users to share their thoughts.

The team also attended, gave project updates, and took input, at regularly scheduled meetings of the local Registered Neighborhood Organizations (RNO’s) in adjacent Valverde, Baker and Athmar Park neighborhoods.
Policy Review

Relevant Plans and Policies
The Alameda corridor falls within a number of overlapping city plans, including the following:

- Blueprint Denver (2018, draft)
- Denver Moves: Transit (2018, draft)
- Denver Moves: Pedestrians and Trails (2018, draft)
- Denver Moves: Enhanced Bikeways (2016)
- Denver Moves: Bikes (2011)
- Neighborhood Planning Initiative Strategic Plan (2016)
- Transit Oriented Development Strategic Plan (2014)
- Denver Living Streets (2014)
- Alameda Station Area Plan (2009)
- Athmar Park Neighborhood Perimeter Plan (2000)
- Valverde Neighborhood Plan (1991)

From a vision point of view, the documents collectively call for a higher level of pedestrian and cyclist connectivity, identifying the Platte River Trail, the LRT station and mixed uses of the future Broadway Park as key destinations. Grade-separated crossing of Alameda is also discussed in a number of the documents, as are width and aesthetics of the east-west path.

Grade-Separated Crossing
Denver Moves Pedestrians and Trails (2019) specifically identifies a grade-separated crossing of Alameda at the rail lines as a future project; it is ranked as 33rd of 36 projects listed in the prioritized list of Grade Separated Crossings. Similarly, the slightly older Transit Oriented Development Strategic Plan (2014) identifies the re-purposing of the Elati Bridge (the now-demolished Trestle Bridge discussed in the next section) as a likely catalyst for redevelopment of the area. Although the bridge has been removed, the importance of the connection remains and aligns with elements of the current project.

Platte River / West Neighborhood Connection
Multiple plans, including the Alameda Station Area Plan (2009) and the Baker Neighborhood Plan (2003) underline the importance of connecting the east and west sides of I-25, via Alameda. Access to the Platte River Trail is specifically mentioned, as are widened sidewalk, ADA compliance, better lighting and aesthetic improvements of the pedestrian and cyclist facilities.

Drainage Issues
The Transit Oriented Development Strategic Plan classifies the station as a ‘catalyze’ station, which is one with potential but which requires infrastructure improvements to promote development. The document specifically notes that the station is likely to move up into the ‘energize’ (development-ready) category once major stormwater investments are completed. This observation underlines long-standing City awareness of issues with the Alameda ‘waterfall’ (standing water overtopping the south retaining wall during large weather events).
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Prior Studies and Concurrent Projects

**Trestle Bridge Study**

Over the last decade, the community expressed a strong desire for a north-south, grade-separated crossing over Alameda that would connect pedestrians and cyclists from the Baker Neighborhood, to the north, to the Alameda LRT station and adjacent mixed-use development. At the same time, the deteriorated condition of the 1910 trestle bridge over Alameda required that the City either rehabilitate or demolish the structure. This 2015 study evaluated options for demolition or rehabilitation of the bridge, seeking specifically to determine if the bridge could be re-purposed as a pedestrian/cycle connection.

The study considered four primary scenarios, listed here in order of estimated cost: stabilize the bridge but do not provide public access; demolish the bridge, stabilize and re-purpose the bridge as a pedestrian/cycle facility; stabilize and widen the bridge to act as a pedestrian/cycle facility and public space. The City ultimately decided to demolish the bridge, and the structure was removed just as the Alameda Underpass Study was initiated in August 2019.

**I-25 Central Planning and Environmental Linkages (PEL) Study**

The Colorado Department of Transportation (CDOT) is studying the causes of congestion, and potential options to improve travel time and reliability, in the 4.5 mile segment of I-25 between Santa Fe Drive and 20th Street. The study includes assessment of potential environmental impacts of all actions as well as coordination with local, state and federal stakeholders. The Central I-25 PEL will develop a vision for the corridor and identify and prioritize future projects along this segment of the highway.

The outcomes of this study are important to the Alameda corridor because it is anticipated to reconfigure circulation patterns and intersections at the west end of the Alameda Underpass study area, essentially picking up where the Alameda Underpass study leaves off.

**Broadway Park Redevelopment**

The 75-acre redevelopment of the former Denver Design District will feature a linear park, Rail Line Park, stretching from Alameda Station to Broadway Station. The approximate ½-mile park is anticipated to include a mixed-use trail that ensures residents and workers from all areas of the new development will have easy access to light rail. This park is important to the Alameda corridor as it provides further justification for the community’s desired grade-separated crossing of Alameda. The new Broadway Park’s pedestrian/cycle link would combine with a new Alameda pedestrian/cycle bridge and northern trail connecting to the City’s bicycle network to provide long-distance access into downtown Denver.
Resource Conditions Review

The study area needed to reconstruct the Alameda underpass from Santa Fe Drive to Cherokee Street contains no to minimal potential for natural resources based on the highly urbanized and disturbed nature of the site. The site contains historic resources eligible for listing in the National Historic Preservation Act (NHPA) including the West Alameda Underpass, Subway, which is wholly within the proposed project area. As a result, future planning and design should consider the historic significance of the West Alameda Underpass, Subway as well as other sites that transect the study area (Attachment 1). If the proposed project constitutes a Federal action (e.g., Federal funding or Federal permit requirement), the City and County of Denver would need to comply with Section 106 of the National Historic Preservation Act of 1966 and consult with the Colorado State Historic Preservation Office. Given the age of the structures and urban nature of the study area, it is recommended that a Phase I Environmental Site Assessment with limited testing of the bridges for lead and asbestos be performed to determine the potential presence of recognized environmental concerns.

