

Prepared for the

City of
Fort Collins

BICYCLE & PEDESTRIAN



Grade Separated Crossing Prioritization Study



Prepared by

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April 10, 2018

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1. Introduction

Purpose of Study

The addition of grade separated crossings for bicycles and pedestrians in the City of Fort Collins can create new connections, make existing connections safer, and enhance the low stress bicycle network. The City has already invested in constructing several new crossing locations, and there is an identified need for investment in many other areas in the City. This prioritization study established an approach to prioritize candidate bicycle and pedestrian grade separation locations to direct future investment towards locations that need it most using a data driven approach using both data and engineering judgement. The prioritization process included:

- Crossing opportunities identification
- Evaluation criteria identification and definition
- Data compilation
- Screening and prioritization according to the benefits generated for the bicycle network and the community

Project Management Team (PMT)

The multi-disciplined team included representatives from multiple City departments to provide a balanced comprehensive assessment of project opportunities.

- Aaron Iverson, Transportation Planning
- Nancy Nichols, Safe Routes to School
- Tessa Gregor, FC Bikes
- Nicole Hahn, Capital Projects
- Suzanne Bassinger, Park Planning and Development
- Tim Tuttle, Traffic Engineering

Consultant team staff from AECOM and Toole Design Group also participated on the PMT.

2. Crossing Opportunities Identification

Prior to this prioritization study, many crossing locations were discussed in previous studies in other contexts. A consolidation of various sources was required to generate a comprehensive list and GIS data layer that could be used to measure each potential crossing location.

Review of Previous Studies

Previous studies identified key crossing locations and pedestrian and bicycle connectivity in Fort Collins. Each of the following studies was reviewed for relevant information to inform the prioritization of grade separated crossing locations:

- Fort Collins Bicycle Master Plan (2014)
- Paved Recreational Trail Master Plan (2013)
- Fort Collins CIP (2012)
- Pedestrian Plan (2011)
- NFRMPO Non-Motorized Plan (2017)

In addition to locations identified in previous studies, the PMT identified other crossing locations that had been identified as potential grade separations in the context of other projects. Together, the PMT agreed upon the locations that should be evaluated for further prioritization. Figure 1 on the next page shows the top 25 priority locations.

Map of Locations

Potential new crossing locations and all existing grade separated crossings are identified below.

