

**PREFERRED ALTERNATIVE DEVELOPMENT AND REFINEMENT
I-25 AND BICYCLE PATH REALIGNMENT, PEDESTRIAN OVERPASS,
RTD MEDIAN STATION**

DESIGN DECISION EVALUATION AND VERIFICATION SUMMARY

TECHNICAL MEMORANDUM

FOR THE

**I-25 (US 36 to 104th Avenue)
Environmental Assessment**

Prepared for:



Colorado Department of Transportation
Region 1
2829 W. Howard Place
Denver, CO 80204

August 2018

DRAFT NOT CDOT APPROVED



COLORADO
Department of Transportation
Region 1

CDOT Region 1 North Program
4670 Holly Street
Denver, Colorado 80216

August 17, 2018

To: Stephanie Alanis, PE, Project Manager, Colorado Department of Transportation (CDOT) Region 1
Andrew Stratton, PE, North I-25 Metro Resident Engineer, CDOT Region 1
Chris Horn, Senior Area Engineer, FHWA

From: Jeanne Sharps, PE, Felsburg Holt & Ullevig (FHU) Project Manager
Rick Erjavec, PE, FHU Deputy Project Manager

Subject: I-25 North, US 36 to 104th Avenue Project
Preferred Alternative Development and Refinement
I-25 and Bicycle Path Realignment, Pedestrian Overpass RTD Median Station
Design Decision Evaluation and Verification Summary

INTRODUCTION

Felsburg Holt & Ullevig (FHU), acting on behalf of the Federal Highway Administration (FHWA) and the Colorado Department of Transportation (CDOT) as lead agencies and the Regional Transportation District (RTD) as a cooperating agency, is conducting an Environmental Assessment (EA) and Conceptual/Preliminary Engineering Design for the Interstate 25 (I-25) North, United States Highway 36 (US 36) to 104th Avenue project.

The I-25 North, US 36 to 104th Avenue project includes improvements to relieve congestion and improve safety on I-25 from US 36 to 104th Avenue in Adams County and the City of Thornton, Colorado. The project will provide improvements to an approximately 4-mile segment of I-25 between US 36 and 104th Avenue. The current cross-section of I-25 between US 36 and 104th Avenue generally includes three general-purpose lanes and one Express Lane along the inside shoulder with an auxiliary lane between 84th Avenue and Thornton Parkway. The inside shoulder varies in size between 2 and 12 feet, and the outside shoulder varies between 10 and 12 feet. There is a 2-foot inside shoulder and a 2-foot buffer between the Express Lane and the nearest general-purpose lane.

Proposed improvements associated with this project are as follows:

- ▶ Adding a fourth general-purpose lane in each direction from 84th Avenue to Thornton Parkway with the northbound general-purpose lane extending to 104th Avenue,
- ▶ Constructing continuous acceleration and deceleration lanes between the I-25/84th Avenue interchange, and the I-25/Thornton Parkway interchange,
- ▶ Widening the inside and outside shoulder to a consistent 12-foot width,
- ▶ Accommodating a proposed median transit station and pedestrian bridge for the Thornton Park-n-Ride just south of 88th Avenue, and
- ▶ Replacing the 88th Avenue bridge.

The proposed typical section on I-25 will consist of four 12-ft general-purpose lanes, a 12-ft Express Lane along the inside travelled way, and a 12-ft outside auxiliary lane between each interchange. Additionally, the inside and outside shoulders will be widened to 12 feet and the Express Lane buffer will be widened to 4 feet, and a 2-foot barrier will separate the northbound and southbound lanes of I-25. Surrounding the median station will be a 2-foot concrete barrier separating the Express Lanes from the bus station and bus lanes.

This memo summarizes the evaluation of design options related to the RTD median station, the widening and realignment of I-25, the Niver Creek multi-use trail realignment and crossing of I-25, RTD median station accessibility, and the pedestrian and bicycle crossings of I-25.

The location and configuration of the Thornton Park-n-Ride median station was determined first. Once the location and configuration of the median station was selected, the alignment of I-25 between US 36 and 104th Avenue could be established. In addition, a decision had to be made about the accessibility to the median station and the realignment of the regional Niver Creek Trail. A summary of the considerations and decisions follows.