Environmental

The City of Denver is assessing the improvements needed to reconstruct the Alameda underpass from Santa Fe Drive to Cherokee Street. As part of that assessment, a site tour was conducted by Stantec to understand and identify current environmental resource conditions within the vicinity of the proposed West Alameda Ave study area, which is located in an urbanized, previously disturbed area. A desktop analysis was conducted on the US Fish and Wildlife Service (USFWS) Information for Planning and Consulting website to identify special status species and critical habitat within the area.

No critical habitat is within the project area (USFWS 2018a). Least turn (Sterna antillarum), piping plover (Charadrius melodus), whooping crane (Grus americana) may exist within the area; however, the project area is on previously disturbed land and along a busy roadway, so it is unlikely that these species exist or would be impacted (USFWS 2018a).

According to the USFWS (2018b) National Wetland Inventory (NWI) database and site visit, wetland resources or waterbodies do not exist within the study area, although the South Platte River is located less than 0.25 miles west of the project area. Project activities are not expected to impact the South Platte River; as such, the pallid sturgeon (Scaphirhynchus albus), a federally-endangered South Platte River species, likely would not be affected (USFWS 2018a, b). A small waterbody classified as a freshwater pond within the NWI database exists just south of the project area; however, this pond is located on bare, disturbed ground adjacent to a roadway (USFWS 2018b). The project area falls within an area of minimal flood hazard as defined by the Federal Emergency Management Agency (FEMA 2018).
Historic Resources
Records maintained in the Colorado Compass online cultural resources database were reviewed in order to identify historic resources within project area. Ten built environment resources were identified that intersect or are located immediately adjacent to the proposed West Alameda Ave project area (Attachment 1). No pre-contact or historic archaeological resources have been documented within or directly adjacent to the West Alameda Ave project area.

One of the previously recorded resources (5DV.9146 – West Alameda Underpass, Subway) is wholly within the proposed project area; this resource was determined to be eligible for listing on the National Register of Historic Places (NRHP) in 2004 (Attachment 1). Six of the previously recorded resources are railway segments and bridges that cross West Alameda Ave. Three of the railway-related properties were recommended Eligible for NRHP listing in 2000 and three were determined Not Eligible for NRHP listing in 2004. Two of the adjacent resources are large commercial buildings located north and south of West Alameda Ave; both of these have been determined to be Not Eligible for NRHP listing. In addition, one NRHP-listed historic district is located less than 200 feet northeast of the project area.

Hazardous Materials
A desktop survey of US Environmental Protection Agency National Cleanup Databases was conducted on January 9, 2018 for properties abutting the site. The databases include sites where active or historical remediation is being or was conducted in accordance with Superfund, Resource Conservation and Recovery Act of 1976, Corrective Action, Brownfields, Emergency Response, Incidents of National Significance, and Federal Facilities programs. No listings were found to abut the subject property. A survey of asbestos-containing materials and lead-based paint was conducted on the Trestle Bridge on October 3, 2017 (Stantec 2017). The Trestle Bridge was located in the project area but has since been demolished. The survey found no asbestos-containing materials in sampled bridge materials or soils located on top of the bridge deck; the survey did not include areas of the bridge accessed from Alameda Avenue. Three paint samples were collected from the surface of bridge materials and all were found to contain lead at concentrations sufficient to classify the materials as lead-based paint.
Drainage

The intersection of Alameda Avenue and Santa Fe Drive experiences significant flooding during large storm events, and is at risk of even greater flooding when a 100-year storm event occurs in the South Platte River. City studies have noted that additional areas north of Alameda Avenue may also contribute runoff to this flooding. While existing conditions have not flooded adjacent commercial buildings, they do not meet City standards. The only way to permanently mitigate these drainage issues is to redirect drainage from the Alameda corridor northward to a separate new outfall from Kalamath Street to the South Platte River. This solution has been judged technically feasible, but is estimated to cost approximately $5 million.

In addition to these issues within the Alameda right-of-way, ponding on BNSF/UPRR property south of Alameda creates a nuisance cascading of water onto Alameda when the pond gets too full. The City has developed a solution developed that would remedy this situation by constructing a drain south to the Dakota Outfall. This option is also costly, and has not been pursued due to a lack of resolution of contributing parties. Collection of this stormwater would be included in the ultimate Alameda improvement to assure the walls are not impacted.

While a new Kalamath outfall would fully mitigate flooding at the Alameda Avenue Intersection, the cost and complexity of the project may not be necessary to meet City and County of Denver criteria. If a portion of existing flows can be diverted from the Baker area NE at Cherokee down to the Dakota Outfall, the existing system may function sufficiently to mitigate excessive flow depths at the intersection. The Engineers Estimate in this report includes costs for drainage improvements as part of the ultimate Alameda Improvements only. Construction of the $5 million-dollar Kalamath Street Outfall should be a regional sponsored project with multiple funding partners.
Technical Parameters

Existing Constraints

Existing Walls and Bridges, Rail Service
A critical parameter is the structural interdependence of the existing underpass walls and the two rail bridges that pass over them. These walls serve as abutments for both the freight and LRT bridges, so that any option that removes one or both walls must also reconstruct both rail bridges. When/if the bridges are reconstructed, it is desirable to eliminate the intermediate piers in order to improve traffic flows of Alameda Avenue and to improve vertical clearance between the roadway and bridges in accordance with the Guidelines for Railroad Grade Separation Projects (UPRR & BNSF, 2016).

Both of these rail services are regionally important for movement of goods and people, and cannot be taken out of service for more than 8 – 12 hours (actual time dependent on coordination with each service). It is not technically feasible to demolish and reconstruct a bridge in such a short window, and for this reason, both rail lines would have to be re-routed to reconstruct the bridges. The re-route could be temporary or permanent, but in either case would require property acquisition on both sides of Alameda Avenue.