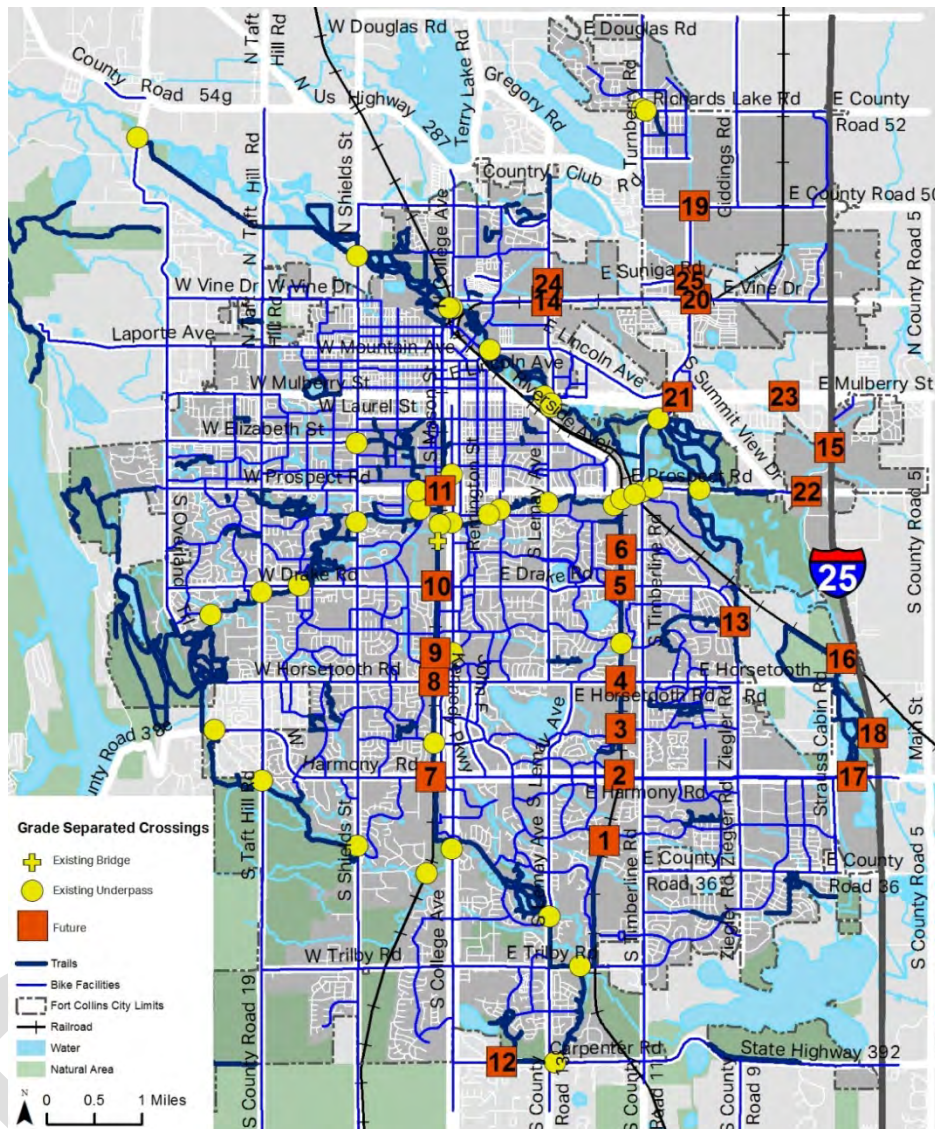


Figure 1: Identified Grade Separated Crossings

- | | |
|---|---|
| 1 Power Trail Connection over UPRR | 14 Future crossing over RR |
| 2 Power Trail/Harmony | 15 Boxelder Creek under I25 |
| 3 Caribou to Power Trail (RR Xing) | 16 Poudre River Trail crossing GWR west of I25 |
| 4 Power Trail at Horsetooth Rd | 17 Connection to future trail south of Harmony |
| 5 Power Trail at Drake Rd | 18 Poudre River Trail at I25 (funded with I25) |
| 6 Nancy Gray to Power Trail (RR Xing) | 19 Future Timberline Trail at Mountain Visa Dr |
| 7 Mason Trail Crossing at Harmony Rd | 20 Future Timberline Trail at Vine Dr |
| 8 Mason Trail at Horsetooth Rd | 21 Future Timberline Trail at Mulberry St |
| 9 Mason Trail to Foothills Pkwy (RR overpass) | 22 Future NE Trail at Prospect Rd (approximate) |
| 10 Mason Trail at Drake Rd | 23 Future NE Trail at Mulberry St (not in FC) |
| 11 Mason Trail at Prospect Rd | 24 Future Suniga crossing Lemay Ave |
| 12 Carpender Road btwn College & Lemay | 25 Future Suniga crossing Timberline Rd |
| 13 Trail crossing Ziegler Rd near Drake Rd | |

3. Prioritization Criteria

To support a data driven prioritization process, categories important to prioritization were identified and specific criteria were identified to roll up into a category score for each crossing. Specific criteria were identified within each category, as detailed below. The "range" identifies the metric for scoring or ranking each criterion, which was later used in spreadsheet format to compare criteria between each other.

Demand Category

Criteria	Definition	Source	Range
Bicycle Demand	Annual usage of bicycling infrastructure in the immediate area	Strava Metro 2016 total bike trips. For non-existent crossings, average activity taken on each side.	23 to 1339. No data available in several locations.
Pedestrian Demand	Walkability in the immediate area	Walkscore.com	1 to 76
Population Density	Existing populations within ½ mile of crossing	US Census ACS Block Group. Portion of block groups contained in buffer are proportionally weighted and summed.	371 to 3819
Youth Density	Population under 18 within ½ mile of crossing	US Census ACS Block Group. Portion of block groups contained in buffer are proportionally weighted and summed.	10% to 26%
Student Density	Number of schools within ½ mile of crossing	City of Fort Collins, Poudre School District	0-4
Senior Density	Number of seniors (65+) living within ½ mile of crossing	US Census ACS Block Group. Portion of block groups contained in buffer are proportionally weighted and summed.	6% to 22%