THORNTON PARK-N-RIDE MEDIAN STATION OPTIONS

Adding the thru and auxiliary lanes to I-25 affects the existing northbound and southbound slip ramps to RTD's Thornton Park-n-Ride. The slip ramps cannot be replaced in kind safely due to the insufficient weave and merge lengths along I-25 with the north side 84th Avenue ramps. As such, the configuration needed to be developed.

The team coordinated with RTD and CDOT to develop and evaluate three options:

- ▶ No direct access to or from I-25 with buses using the 84th Avenue on- and off-ramps to access the Park-N-Ride, with and without queue jump lanes,
- ▶ Modification of the slip ramps and braiding the bus-only ramps with the 84th Avenue north ramps, and
- ▶ A full median station option.

Attachment A includes the technical memorandum documenting the coordination with RTD and the identification of the Thornton Park-n-Ride median station.

RTD selected the full median station option because it provides a more efficient use of the Express Lanes for the buses, eliminating the need for the buses to weave across the I-25 general-purpose lanes to enter and exit the Park-n-Ride. RTD provided CDOT a 240-ft-wide template for the median station on December 6, 2017.

I-25 ALIGNMENT DEVELOPMENT

The I-25 alignment was developed with the following considerations:

- ▶ **Park-n-Ride.** Northbound and southbound I-25 required realignment to provide the width necessary for the Thornton Park-n-Ride median station. In addition, the alignment needed to accommodate the additional width needed for an auxiliary lane and thru lane in each direction.
- ▶ **Construction Cost.** The realignment of I-25 needed to minimize costs and impacts.
- ▶ **Right-of-Way (ROW) Acquisition/Relocations.** The acquisition of property for ROW and the displacement of tenants from the apartment complex adjacent to the east side of I-25 and north of 88th Avenue was minimized. The complex includes four apartment buildings totaling 96 units that would have been acquired if I-25 was realigned to the east or stayed at the existing alignment. The estimated cost to purchase the four buildings and relocate the

tenants in the 96 units is approximately \$25 million. Due to the estimated ROW acquisition cost and the displacement and relocation of the tenants of 96 units, the alignment of I-25 was modified and shifted to the west to avoid the need to acquire the buildings.

- ▶ **Design Criteria.** The horizontal and vertical alignment of the I-25 roadway must meet current safety and design criteria for design speed. The design speed for the facility is 70 miles per hour (mph). The design speed sets the curvature criteria and the sight distance criteria.
- ▶ **Vertical Clearance.** The minimum vertical clearance under 88th Avenue is required to be 16 feet 8 inches. The roadway profile was adjusted, such that the point of minimum vertical clearance at the southbound edge of shoulder, met this criterion.

Given the constraints of the apartment complex and the design criteria, including the vertical clearance, curvature, and superelevation, the alignment of I-25 was realigned to the west to avoid the acquisition of the apartment complex and to shift the horizontal curve north of 88th Avenue to meet the vertical clearance with superelevation.

88TH AVENUE BRIDGE LOCATION EVALUATION

The 88th Avenue bridge is being reconstructed due to the I-25 widening and the associated realignment of I-25. The bridge is being lengthened to approximately 300 feet to accommodate the changes to I-25. The bridge is also being widened to 81 feet to accommodate the City of Thornton's cross-section for 88th Avenue.

REGIONAL TRAIL REALIGNMENT AND CONNECTIVITY ACROSS I-25

Widening I-25 for the auxiliary and thru lanes and the median station affects the existing pedestrian underpass at the Thornton Park-n-Ride and the regional Niver Creek multi-use trail that crosses I-25 via the existing underpass. CDOT met with RTD and the City of Thornton to determine each agency's preferences in respect to relocating the regional trail and underpass.

RTD preferred an overhead pedestrian structure to provide access to the median station from the Thornton Park-n-Ride. A pedestrian bridge was favored based on safety concerns of pedestrians using a long I-25 underpass. RTD also requested that pedestrians using the transit facility be separated from pedestrians and bicyclists using the regional Niver Creek Trail.

Five alternative Niver Creek Trail realignments were developed and discussed with the City of Thornton. **Attachment A** summarizes the options and the preferences. After comparing the benefits and impacts of the options, the City agreed that the Niver Creek Trail should be realigned as shown in attached Option A. This option relocates the trail to the top of the existing detention pond berm adjacent to and west of I-25 in the Niver Creek Open Space, continues the trail under 88th Avenue in a concrete box culvert, crosses I-25 using the 88th Avenue bridge and then ties into the existing trail near the east RTD Thornton Park-n-Ride. Option A provides a direct regional trail route, separating trail users from RTD patrons, is cost-effective, and is CDOT's preferred option.