Shallow Utilities and Bridge Clearance
Existing underground utilities within the Alameda right-of-way are assumed to be at minimum cover depth, making lowering of the road infeasible.

Current bridge clearance is approximately 16’-5”, which meets current standards but also provides little room for change in structure depth. Given these two parameters, both roadway elevation and under-bridge-clearance must be maintained. If a new bridge would require a greater structure depth than the existing bridge, depth would have to be taken up by raising the elevation of the rails crossing the bridge, which would in turn require extensive lineal reconstruction of the track in order to not exceed maximum vertical rail grades.

In addition, the low point of the underpass (located under the existing LRT bridge) is lower than the elevation of nearby Platte River to which it drains. This condition creates drainage issues discussed elsewhere in this report, but further underlines that the roadway cannot be easily lowered.

Rights-of-Way, Easements and Ownership
The study includes evaluation of alternatives which would relocate the underpass walls further from the existing roadway, as well as potential alignments for a north-south, grade-separated pedestrian and cycle path over Alameda. Rights-of-way, easements and ownership are an important part of this discussion.

On the south side, the existing face of wall is approximately 20 feet from the City right-of-way boundary. The portion of the right-of-way behind the wall is currently used by the adjacent property owner for parking and is fenced to prohibit public access; no easement or other formal agreement for
Property ownership adjacent to the study area, as recorded in records of the Denver Assessor’s Office.

this use is on file with the City. The City has indicated that it will exercise its property rights to this piece of land, should it be required by the vision for the corridor. On the north side, the existing face of wall is a similar 20 feet from right-of-way boundary. This piece of right-of-way was landscaped as part of the development of the adjacent multi-family project. It is bordered by a private roadway, and by a residential building with a five-foot setback from right-of-way.

Considering potential for a north-south path, two easements should be noted. On the south side, land between the Alameda corridor is owed by IMT Pharmaceuticals and by RTD. Where RTD property meets the north side of the Denizen multi-family building, the project provided an easement on the property’s western edge in order to maintain the potential for a future pathway connection from the north to the LRT station. This area is subject to a permanent easement. On the same plans, the potential landing area for an east-west pedestrian bridge across the rail tracks is noted. This landing area would disrupt a north-south path and force the path to turn into the multi-family courtyard. Through discussion about this project, RTD indicated that it does not intend to construct this bridge.

The IMT multi-family building on the north side of Alameda provides a similar permanent easement at the western edge of the property; the roadway and adjacent landscape are subject to a permanent, 35-foot wide public access easement. Property between the IMT parcel and the LRT tracks is owned by RTD and currently used for storage.

Parcel ownership is illustrated in the diagram at left.
City Design Standards
Denver has multiple design guides and standards manuals pertaining to roadway, bike and pedestrian transportation facilities. Although there are many items specific to Denver, most of them default back to the AASHTO – A Policy on Geometric Design of Highways and Streets, AASHTO Guide for the Development of Bicycle Facilities, the Manual of Uniform Traffic Control Devices (MUTCD) and the Americans with Disabilities Act (ADA). The many Denver design guides and each of these documents was used in the development of options for Alameda and the associated infrastructure improvements.

For a 2-lane major arterial, such as Alameda, Denver design guides depict a 25-foot pavement section in each direction from flowline to flowline. This section accommodates an 11-foot inside lane and a 14-foot outside lane. There should also be a 12-foot clear zone behind the back of curb and 8-foot sidewalk on both sides. Unfortunately, from face of wall to face of wall in this section of Alameda, we only have approximately 70-feet to work with.

Per ADA the minimum width of a sidewalk should be 5-feet and AASHTO sets the minimum width of a multi-use trail at 8-feet wide. AASHTO also recommends a minimum of 5-feet of separation from a travel lane to the edge of a multi-use trail or a physical barrier. The normal minimum trail width is 10-feet wide with 1.5-foot clear zones on each side for handlebar clearance. Denver allows for trails as narrow as 8-feet wide, but the preferred dimension is 12-feet with clear zones.
Wall Structures
The existing retaining walls on both north and south sides have heavy spalls, leaving pedestrian and cyclist traffic exposed to safety hazards. In order to increase public safety, the retaining walls need to be rehabilitated either by being resurfaced or by being completely replaced. In the case of resurfacing, architectural panels or form liner surfaces are an option that could enhance underpass aesthetics. For reconstruction, the study considered three types of walls: soldier pile walls, tangent pile walls, and soil nail walls.

Method of rehabilitation will have has significant lifespan and cost implications. If resurfaced, the walls can be expected to have a useful life of approximately 10-20 years (10-15 for shotcrete or 15-20 for cast-in-place (CIP) liners). If reconstructed, the walls can be expected to last for approximately 75 years under present conditions.

Resurfacing both walls will cost approximately $1 (shotcrete) to $5 million (panels or form liners), while reconstruction is anticipated to cost between $15 (reconstruct one wall, resurface one wall) and $22 million (reconstruct both walls). All figures are in 2019 dollars, and exclude associated costs of roadway and path improvements, engineering fees, and rail impacts. Comprehensive project estimates are discussed later in this report.

Resurfacing
This approach keeps the existing concrete walls, partially removes the existing wall surface, and provides a new front face finish using either shotcrete, precast panels or CIP form liners.

The unsound concrete on the front face of the walls would be removed to an approximate depth of six inches using hydraulic demolition or another applicable means. The entire length of the wall has a 6” forehead (overhang) and it is recommended to remove this forehead to leave a completely flat front face surface. Due to extensive damage, reconstructing the overhang would be labor intensive and costly but provide no functional benefit.