Connectivity Category

Criteria	Definition	Source	Range
Connectivity to Transit	Transit located within ½ mile of crossing	City of Fort Collins, Transfort bus stops.	MAX, bus, none
Part of an Enhanced Travel Corridor (ETC)	Yes/No if projects is located in Enhanced Travel Corridors, defined by the FC TMP	FC Transportation Master Plan (TMP)	Yes/No
Regional Trail Connection	Yes/No if new regional trail connection is created	Fort Collins GIS	Yes/No
Connects a Bicycle Path and/or Trail	Connects existing trail, connects future trail (if planned trail has not been constructed), or does not connect a trail	Fort Collins GIS	Yes/No
Alternate Crossing Location	Out of direction travel distance (in feet) of an alternate crossing location	Fort Collins GIS, Google	150 to 3620 ft
Connects to Existing	Yes/No if connects to existing streets and	Fort Collins GIS	Yes/No

Streets and Sidewalks	sidewalks		
Connectivity to Natural Resources	Proximity of walkable natural resources	Fort Collins GIS	0-5 min, 5-10 min, 10+ min
Connectivity to Destinations and Amenities (BNA)	Calculation of increased connectivity by low stress networks factoring in destinations and amenities over a 1 2/3 mile radius	BNA tool	0-100

Safety Category

Criteria	Definition	Source	Range
2020 Low-Stress Network Location	Crossing is along 2020 Low-Stress Network from Bicycle Master Plan	2014 Bicycle Master Plan	Yes/No
Crash Reduction Potential	Number of pedestrian and bicycle related crashes near crossing within last 5 years	Fort Collins Traffic Operations	Bike: no data, 0, 1, 2-3, 4-6; Ped: no data, 0, 1
Quality of Existing Crossing	Existing quality level and availability of existing crossing	Aerial assessment and engineering judgement	No crossing, low, medium, high

Public Support Category

Criteria	Definition	Source	Range
Included in Previous Plan	Positively mentioned in documented planning study	Various studies	Yes/No

Social Equity Category

Criteria	Definition	Source	Range
Social Equity	Number of low and moderate income populations served within 1/2 mile of project	US Census ACS	15%-70%

Cost and Constructability Category

Criteria	Definition	Source	Range
Order of Magnitude Cost & Overall Feasibility	Estimate based on level of right of way impact, physical barriers/ infrastructure, and estimated cost	Based on professional engineering judgement	Low, Medium, Medium/High, High
Partnership or Funding Opportunities	Secured or near future non City funding and partnership opportunities	City of Fort Collins	no, partial, full

4. Screening Analysis

Data Collection

Available data for each crossing location was gathered and calculated. At some crossing locations, specific criteria data were not available (for example, future crossing locations where no existing bike activity occurs). Data sources for each of the criteria are documented in the spreadsheet tool.

Screening Process

To standardize the rollup of data in each criteria to the category score, the data for each criteria were standardized into a 0-100 scale score. Depending on criteria, locations with no data were given a score of 0 or other defined score.

A full set of collected data, category weighting, and screening results are available in the supplemental prioritization spreadsheet which is meant to be a living tool to be updated as future crossing locations are identified or evaluation criteria changes.

Figure 2 shows the results of the prioritization tool at the time this report was published.