Attachment A

CDOT. 2017. Memorandum to RTD (Bruce Abel, Bill VanMeter, and Jesse Carter) from CDOT (Stephania Alanis and Andrew Stratton) regarding Need for Coordination with RTD on Potential Impacts to I-25 Thornton Park-n-Ride Median Station Evaluation. March 6.

FHU. 2018. Memorandum to CDOT (Stephanie Alanis) from FHU (Jeanne Sharps and Rick Erjavec) regarding I-25, US 36 – 104th Improvements – City of Thornton Regional Trail Relocation Options. April 19.

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COLORADO

Department of Transportation

Region 1

CDOT Region 1 North Program
4670 Holly Street
Denver, Colorado 80216

March 6, 2017

To: Bruce Abel, Assistant General Manager for Bus Operations, RTD
Bill VanMeter, Assistant General Manager of Planning, RTD
Jesse Carter, Manager of Service Planning and Scheduling, RTD

From: Stephanie Alanis, PE, I-25 NEPA Clearance Project Manager, CDOT
Andrew Stratton, PE, North I-25 Metro Resident Engineer, CDOT

Subject: Need for Coordination with RTD on Potential Impacts to I-25 Thornton Park-n-Ride Median Station Evaluation

INTRODUCTION

CDOT is currently completing preliminary design to clear the I-25 corridor from US 36 to Thornton Parkway per the I-25 US 36 to SH 7 PEL, completed in 2014.

The PEL recommended a median station to replace the side slip ramps on I-25 at RTD's Thornton Park-n-Ride and a critical decision needs to be made regarding the most probable and efficient concept to move forward with design. This memo evaluates three potential options for addressing bus service and access to the Thornton Park-n-Ride.

PROJECT

Although the project study area is from US 36 to SH 7, the focus of the initial improvements is I-25 from 84th Avenue to Thornton Parkway. CDOT will be adding one general purpose lane and continuous auxiliary lanes in each direction from US 36 to Thornton Parkway. This widening will impact the existing side slip ramps that provide direct bus only access to the Thornton Park-n-Ride.

STATION OPTIONS

Three options are being compared currently with varying safety, general traffic operations, and physical impacts. Subsequent discussions with RTD are needed to better understand how best to compare the potential transit operational benefits and impacts of these options as well as any additional options that the project should consider.

Option 1 – No Direct Park-n-Ride Access

This option would eliminate direct bus access to I-25 by relocating or closing the existing Park-n-Ride. Key aspects of operation and design are described below.



- **Bus Operations.** If the Park-n-Ride remains open and in its current location, direct access to I-25 would be eliminated. The Park-n-Ride access would be via the ramps at 84th Avenue and local roads. Buses traveling to and from downtown Denver to the Park-n-Ride station would have to exit the express lanes northbound and weave to the 84th Avenue ramp and southbound weave from the 84th Avenue ramp to the express lanes.
- **Private Automobile Impacts.** General traffic operations would be improved from existing by eliminating bus weave from express lanes to side bus only slip ramps.
- **88th Avenue Bridge Length.** This option would require the shortest length (252').
- **Culvert Replacement/Pedestrian Bridge.** Existing Niver Creek 8'x4' box would be replaced with two 11'x4' boxes to increase capacity. The existing box is undersized; the existing pedestrian underpass is used as the overflow. The existing pedestrian underpass would be replaced with a pedestrian bridge.
- **Right-of-Way (ROW) Impacts.** This option requires the fewest ROW impacts; no structure removal or owner/renter relocations are anticipated.
- **Construction Phasing.** Eliminating the need to maintain access to the Park-n-Ride during construction would simplify phasing.
- **Cost.** This option would be the least expensive based on the smallest footprint.

Option 2 – Modified Park-n-Ride Access

This option would modify the bus access to I-25 using new bus ramp lanes at the 84th Avenue interchange to access the Park-n-Ride stations to and from the south. It also modifies the acceleration and deceleration lanes to the north from the Park-n-Ride to meet AASHTO criteria.