Once surface removal is complete, the most economical approach would be to resurface the walls with shotcrete. This approach uses a splayed concrete or mortar, and only addresses the existing water damage and spalling issues. This approach has a very limited life span (10-15 years) and spalling and cracking will reappear within a few years due to shrinkage and temperature fluctuation.

A longer-lasting solution would be to install precast concrete panels to the prepared surface and fill the gap with non-shrink grout for water tightness. CIP concrete form liners are also an option to finish the wall with an architectural design. Drilled and epoxy dowels are installed and tied with wire mesh providing minimum reinforcement on the surface to prevent shrinkage and temperature cracks. In this case the grouting process is not required, and the process is similar to concrete surface repair.

Both options are similar in cost, with CIP form liners costing approximately 9% more than precast panels. The finished surface may be coated with water repellents, anti-graffiti paint, and/or anti-icing coating for either option.

A stability analysis of the retaining walls was performed for the condition during construction and the final condition to check overturning, sliding and bearing pressure; detailed calculations are provided in Appendix F.
Reconstruction

SOLDIER PILE WALL
A soldier pile wall would replace the existing concrete cantilever wall with the least disturbance to existing conditions behind the existing walls. This type of wall reduces the excavation and backfill and minimizes the disturbance to existing buildings and facilities.

First, steel HP piles would be driven behind the current retaining walls, and precast reinforced concrete panels would be installed between the piles. Once the panels are in place, the old concrete retaining walls could be removed, leaving a wider space for the pedestrian/bike path.

Detailed preliminary design calculations and quantities are shown in Appendix G.

CONCRETE TANGENT PILE WALL
This approach would use side by side concrete columns (tangent piles) behind the existing concrete cantilever walls. Like the soldier pile approach, this system would first install the piles behind the existing wall, then demolish the old wall. The new wall could be surfaced with precast panels or CIP form liners. The study considered columns of 2.5-foot and 3-foot diameters, and these calculations are included in Appendix H.

This construction approach creates wider space for pedestrian/cycle traffic similar to the HP soldier pile wall system.

SOIL NAIL WALL
This approach would drive long metal rods (nails) into the soil behind the face of the existing wall. Shotcrete, precast architectural panels or CIP concrete would then be attached to the exterior heads of the nails to create the vertical wall surface. Soil nails are driven into the soil at a downward angle, and nails increase in length as the wall increases in height.

This method has several significant drawbacks, including potential interference with certain types of communication lines and larger right-of-way/easement requirements for taller walls/longer nails. This method is typically more expensive the pile walls.

Refer to Appendix I for preliminary structural analysis and quantity calculations.

RECOMMENDATION
Of the three wall types described, the study recommends concrete tangent pile construction. This approach provides the slimmest wall, taking up the least amount of right of way and allowing for maximum width of the adjacent pedestrian/cycle path. It offers the additional advantages of being the most efficient to build, time-wise, and the least expensive.
Bridge Structures

Bridge Design
Based on current best practices and freight rail guidelines, the study recommends a 1-span steel through plate girder structure with floor beams bolted to bottom flanges for both the rail and freight bridges. This structure type will allow a single bridge span with no piers in Alameda, and an increased roadway-to-bridge clearance of approximately 17’6” (current clearance is approximately 16’5”). The lack of piers will allow more flexibility in configuring the roadway cross-section, including adding/widening pedestrian and cyclist facilities, and the increased clearance will better accommodate overweight/oversize vehicles and minimize damage due to traffic collision loads on the proposed superstructure. Preliminary design calculations and a proposed bridge concept sketch are provided in Appendix D.

Right-of-Way (ROW) Impact
No additional ROW will be needed horizontally (i.e. perpendicular to W. Alameda Avenue) in order to accommodate the proposed bridge replacements. However, the complexity of bridge demolition and construction requires that the existing bridges be shut down for a period longer than acceptable to either freight or RTD operations. Both rail lines will need to be re-aligned to ensure continuous operation; additional ROW will be required between existing RTD/UPRR rail tracks for this relocation.

Both the Freight and RTD tracks will need to be permanently relocated north and south of the new Alameda bridges, and re-merged back to the existing alignments north and south of the proposed project limits. On the north side of Alameda, acquisition of private property will be required; south of Alameda, ROW acquisition/approvals from the UPRR/BNSF railroads will be required.

Proposed track alignments
Neither the Alameda roadway nor the railway track elevations will be altered significantly; some minor elevation adjustment to the tracks may be needed to accommodate super-elevations during merging and re-merging of the proposed tracks. Under the proposed plan, impact on the flow of freight and RTD traffic will be minimum. All costs including future maintenance, phasing and construction delays will be taken into consideration before making a final decision. No new signals will be required at this site.
Community members were asked to weigh in on priorities related to the study area’s constrained right-of-way.

Public Input

The study reached out to the public very early in the process, even as initial alternatives were being identified. Initial data collection and base mapping showed a very constrained Alameda right-of-way that, even with relocation of one or both walls and elimination of the intermediate bridge piers, would likely need compromise and prioritization in its ultimate solution.

Public outreach focused on understanding stakeholder priorities, and asked three questions, shown at right. The results showed strong support for a path on both sides, and if a path could only be on one side, then on the north. The public favored stronger separation between pedestrians/cyclist and motorists, over stronger separation between pedestrians and cyclists. City Councilman Clark also concurred with public opinion in strongly favoring a path on both sides.
Bikes and pedestrians will share space. Bicicletas y peatones compartirán espacio.

Bicycles and pedestrians will have separate lanes, side by side. Las bicicletas y los peatones tendrán carriles separados, uno al lado del otro.