Map #	Location	Demand	Connectivity	Safety	Public Support	Social Equity	Cost and Constructability	Overall Score	Overall Rank
		<input checked="" type="checkbox"/> Bicycle Demand <input checked="" type="checkbox"/> Pedestrian Demand <input checked="" type="checkbox"/> Population Density <input checked="" type="checkbox"/> Youth Density <input checked="" type="checkbox"/> Senior Density <input checked="" type="checkbox"/> School Density	<input checked="" type="checkbox"/> Transit <input checked="" type="checkbox"/> Nature <input checked="" type="checkbox"/> ETC <input checked="" type="checkbox"/> Connects Path/Trail <input checked="" type="checkbox"/> Alt Crossing <input checked="" type="checkbox"/> Destinations (BNA)	<input checked="" type="checkbox"/> Crash Reduction Potential <input checked="" type="checkbox"/> Low Stress Network <input checked="" type="checkbox"/> Quality of Existing Crossing	<input checked="" type="checkbox"/> Included in Previous Plan	<input checked="" type="checkbox"/> Low/Moderate Income	<input checked="" type="checkbox"/> Order of Magnitude Cost <input checked="" type="checkbox"/> Partnership/Funding Opportunities		
		25%	25%	25%	0%	15%	10%	100%	
2	Power Trail/Harmony	80	57	100	0	37	63	71	1
3	Caribou to Power Trail (RR Xing)	72	61	100	0	43	13	66	2
11	Mason Trail at Prospect Rd	77	79	50	0	94	0	66	3
8	Mason Trail at Horsehooth Rd	78	66	50	0	82	13	62	4
1	Power Trail Connection over UPRR	69	57	100	0	29	0	61	5
9	Mason Trail to Foothills Pkwy (RR overpass)	71	79	33	0	83	13	60	6
6	Nancy Gray to Power Trail (RR Xing)	55	62	83	0	51	13	59	7
5	Power Trail at Drake Rd	68	62	67	0	49	25	59	8
10	Mason Trail at Drake Rd	83	57	50	0	65	0	57	9
4	Power Trail at Horse tooth Rd	69	61	67	0	33	25	56	10
7	Mason Trail Crossing at Harmony Rd	69	57	50	0	51	25	54	11
13	Trail crossing Ziegler Rd near Drake Rd	54	57	67	0	24	25	50	12
19	Future Timberline Trail at Mountain Visa Dr	51	48	50	0	52	50	50	13
21	Future Timberline Trail at Mulberry St	51	36	50	0	100	0	49	14
20	Future Timberline Trail at Vine Dr	52	37	50	0	69	13	46	15
25	Future Suniga crossing Timberline Rd	52	38	50	0	55	25	46	16
23	Future NE Trail at Mulberry St (not in FC)	52	29	50	0	83	0	45	17
22	Prospect Rd (see comments)	43	36	50	0	61	25	44	18
24	Future Suniga crossing Lemay Ave	50	41	50	0	41	25	44	19
16	crossing GWR west of I25	41	64	50	0	22	13	43	20
15	Boxelder Creek under I25	53	51	17	0	68	25	43	21
14	Future crossing over RR	51	36	50	0	57	0	43	22
18	Poudre River Trail at I25 (funded with I25)	49	50	50	0	23	0	41	23
12	Carpender Road btwn College & Lemay	46	50	33	0	36	25	40	24
17	Connection to future trail south of Harmony	44	46	50	0	22	13	40	25

Figure 2: Prioritization Results

5. Concept Design at Priority Locations

To be better prepared for future funding opportunities such as CIP funding, BFO offer, or grant applications, a more detailed analysis on the constructability of the top five priority crossing locations was completed to catalog order of magnitude cost estimates, major construction items, and major opportunities and constraints. The detailed analysis on these locations does not preclude moving forward with other locations but serves as a starting point to direct future investments and grant opportunities. Variables, such as new funding sources, could become available for locations outside of these five which could rank others higher in the future. The intent is to make this a living tool that can be modified over time.

The top five locations from the screening process are:

1. Power Trail/Harmony
2. Caribou to Power Trail (RR Xing)
3. Mason Trail at Prospect Rd
4. Mason Trail at Horsetooth Rd
5. Power Trail Connection over UPRR

In addition to these five crossings, the PMT decided to also investigate Mason Trail at Drake Rd due to the planned development in the area that could potentially contribute towards funding a new crossing.

Design Standards and Assumptions

Concept development of pedestrian and bicycle grade separated crossings for each location included an evaluation of bridge and underpass options depending on adjacent topography and site constraints. A wide variety of structure types are available at each location, but for the purposes of cost estimating the following general assumptions were made on structure type.

- Grade separated approaches and crossings were designed to accommodate a maximum grade of five percent (conforms with Americans with Disabilities Act (ADA) Standards)
- The minimum inside clear width of a pedestrian bridge on a pedestrian accessible route is 8 feet (AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2004).
- Pedestrian grade separations at railroad locations shall be in accordance with the 2016 BNSF-UPRR Railroad Guidelines for Railroad Grade Separation Projects.
- Underpass options assume the following:
 - Width of 16 feet and vertical clearance of 12 feet
 - 3-ft and 6-ft vertical cover over roadways and railroad tracks; respectively.
 - Headwalls extend approximately 5-ft (min) beyond edge of roadway or sidewalk.
 - Retaining wall and approach ramp geometric requirements based on 5% approach grades.

Power Trail at Harmony

The existing Power Trail alignment stretches 5 miles from Trilby Road on the south, to Prospect Road on the north, paralleling the west side of the Union Pacific Railroad. A 1-mile gap in the trail exists in the vicinity of Harmony Road due to the lack of a safe crossing location. Trail counts for 2017 at Horsetooth Road (1-mile north of Harmony Road) equaled 120,000. At the Southridge Greens counter (1-mile south of Harmony) the trail count equaled 78,000. The Power Trail has been identified by the North Front Range MPO as Fort Collins's portion of the Front Range Trail, identified by the state of Colorado to one day to stretch from New Mexico to Wyoming. The missing section of trail and grade separated crossing at Harmony Road will complete this popular and heavily used trail through Fort Collins.