- **Bus Operations.** Adding the through and auxiliary lanes to I-25 exacerbates an already substandard RTD Park-n-Ride ramp configuration. To resolve this, dedicated bus lanes will be constructed on the 84th Avenue interchange ramps to provide bus access to the existing Park-n-Ride lots. Queue jump lanes will be implemented at the 84th Avenue signals and ramp meters to minimize delay to bus routes. It is anticipated that Park-n-Ride bus access to and from the north can be modified to be AASHTO compliant given the distance between the Park-n-Ride station and Thornton Parkway. This option does not make optimal use of the express lanes since the buses will have to weave between the express lanes and the south side 84th Avenue ramps to access the Park-n-Ride.
- **Private Automobile Impacts.** This option would improve general purpose traffic safety and operations by eliminating substandard bus ramps and associated weaving in a short distance. However, buses would still have to weave across all the general purpose lanes from/to the Express Lanes having some impact on the operations of I-25 traffic.
- **88th Avenue Bridge Length.** This option would require a span of 310'.
- **Culvert Replacement/Pedestrian Bridge.** Existing Niver Creek 8'x4' box will be replaced with two 11'x4' boxes to increase capacity. The existing box is undersized and the existing pedestrian underpass is used as the overflow. The existing pedestrian underpass would be replaced with a pedestrian bridge.
- **Right-of-Way (ROW) Impacts.** Although this option would require more ROW than Option 1, building acquisition and relocations are not anticipated to be necessary.
- **Construction Phasing.** Construction phasing would be more complex than Option 1 because access to the Park-n-Ride will need to be maintained.
- **Cost.** This option would be costlier than Option 1, and less costly than Option 3.

Option 3 – Full Median Station

Per the PEL, RTD and the local jurisdictions have indicated their preference for a median station that includes two platforms with bypass lanes at the platforms; this is the option that was presented in the PEL.

- **Bus Operations.** This option would maximize the use of the express lanes and eliminate bus weaving movements across I-25. It would provide the best travel time and reliability for bus service.
- **Private Automobile Impacts.** This option would improve general traffic operations by eliminating bus weave from express lanes to side bus only slip ramps.
- **88th Avenue Bridge Length.** This option would require the longest length (348').
- **Culvert Replacement/Pedestrian Bridge.** Existing Niver Creek 8'x4' box will be replaced with two 11'x4' boxes to increase capacity. The existing box is undersized and the existing pedestrian underpass is used as the overflow. The existing pedestrian underpass would be replaced with a pedestrian bridge.
- **Right-of-Way (ROW) Impacts.** This option could likely be the most impactful, potentially requiring acquisition of four apartment buildings plus tenant relocations.
 - ROW impacts can be avoided by modifying the two platform station and making some adjustments to design variables.
- **Construction Phasing.** This option would be the most complex, requiring additional phasing to maintain bus access to the existing Park-n-Ride.
- **Cost.** This would be the costliest option based on the physical footprint and impact to the apartments located north of 88th Avenue and west of I-25.

BUS SHOULDER RUNNING

CDOT and RTD have discussed adding bus shoulder running to the corridor, similar to that used on US 36 between interchanges. All three of these options do not preclude potential outside bus shoulder running as being considered by CDOT and RTD. However, since the goal of the project is to add auxiliary lanes between interchanges, the effectiveness of shoulder running lanes may be reduced. An operations analysis would need to be prepared to determine if the bus shoulder running option would still be beneficial with the planned added auxiliary lanes.

CONCLUSION

Evaluation of the three options presented found that there are pros and cons to each. As shown in the table below and based on the evaluation, Option 2 Modified Access currently appears to provide the best option when considering bus operations, general purpose travel, ROW impacts, construction, and cost. However, if funding can be secured for the median station, Option 3 would provide the highest quality bus service and enable buses to maximize their use of the new express lanes on I-25.

Option Evaluation Metric	Option 1 No Direct Access	Option 2 Modified Access	Option 3 Median Station
Bus Operations	(-)	++	+++
Private Automobile Impacts	+++	++	+++
ROW Impacts	+++	++	+
Phasing	+++	+++	+
Cost	+++	++	(-)



MEMORANDUM

TO: Stephanie Alanis, PE, CDOT Resident Engineer

FROM: Jeanne Sharps, PE
Rick Erjavec, PE

DATE: April 19, 2018

SUBJECT: I-25, US 36 -104th Improvements - City of Thornton Regional Trail Relocation Options
CDOT Project NHPP 0253-250 (21180)
FHU Reference 115388-01

CDOT is completing preliminary design and an Environmental Assessment for improvements to I-25 from US 36 to 104th Avenue. Proposed improvements impact the City of Thornton Regional Trail along the west side of I-25 north of 88th Avenue, and the current I-25 crossing at the RTD Thornton Station pedestrian underpass structure. The scope of CDOT's project includes replacing bus access to the Thornton Station east and west of I-25 to access at a median station. With the median station, a new pedestrian overpass will be completed for station access from the park-n-rides east and west of I-25, as well as allow patron crossing of I-25.