Bikes and pedestrians will be separated from each other. Bicicletas y peatones se separarán unos de otros.

Bikes and pedestrians will be separated from vehicles. Las bicicletas y los peatones serán separados de los vehículos.

Is it more important to have a path on the south side? ¿Es más importante tener un camino en el lado sur?

Is it more important to have a path on the north side? ¿Es más importante tener un camino en el lado norte?
Initial Alternatives

Initial assessment studied three ways for pedestrians and cyclists to cross the existing freight and light rail tracks: cross the tracks at grade, cross above the tracks (an east-west bridge), or cross below the tracks (an underpass, like currently exists on Alameda). The first two categories were studied at a very high level, and were not advanced into any type of plan analysis.

The last category, an underpass, was judged the most feasible and was further refined into multiple variations. The study evaluated two key questions (and their sub-questions) at this point:

- Should there be a mixed-use path on one side or both sides?
  ◊ If just one side, which side?
  ◊ If both sides, should the paths be equal or different in widths?

- How can the design make space for the desired path(s)?
  ◊ Keep the retaining walls and bridges, narrow traffic lanes to the extent possible
  ◊ Move one retaining wall and replace the bridges?
  ◊ Move both retaining walls and replace the bridges?

In options which remove and relocate only one of the retaining walls, relocation of the north wall provided opportunity for a wider multi-use path on the north side. While both walls have approximately 20’ of currently unused right-of-way that can be reclaimed, the ‘new’ space on the north would be combined with the existing seven-foot path to provide a wider path. Moving the north wall instead of the south wall is also likely to be better supported by adjacent property owners, since the owner to the south has indicated a strong desire to continue using City right-of-way for surface parking.

Many alternatives were studied, and some were found to be technically infeasible and discarded. For this reason, the alternatives described here do not follow sequential numbering and some numbers are not represented. The ‘missing numbers’ are alternatives that were technically infeasible; numbering has been maintained to provide consistency with materials that were presented to internal and external stakeholders throughout the process. These materials can be found in the appendices.

As discussed in the preceding section, stakeholder involvement occurred concurrent with the identification of initial alternatives. As this feedback came in, it became clear that the community very strongly desired a path of some sort on both sides of the roadway. At this point, Alternative 7 (moving the north wall, with a path only on the north side) had already been drawn, but no further options with a one-sided path were considered.
At-Grade Crossing

Alternative 13

◊ Eliminated
due to unlikeliness of PUC approval

This option would keep both walls and keep the existing rail bridges. It would remove the existing, roadway-level pedestrian/cycle path on the north side of the roadway, and build a new pedestrian/cycle path at the top of the north wall. This path would cross both LRT and freight tracks at grade.

This option is technically feasible but has a very low likelihood of being approved by the Public Utilities Commission (PUC), which holds jurisdiction over crossings of this kind. This option was discarded due to this likely difficulty of implantation. This option was not studied in plan.

Overpass Alternative

Alternative 14

◊ Eliminated
due to likely high cost

This alternative would construct an east-west pedestrian/cycle bridge parallel to Alameda. Pedestrians and cyclists would use the bridge to cross above both the LRT and freight tracks.

City direction indicated that the study should preclude any options that would require elevators, thus limiting overpass access to an ADA-compliant (5% max grade) ramp.

Initial calculations of required rail and roadway clearance indicated that there is insufficient length between the freight rail and the project boundary at Santa Fe Drive to create an ADA-compliant ramp for a pedestrian/cycle bridge. Going further west beyond the project boundary, there is insufficient length between Santa Fe and Kalamath, and between Kalamath and the I-25 off-ramp to construct a 5% ramp. These linear challenges would create a bridge in excess of 0.4 miles, forcing the bridge to extend to or over Platte River Drive, where it could turn to north and land along the Platte River Trail.

This option was discarded due to likely cost. This option was not studied in plan.
Keep Both Walls and Bridges  
*Alternative 1A*

◊ **Moved forward as ‘base’ option**

This option would keep both walls and keep the existing rail bridges. It would remove the existing, roadway-level path on the north side of the roadway, and build a new pedestrian/cycle path approximately four feet above the roadway. Pedestrians and cyclists would still pass under the LRT and freight tracks, but would have some degree of vertical separation from adjacent vehicular traffic. Walls would remain in their existing locations, and be stabilized and resurfaced.

A plan of Alternative 1A is included in Appendix C.

*Alternative 3*

◊ **Eliminated due to safety concerns**

This option would keep the majority of both walls and keep the existing rail bridges. It would maintain the existing north path and add a sidewalk along the south wall. Pedestrians and cyclists would still pass under the rail bridges.

Between the two bridges, the existing walls would be removed and the soil graded into a landscaped slope. The pedestrian/cycle path would separate from the roadway to take advantage of this landscape buffer. Both paths will have a retaining wall on their ‘outside’ edge, in order to maintain the elevation of adjacent parcels and their existing land uses.

Internal City stakeholders felt this option presented significant concerns for personal safety of path users, since the path would not be easily visible from either Alameda Avenue or the adjacent development parcels. The option was discarded for this reason.

A plan of Alternative 3 is included in Appendix C.

Reconstruct One Wall and Both Bridges  
*Alternative 7*

◊ **Eliminated due to public input**

This option would remove and relocate the north wall, replace both rail bridges, and provide a new, widened pedestrian/cycle path on the north side of the roadway only.

Public involvement showed a very strong preference for a path on both sides, so this path was not moved forward.

A plan of Alternative 7 is included in Appendix C.