Figure 3: View from Harmony Rd Looking North



Figure 4: View from Harmony Rd Looking South

An underpass with ramps aligned parallel to the trail is the concept that was considered as a design in this location. The trail would be extended to the north and south of the crossing to connect with the existing Power Trail. Other tunnel and bridge concepts could be further explored as part of a more detailed design effort.

Power Trail at Harmony Assumptions

- Assume 12 feet high by 16 feet wide by 200 feet long
- Assume 1 foot slab and wall thickness
- Assume 3-ft of cover (Roadway to Top of Structure)
- Assume 8" of PCCP pavement removal and replacement
- Structure excavation is computed in accordance with the CDOT M&S standard specifications.
- Retaining walls extend along a straight 5% grade between the bottom of the underpass to finished grade
- Assume north and south approaches are 240 feet each.
- Assumes 4850 linear feet of trail required to connect with existing trails

Power Trail at Harmony Challenges

- Right of way/easement requirements likely needed from railroad. Temporary signals may be required to accommodate the phased construction
- City of Fort Collins Utilities' substation on the north side of Harmony Road is an unknown utility conflict and will require significant design coordination efforts
- Manhole structures both north and south of Harmony Road may require relocation
- Constraint for the trail is limited at railroad right of way
- Revisions to the roadside drainage along Harmony Road are anticipated
- Potential PCBs from Fort Collins Utilities' substation
- Parcel south of Harmony Rd has parking lot that extends into the right of way where the trail would go. This will need to be addressed with the parcel owner.