The FHU team has evaluated multiple options to replace the Thornton regional trail north of 88th Avenue and the I-25 trail crossing. A summary of the evaluations is listed below:

Option A (blue):

Description: Relocate the trail to be on top of the detention pond berm adjacent to and west of I-25, continue the trail under 88th Ave in a concrete box culvert (CBC), cross I-25 using the proposed 88th Avenue bridge then tie into the existing trail near the existing pedestrian underpass at the RTD Thornton Station. This option provides a direct regional trail route and is a cost-effective; it is CDOT's preferred option.

Status: Option A remains valid.

Option B (yellow):

Description: Relocate the trail to be on top of the detention pond berm adjacent to and west of I-25 and continue the trail under 88th Ave in a CBC. The Trail then would remain on the west side of I-25 through RTD park-n-Ride down to Tributary L, then cross under I-25 in a CBC parallel to the proposed Tributary L crossing structure. (See later discussion on investigation of pairing the trail crossing with the Tributary L crossing of I-25.)

Status: Option B was eliminated due to safety concerns associated with the length of CBC and flooding during storm events.

Option C (green):

Description: Relocate the trail to be on top of the detention pond berm adjacent to and west of I-25 and continue the trail under 88th Ave in a CBC, then cross I-25 in a CBC near the existing RTD Thornton Station pedestrian underpass.

Status: Option C was eliminated due to drainage issues (overall low spot of entire corridor), grading concerns (being able to get under I-25 in a short distance), and safety concerns (longer box culvert due to extra width of RTD station in I-25 median).

Option D (purple):

Description: Trail relocated to the west side of Niver Creek open space onto existing local trail alignment, the trail crosses under 88th Ave in a CBC then crosses over I-25 on 88th Ave bridge and ties into the existing regional trail at the west RTD Thornton Station park-n-Ride.

Status: Option D remains valid.

Option E (orange):

Description: Trail is relocated to the inside at toe of the detention pond berm, it then meanders around the berm and then crosses under 88th Ave in a CBC. The trail then crosses I-25 on the proposed 88th Ave bridge.

Status: Option E remains valid.

Eliminated I-25 Trail Crossing Alternatives:

The following were eliminated from consideration for the CDOT project.

- *RTD Thornton Station* - Cross I-25 at the proposed RTD Thornton Station overpass pedestrian structure. RTD's preference is to separate RTD patrons from regional trail users, specifically bicyclists; therefore, they do not favor regional trail users crossing I-25 on RTD's pedestrian overpass, and this alternative was eliminated.
- *RTD Thornton Station* - Cross I-25 on a separate overpass structure near the RTD pedestrian overpass; the overpass is possible however associated approach retained fill or structures would conflict with access for the RTD pedestrian structure.
- *Tributary L* - Cross I-25 on a separate overpass structure near Tributary L. This was not advanced due to cost, and issues associated with the bridge approach retained fill. Tall walls/retained fill would block viewsheds of the surrounding area and would require significant right-of-way.
- *North of 88th Avenue* - Cross I-25 via an underpass north of 88th Avenue. This is not feasible due to grades and probable impacts to the existing apartment buildings north of 88th Ave and east of I-25.

I-25 Trail Crossing Alternatives at Tributary L:

Two alternatives were evaluated for pairing the trail crossing with the Tributary L crossing of I-25:

1. Leave the existing 8'x8' Tributary L CBC and lengthen to accommodate the widening of I-25, noting that the CDOT headwater to depth ratio criteria would be exceeded. Install a parallel 14'x10' CBC to accommodate the trail crossing along with a weir to direct all flows up to the 10-year event through the existing CBC; overflows would be conveyed through the trail CBC. The elevation of the weir and the invert of the bike crossing could be designed such that I-25 would not have to be raised.
2. Replace the existing Tributary L CBC with an upsized CBC and construct a parallel 14'x10' trail CBC. The new Tributary L CBC would be sized to meet the current 100-year event plus headwater to depth ratio criteria. A weir would be installed to divert 10-year, and under, flows to the Tributary L

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I-25, US 36 -104th Improvements - City of Thornton Regional Trail Relocation Options

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CBC; greater flows would overflow into the trail CBC. This option would not require I-25 vertical alignment to be raised.