*Alternative 9*

◊ **Moved forward**

This option would remove and relocate the north wall, replace both rail bridges, and provide a new, widened pedestrian/cycle path on the north side of the roadway only and a new sidewalk on the south side of the roadway. Pedestrians and cyclists would still pass under the LRT and freight tracks, and the north path would be wider than the south sidewalk.

This alternative meets City and stakeholder desire for a pedestrian/cycle facility on both sides of the roadway, and was moved forward for further evaluation.

A plan of Alternative 9 is included in Appendix C.
Reconstruct Both Walls and Both Bridges

*Alternative 12*

◊ Moved forward

This option would remove and relocate both walls, replace both rail bridges, and provide a pedestrian/cycle path on both sides of Alameda. Pedestrians and cyclists would still pass under the LRT and freight tracks, and the north path would be wider than the south path.

This alternative meets City and stakeholder desire for a pedestrian/cycle facility on both sides of the roadway, and was moved forward for further evaluation.

A plan of Alternative 12 is included in Appendix C.

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Short List

Three alternatives were selected to move forward to concept-level cost estimating. The alternatives are shown in the spreads on the next pages, and were expected to reflect a spread of low, medium and high cost based on the extent of reconstruction required.

Alternative 1A, the ‘base option’ does not require reconstruction of the rail bridges, and is therefore estimated to cost significantly less than Alternatives 9 and 12. These latter two options are much closer in cost, highlighting that the replacement of LRT and freight bridges have the largest impact on overall project cost.

Plans on the following pages illustrate all three options at the same point of initial evaluation. Further development of the single preferred option is discussed in Chapter 4.
Alternative 1A
This option was studied as a ‘base option’ that would provide near-term repairs and safety improvements. Due to spatial limitations, however, it is considered a near-term, temporary approach; it does not substantially address the community and Denver’s desire for a better pedestrian/cyclist experience and enhanced connectivity.

This option rehabilitates both retaining walls in their existing locations, and leaves the existing rail bridges untouched. It is anticipated that the walls would be sandblasted and resurfaced with shotcrete, a sprayed concrete or mortar, to address the existing water damage and spalling issues. The mixed-use path would be removed and replaced in a raised condition to increase the vertical separation from motorized vehicles. In order to maintain approximately ten feet clearance from the bottom of existing bridges, the path would be approximately four feet above the roadway. Thinner railing would provide a small increase in path width (less than two feet) and pedestrian lighting would be upgraded.

Since both walls and bridges remain in place, there is very little opportunity for ‘extra’ space to widen the existing path and no room to create a new path on the south side. In particular, the intermediate bridge piers limit any ‘found’ space to reductions of the northern two lanes; at 12’ in width, each of these spaces could be narrowed to City-minimum of 11’ to provide an extra two feet of space.

Estimated Construction Costs

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*The full Engineers Opinion of Probable Construction Cost (EOPCC) can be found in Appendix J.*
Chapter 3: Alternatives Analysis

Alternative 1A cross-sections.
Alternative 9
This option replaces both rail bridges and reconstructs the north wall further back from Alameda.

Some of the space gained by clear-spanning the bridges and removing the intermediate piers, and by relocating the north wall can be taken up on the south side of the roadway. The need to keep appropriate intersection alignment at Santa Fe and Cherokee and thus also limits the width of sidewalk that can be added to the south side of the roadway. In this alternative, the sidewalk on the south side of the roadway would be narrower than the multi-path on the north.

The study did explore whether the south side facility might be an on-street bike lane, buffered or not, instead of a sidewalk or path. Denver’s technical staff committee felt Alameda was not an appropriate location for this type of a facility, since cyclists would be ‘trapped’ against the southern wall – with no opportunity to jump a curb or go onto adjacent sidewalk as in a normal situation—in the event of a motorist error or other emergency situation.

Estimated Construction Costs

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* Cost does not include ROW acquisition for rail realignment. The full Engineers Opinion of Probable Construction Cost (EOPCC) can be found in Appendix J.
Alternative 9 cross-sections.
Alternative 12
This option replaces both rail bridges and reconstructs the both walls further back from Alameda.

Due to the removal and relocation of both walls, lane shift is less of a concern in this alternative than in Alternative 9; the south path can also be wider than in the preceding options. This option would provide up to twenty additional feet on each side for pedestrian and cyclist facilities (minus the thickness of the new walls), plus the horizontal space gained by the elimination of the bridges’ intermediate piers.

Since the existing path is on the north side of the roadway is already incorporated into the roadway cross-section, the north path would still be wider than the south path in that it adds the width of the existing path to the ‘new’ space created by moving the wall.

This alternative provides the maximum amount of horizontal pedestrian/cycle space of all the alternatives.

Estimated Construction Costs

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*Cost does not include ROW acquisition for rail realignment. The full Engineers Opinion of Probable Construction Cost (EOPCC) can be found in Appendix J.*
Chapter 3: Alternatives Analysis

Alternative 12 cross-sections.
Preferred Alternative

Refined Design
Considering cost, lifespan, technical feasibility and public input, Alternative 12 was judged best among the ‘short list’ options at meeting project goals. Further refinement of the initial concept included further study of the LRT and freight bridge needs, alignment of a north-south pedestrian / cycle bridge and trail above Alameda, vertical circulation connecting the roadway and adjacent development levels, intersection improvements at Cherokee and Santa Fe, potential urban design enhancements. A significant finding of this phase of design included the need to relocate both rail lines during bridge reconstruction. The extent of this relocation, including property acquisition needs and recommendation regarding temporary versus permanent relocation, is further discussed in the following pages.

Cross-Section
The preferred alternative will rebuild both the north and south retaining walls, moving both walls to the edge of city right-of-way and using the full 96-foot width. Vehicular travel lanes will retain their existing 12-foot width, with a 4-foot raised center island between east and westbound lanes.