Power Trail at Harmony Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate

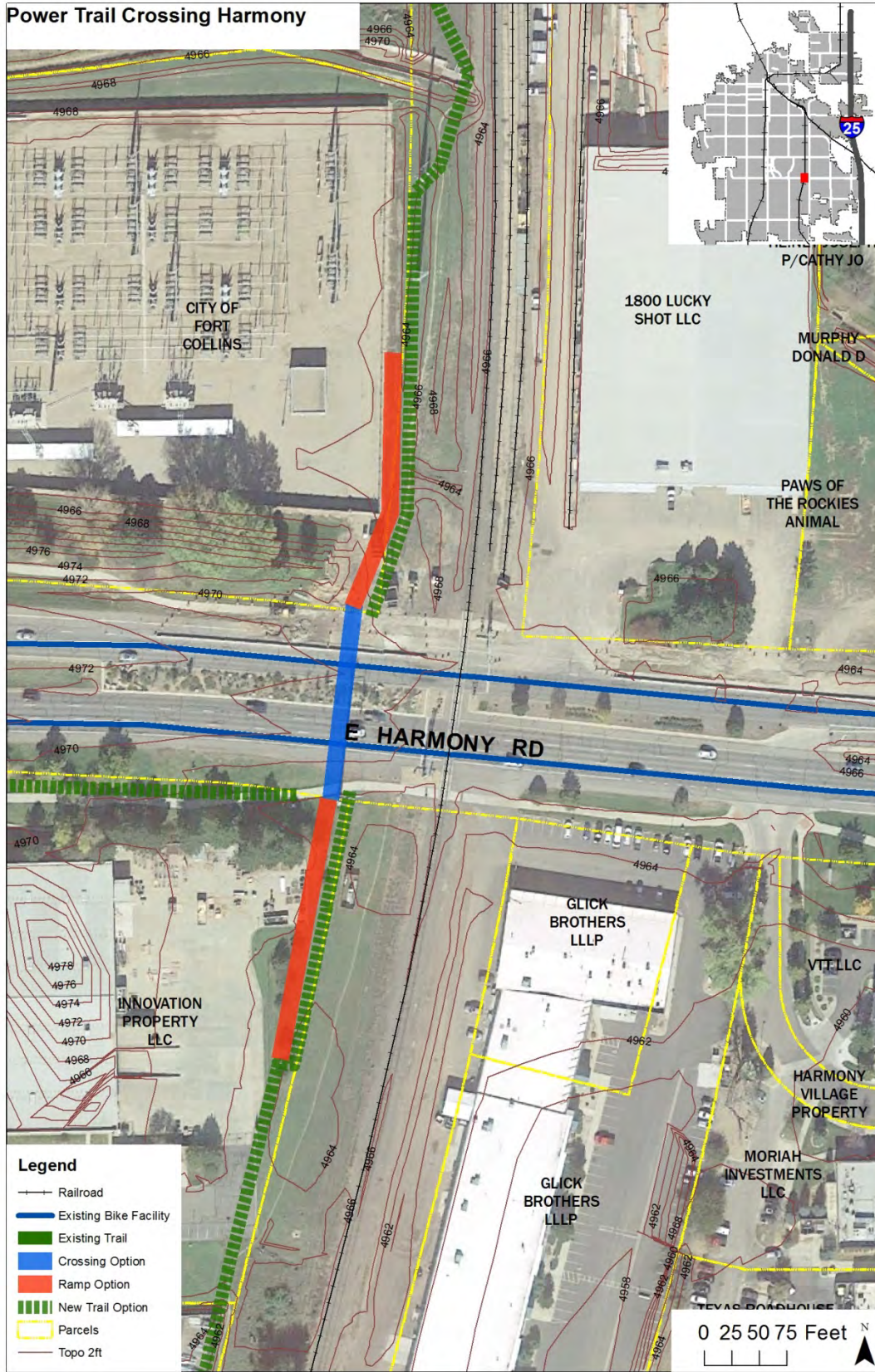


Figure 5: Power Trail at Harmony Underpass Concept

Mason Trail at Prospect Road

The Mason Trail runs east of the railroad and MAX transitway on the north side of Prospect Rd, and switches to the west side of the railroad south of Prospect Rd. Trail users cross the transitway and railroad at grade and then cross Prospect Rd at a signalized at grade crossing. A grade separated crossing at this location could create a more direct and safer route for trail users and could also improve traffic conditions.



Figure 6: Mason Trail at Prospect Rd Looking North



Figure 7: Mason Trail at Prospect Rd Looking South

This location is challenging because the Mason trail moves from the east side of the railroad on the north side of Harmony Road to the west side of the railroad on the south side of Harmony Road. Several concepts were explored, and the option that was explored as part of this effort is a tunnel under Prospect Road that does not cross the railway and transitway to join up with the Mason Trail. With this tunnel, trail users would have a grade separated crossing at Prospect Road but would still need to cross at grade over the railroad and transitway. A switchback ramp on the north side of Prospect was developed to allow this movement to happen, and a straight ramp on the south side was developed to join up with the Mason Trail.

Mason Trail at Prospect Road Assumptions

- Tunnel crossing Prospect Rd only (not crossing the railroad)
- Assume 12 feet high by 16 feet wide by 75 feet long. (Beneath Prospect, West of Mason)
- Assume 1 foot slab and wall thickness
- Assume 3-ft of cover (Roadway to Top of Structure)
- Assume 8" of PCCP pavement removal and replacement
- Structure excavation is computed in accordance with the CDOT M&S standard specifications.

- Assume underpass structure extends 10 feet past either side of roadway
- Retaining walls extend along a straight 5% grade between the bottom of the underpass to finished grade. North of Prospect Road, sidewalk to trail access via switch back is proposed
- Assume north and south approaches are 260 feet and 300 feet; respectively.

Mason Trail at Prospect Road Challenges

- Construction of this underpass will still require an at-grade crossing of the railroad and MAX guideway
- Right of way/easement requirements likely needed from railroad. Relocation of the railroad signal/communication house at the north side of Prospect Road may have significant cost impacts
- Revisions to the roadside drainage along Prospect Road are anticipated
- Retaining walls parallel to railroad tracks may require shoring and need to be designed to accommodate E80 railroad live load surcharge loading and will have significant cost impacts

Mason Trail at Prospect Road Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate

Mason Trail at Horsetooth Rd

The Mason Trail is located along the west side of the railroad both north and south of Horsetooth Road. When continuing on the trail across Horsetooth Road, trail users cross five travel lanes at grade at the signalized crossing. An underpass in this location would reduce delay for Mason Trail users and vehicles traveling on Horsetooth Road.