Both alternatives would increase the capacity of the Tributary L I-25 crossing. Without upstream or downstream mitigation, flooding would occur east of I-25 for properties, that are in the flood plain, but have not seen flooding because of the current inadvertent detention of Tributary L at I-25. Options to mitigate potential flooding include formalization of a planned detention facility at 88th Avenue & Pecos, plus a new detention pond just west of I-25, and yet to be determined downstream mitigation measures.



Option A 2018
0305.pdf



Option B
Yellow.pdf



Option C Green.pdf



Option D 2018
0305.pdf



Option E 2018
0305.pdf

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April 19, 2018

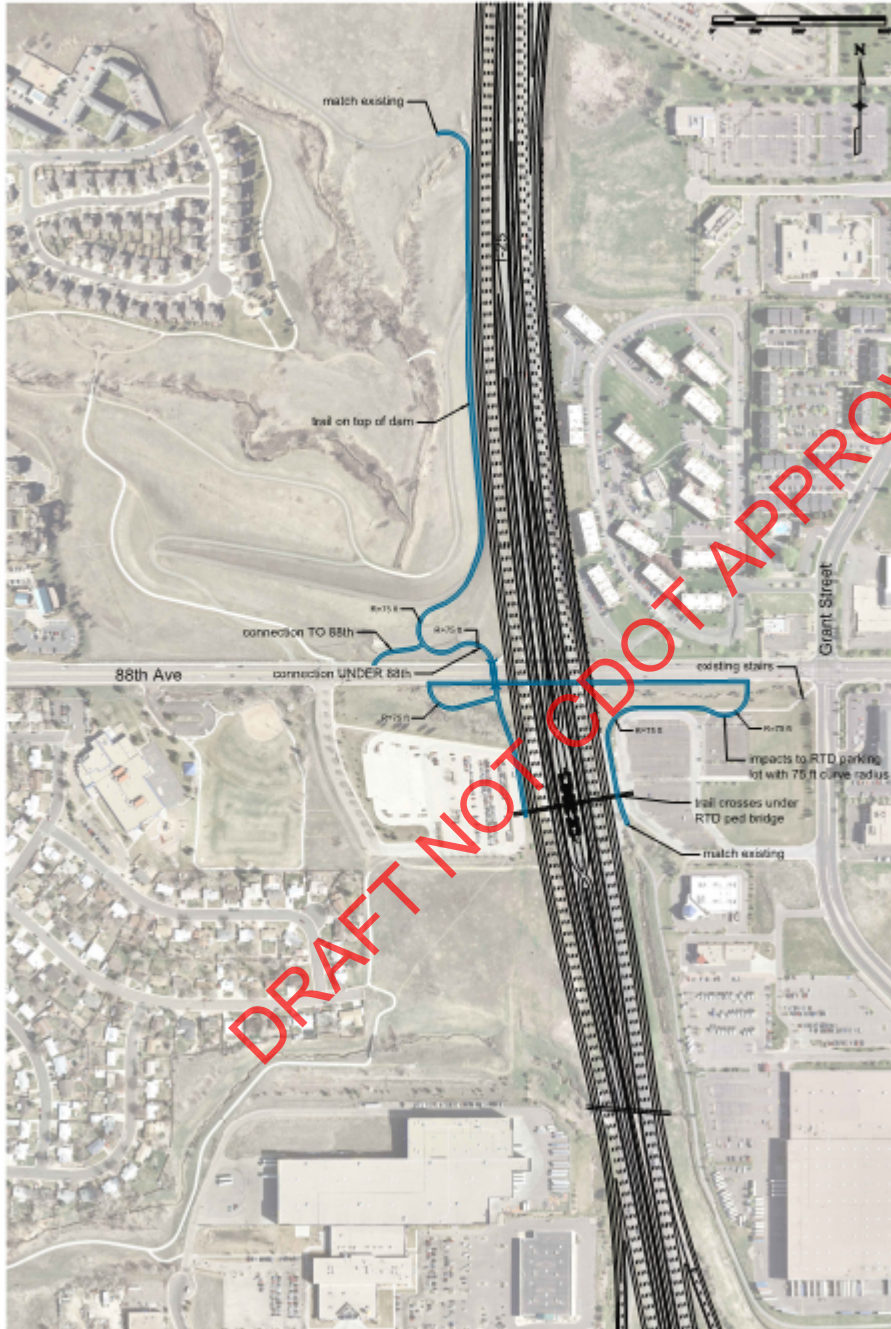
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I-25 North: Potential Trail Realignment