The existing, 7-foot pedestrian/cycle path on the north side of the road will be widened to 10-15 feet, while the proposed southern pedestrian/cycle path will be slightly narrower at 10-12 feet wide. Both paths will be raised approximately four feet above roadway level – providing a greater sense of separation from faster-moving vehicular traffic. A minimum of 12 feet vertical clearance from the overhead rail bridges will be maintained.

The Preferred Alternative provides comfortably-sized multi-use pathways on both sides of Alameda, vertical circulation between roadway and development levels, and a north-south pedestrian trail.
A connection from the both paths adjacent to Alameda up to normal ground level will be provided on the east side of the proposed re-aligned RTD bridge. The vertical difference down to the Alameda paths is approximately 24-feet. Connection on the north side will be with stairs, and on the south side will be a switchback 450-500-foot long ramp, meeting ADA requirements. Adding the stairs and ramp will require use of adjacent properties, and will be part of the north-south pedestrian/cycle trail and bridge described in the next section. This vertical connection will allow users to connect to Alameda Station, and across to the Platte River Trail, without out-of-direction movement toward existing crossing at Cherokee.

**Intersections**

To minimize drastic lane shift and appropriately align both vehicular and pedestrian/cycle facilities, improvements will extend approximately 300 feet east of the Cherokee intersection. All four returns of the intersection will be reconstructed and all pedestrian infrastructure including ramps, signs and pavement markings will be designed to meet all Americans with Disabilities Act (ADA) and Public Rights of Way Accessibility Guidelines (PROWAG) standards.

At Santa Fe, the eastern returns will be reconstructed to match into the proposed Alameda alignment. Similar to the Cherokee intersection all improvements will incorporate pedestrian infrastructure meeting or exceeding local, state and federal codes. Traffic flow and signage will also be addressed to better improve pedestrian safety on the east leg of the intersection by re-moving or restricting the northbound to eastbound free flow right turn movement.

By raising the new multi-use paths above the roadway level, the Preferred Alternative provides greater separation between motorized and non-motorized users.
Urban Design Enhancements
The corridor offers a variety of opportunities for urban design enhancements. All of these enhancements, however, require a mechanism for long-term maintenance other than Denver Public Works, as the City does not have the budget or staff to perform this type of upkeep. Examples of the organizations which might perform this function include a Business Improvement District (BID) or Urban Renewal District; these organizations typically have the ability to impose taxes, fees, dues or other sources of funding on businesses and residents within the subject area. No such organization currently exists in the area of the Alameda Underpass, and would need to be created before the City of Denver would approve urban design enhancements.

Integrating urban design enhancements into underpass reconstruction would provide the best return on investment, as the cost for enhancements can often be partially absorbed in base elements. For example, an artist-designed railing would typically only have to pay the difference between the cost of the basic railing and the upgraded design (instead of the entire cost of the custom railing). Some but not all urban design enhancements can be retrofit after reconstruction, if a maintenance organization is not in place when the project moves forward.

Enhanced Lighting, Overhead Art Lighting, Embedded Lighting
The base assumption for the project is improved lighting which provides consistent light levels, true-color rendering and energy efficiency. Enhanced lighting could include decorative or custom wall fixtures (an upgrade from functional, ‘stock’ fixtures), artistic overhead lighting under the bridges or at selected points along the underpass, decorative uplighting on the walls, and embedded lighting within the pavement.

Some of these elements such as uplighting or overhead lighting could be retrofit after underpass construction other elements such as embedded lighting or upgraded wall fixtures would need to be installed at the time of underpass reconstruction.

Public Art, including Murals and Sound Art
Many styles and media of public art could find a home in the Alameda Underpass, and many examples of murals or other vertical art can be found around Denver. More ephemeral art, such as sound installations, have also been installed around the City, and are another option. Murals and other surface art can often be retrofit, while custom paving patterns or inlay would need to be accounted for during reconstruction.

Enhanced Paving, including Decorative Paving and Jointing
Base assumptions include standard gray concrete for the multi-use path. Enhancements could include colored concrete or pavers, as well as embedded or inlaid art or patterns. It is not cost-effective to retrofit this category of enhancements.

Wayfinding and Identity Signage
Wayfinding signage pointing users to local destinations is a potential enhancement, and given the underpass’s constrained width, would likely be mounted in a location such as wall or railing that would not impede traffic flow. Identity signage could also be integrated into other corridor elements, such as railing, paving or wall pattern. Stand-alone signage could be retrofit, while integrated signage would need to be installed with reconstruction.
A variety of urban design enhancements could be integrated into the design and reconstruction of the Alameda Underpass; all of these enhancements would require a plan for long-term maintenance of those improvements.
Rail Re-Alignment
The railroad re-alignments for this project is primarily a function of the proposed new bridges and phasing of construction (which is described in a later section of this report). The city’s preference is to construct new bridges that span all of Alameda without the need of a center pier. This will allow greater flexibility with roadway and trail alignments as well as increasing safety by not having a center obstruction. To span this far, the bridge depth, top of rail to bottom of girder, will need to be larger than what is currently in use. As discussed previously in the report, due to drainage and utilities, lowering the roadway section is impractical, so in order to get the necessary depth, the bridges will need to be raised, which means adjusting the track vertical alignment.

Due to phasing challenges, it will also be necessary to shift the horizontal alignment. Between the horizontal and vertical alignment changes necessary to facilitate the proposed new bridges, and CDOT’s desire to also shift the tracks for I-25 improvements in the future, we reviewed modifying both the UPRR/BNSF combined rail tracks as well at the RTD line. Following American Railway Engineering and Maintenance-of-Way (AREMA) and RTD design standards, conceptual alignments were laid out. The combined track was shifted east and the RTD track to the west, placing the bridges adjacent to each other with appropriate clearances.