Figure 9: Mason Trail at Horsetooth Rd Looking South

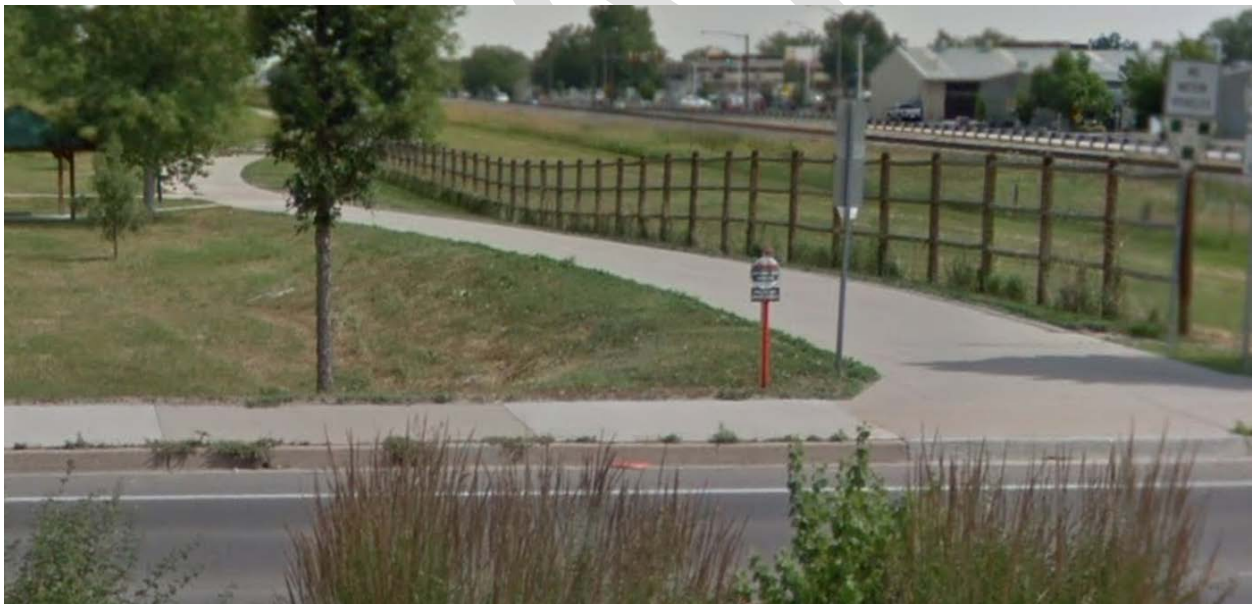


Figure 10: Mason Trail at Horsetooth Rd Looking North

The design concept explored for this location includes an overpass over Horsetooth Road on the west side of the ditch away from the railroad and utility conflicts present at the existing at grade crossing location. The ramp on the north extends down from the bridge to the ditch where it crosses and then continues to descent until it meets the Mason Trail. On the south side of Horsetooth Road, the ramp extends down between the surface parking lot and utility until it joins the existing Mason Trail.