March 5, 2018

Option A: Trail on top of dam, cross I-25 on 88th Ave bridge



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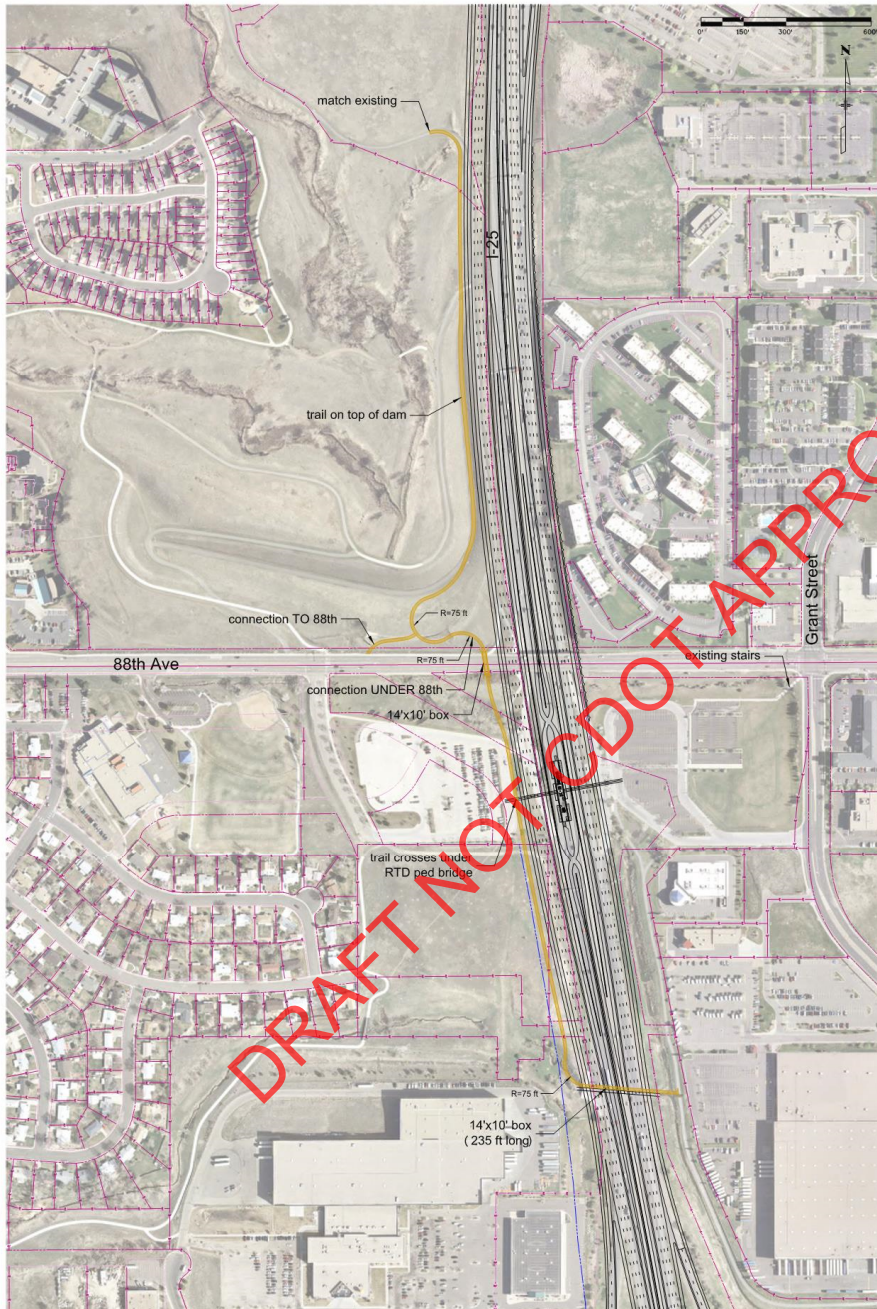
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I-25 North: Potential Trail Realignment