The RTD tracks will need to be shifted approximately 50-feet and the combined rail about 150-feet at Alameda. In order to make these shifts ROW will need to be acquired on the north side of Alameda. Most of the parcels on the south side are already owned by RTD, UPRR or BNSF. Currently there is a large depression on the south side of Alameda that fills with storm runoff, creating a sizable pond that overflows onto Alameda during major rain events. This drainage issue will need to be addressed prior to relocation of any tracks.

The track relocations we are proposing will meet or exceed current design speeds and will not require any changes to the RTD Alameda Station. It is anticipated that this project will require approximately 3,000-feet of combined rail relocation and 2,000-feet of the RTD line. Due to the overall length of relocation, grade changes necessary to accommodate raising the bridges will be minimal. We are also anticipating the need to make changes to the at-grade crossing at Santa Fe. Any changes will be in coordination with the PUC, the city and railroads.
North-South Trail Connection

Property Ownership
As part of the preferred alternative, the study examined potential alignments for a grade-separated, off-road pedestrian/cyclist trail between the north and south sides of Alameda. The goal of this connection would be twofold: locally, a north-south trail link will extend the off-road connectivity that will be introduced by the Broadway Park’s Rail Line Park; regionally, the trail link will tie into the larger city bicycle network.

To connect with the Broadway Park trail and Alameda Station, the connection must be east of the LRT bridge. To the south of Alameda, the connection will need to run across the property of one of two landowners: RTD, or USL Pharma. Once the trail reaches the northern edge of Denver Properties I LLC, a gate and public access easement have been reserved on that property.

North of Alameda, the trail will have to locate on property owned, again, by one of two landowners: RTD or IMT Capital III Alameda Station LLC. When the trail reaches Cedar Avenue, it can either turn to the east and run on public ROW, or continue north on RTD or BCI Private Capital LLC property. Refer to the ‘Technical Parameters’ section of Chapter 3 of this document for a map and further discussion of property ownership.

The City has initiated and will continue conversations regarding alignment options and property acquisition or easement.

Preferred Alignment
The preferred alignment includes direct connection from RTD Alameda Station north to Bayaud Avenue, with the entire length of trail being off-street. Due to the trail’s proximity to the existing at-grade rail crossing at Bayaud, RTD has indicated a strong desire for new and enhanced signalization of this crossing; this cost is not included in the estimate.

Alternate Alignment
The alternate alignment would follow the same path as the preferred alignment, from Alameda Station to Cedar Avenue. At Cedar Avenue, the alternate alignment would turn east onto public roadways, following Cedar Avenue for one block then turning north on Bannock and continuing to Bayaud. This option would introduce new five-foot sidewalks on the north side of Cedar and the east side of Bannock.

Vertical Circulation
All alignment options would include connection between trail level and the lower Alameda pedestrian / cycle paths. On the south side, a 470’ switchbacked ramp would allow pedestrians and cyclists to connect from east-west path to the north-south trail.
A new north-south multi-use trail would connect development on the north and south sides of Alameda with each other and with Alameda Station via a new pedestrian / cycle bridge.

### Preferred Alignment

**Estimated Construction Costs**

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</table>

Preferred alignment includes connection from RTD Alameda Station to Bayaud Ave. Removal and replacement of concrete barrier wall from Alameda north to Cedar. Includes 10-30’ of ROW take from RTD from Alameda to the north.

### Alternate Alignment

**Estimated Construction Costs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Costs</td>
<td>$2,295,690</td>
</tr>
<tr>
<td>Tech Studies and Coordination</td>
<td>$206,612</td>
</tr>
<tr>
<td>Engineering</td>
<td>$229,569</td>
</tr>
<tr>
<td>Construction Mgmt</td>
<td>$229,569</td>
</tr>
<tr>
<td>Contingency (30%)</td>
<td>$688,707</td>
</tr>
<tr>
<td>ROW</td>
<td>$202,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$3,852,147</strong></td>
</tr>
</tbody>
</table>

The Alternate Alignment is the same as preferred south of Cedar Street. ROW take only to Cedar - 10-wide). Removal and replacement of concrete barrier wall from Alameda north to Cedar. Continue east on Cedar to Bannock.

*The full Engineers Opinion of Probable Construction Cost (EOPCC) for both alignments can be found in Appendix J.*
Phasing

Railway
The railway improvements should be constructed first, because the new bridges need to be in place before starting demo on the walls along Alameda. The bridge abutments will be behind the existing walls and the bridges can be erected without greatly affecting roadway traffic. There may need to be some night construction with the road closed while setting girders. The track work can be completed up to the four tie in points. The new track will be tied into the existing track, likely after hours in one night or less to minimize the impact to all rail lines. While the rail work is being constructed, the contractor can be installing the wall caissons behind the existing wall. After the track is open, the existing bridges can be demoed.

Roadway
Roadway phasing is simple on paper but will be difficult in the eyes of the traveling public. The most efficient and safest way to phase this project will be to close half of the roadway at a time, narrowing the travel lanes to one in both directions. Combinations of narrow 10-foot lanes or a variable 3-lane section and nighttime construction should also be reviewed. With half of the roadway closed, the contractor can demo the existing walls, place the new panels and make the required improvements to Alameda for both the roadway and trail.

Trail
The north-south trail can be constructed at the same time as the roadway or later. The only impact of the trail to the motoring public will be the installation of the pedestrian / cycle bridge over Alameda, which will require a nighttime roadway closure. The ramp and stairs tying into Alameda should be constructed at the same time as the wall improvements if possible.