February 21, 2018

Option B: Trail on top of dam, cross I-25 with box culvert at Trib L



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I-25 North: Potential Trail Realignment

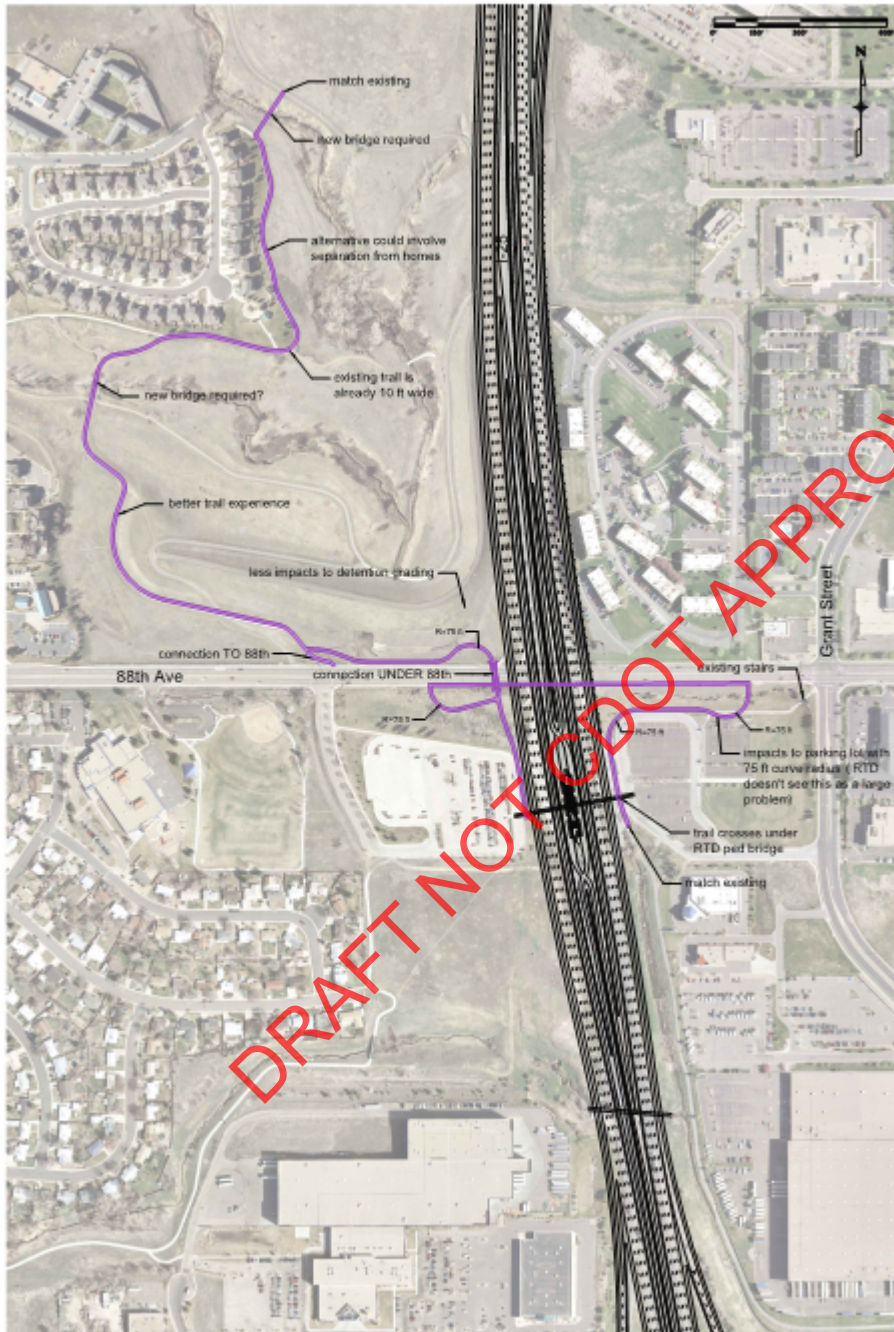
February 14, 2018

Option C: Trail on top of dam, cross I-25 with box culvert near existing underpass



I-25 North: Potential Trail Realignment
March 5, 2018

Option D: Trail moved inside detention, cross I-25 on 88th ave bridge



I-25 North: Potential Trail Realignments March 5, 2018

Option E: Trail moved inside toe of dam, cross I-25 on 88th Ave bridge