Mason Trail at Horsetooth Road Assumptions

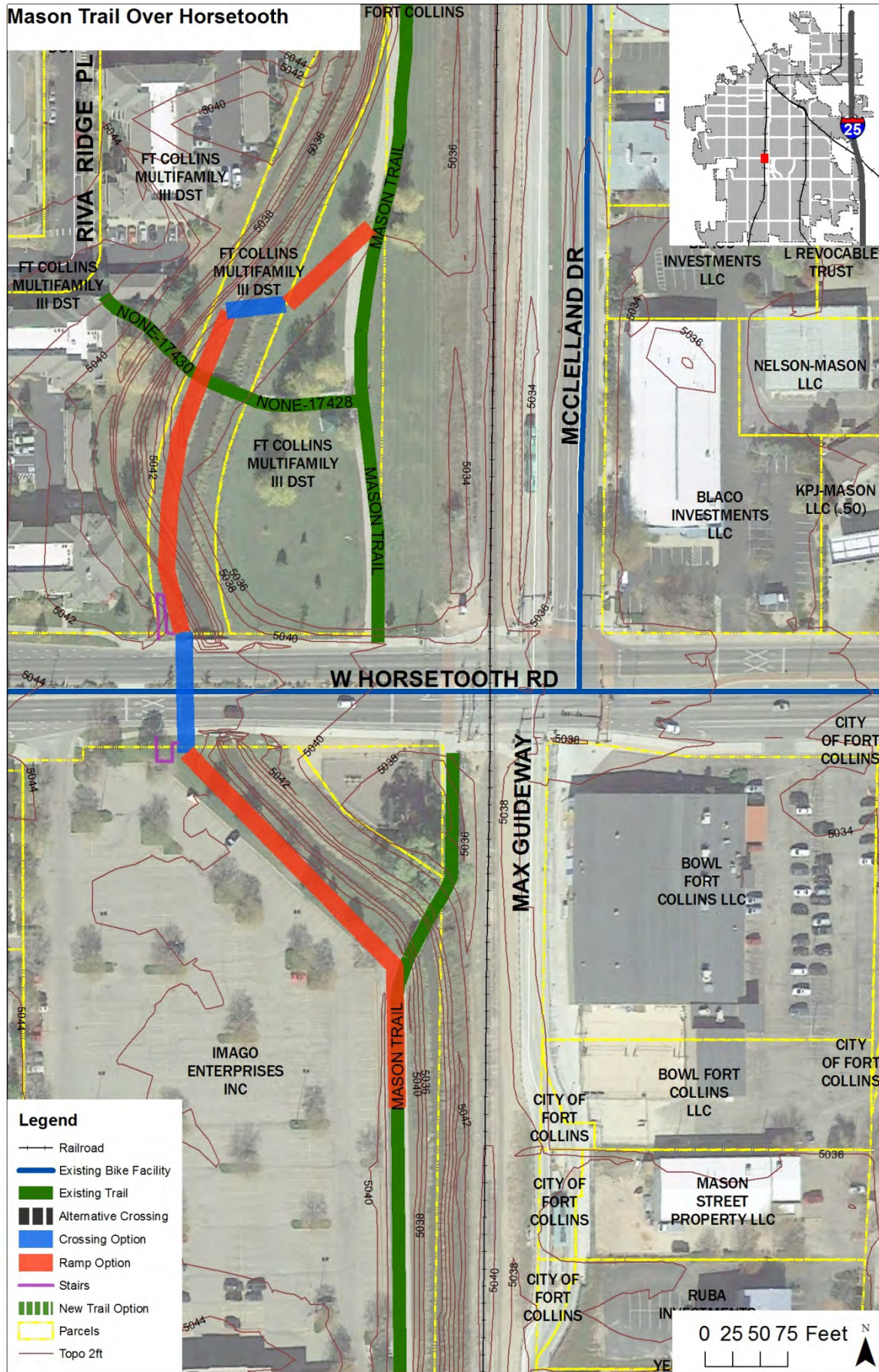
- Assumes ramp and stairway access only (i.e. no elevators)
- Assume pre-fab steel box truss structure types across Horsetooth Road and Ditch
- Assume 20 feet vertical clearance over Horsetooth Road
- Structure excavation is computed in accordance with the CDOT M&S standard specifications.
- Retaining walls are required along the elevated portions of the trail approaches both north and south the Horsetooth Pedestrian Bridge
- Ramp lengths are based on 5% grade
- Pedestrian bridge lengths over Horsetooth Road and the Ditch are 110 ft and 60 ft; respectively
- Ramp between bridge over Horsetooth and bridge over creek - 300 feet
- Ramps up to bridge over creek - 100ft each
- South Ramp up to Pedestrian bridge over Horsetooth - 400 feet

Mason Trail at Horsetooth Rd Challenges

- Right of way coordination along the west side both north and south of Prospect Road could be problematic

Mason Trail at Horsetooth Rd Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate



Mason Trail at Drake

The Mason Trail runs along the west side of the railroad both north and south of Drake Road. When continuing on the trail across Drake Road, trail users cross five travel lanes at grade at the signalized crossing. An underpass in this location would reduce delay for trail users and vehicles traveling on Drake Rd.



Figure 11: Mason Trail at Drake Looking South



Figure 12: Mason Trail at Drake Looking North

The tunnel concept developed for this location includes a tunnel adjacent to the railroad and ramps that run parallel to the railroad until they meet grade at the existing Mason Trail. Trail access points from Drake Road to the underpass are located immediately adjacent to the ramps on the west side to provide access to Drake Road.

Mason Trail at Drake Assumptions

- Assume 12 feet high by 16 feet wide by 130 feet long
- Assume 1 foot slab and wall thickness
- Assume 3-ft of cover (Roadway to Top of Structure)
- Assume 8" of PCCP pavement removal and replacement
- Structure excavation is computed in accordance with the CDOT M&S standard specifications.
- Retaining walls extend along a straight 5% grade between the bottom of the underpass to finished grade
- Assume north and south approaches are 320 feet and 360 feet; respectively

Mason Trail at Drake Challenges

- Available space on south side of Drake Road is ~30 feet between Redwing Road and the railroad right of way
- Tight constraint
- Right of way/easement requirements likely needed from railroad. Relocation of the railroad signal/communication house at the north side of Drake Road may have significant cost impacts
- Revisions to the roadside drainage along Drake Road are anticipated
- Retaining walls parallel to railroad tracks may require shoring, need to be designed to accommodate E80 railroad live load surcharge loading and will have significant cost impacts

Mason Trail at Drake Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate

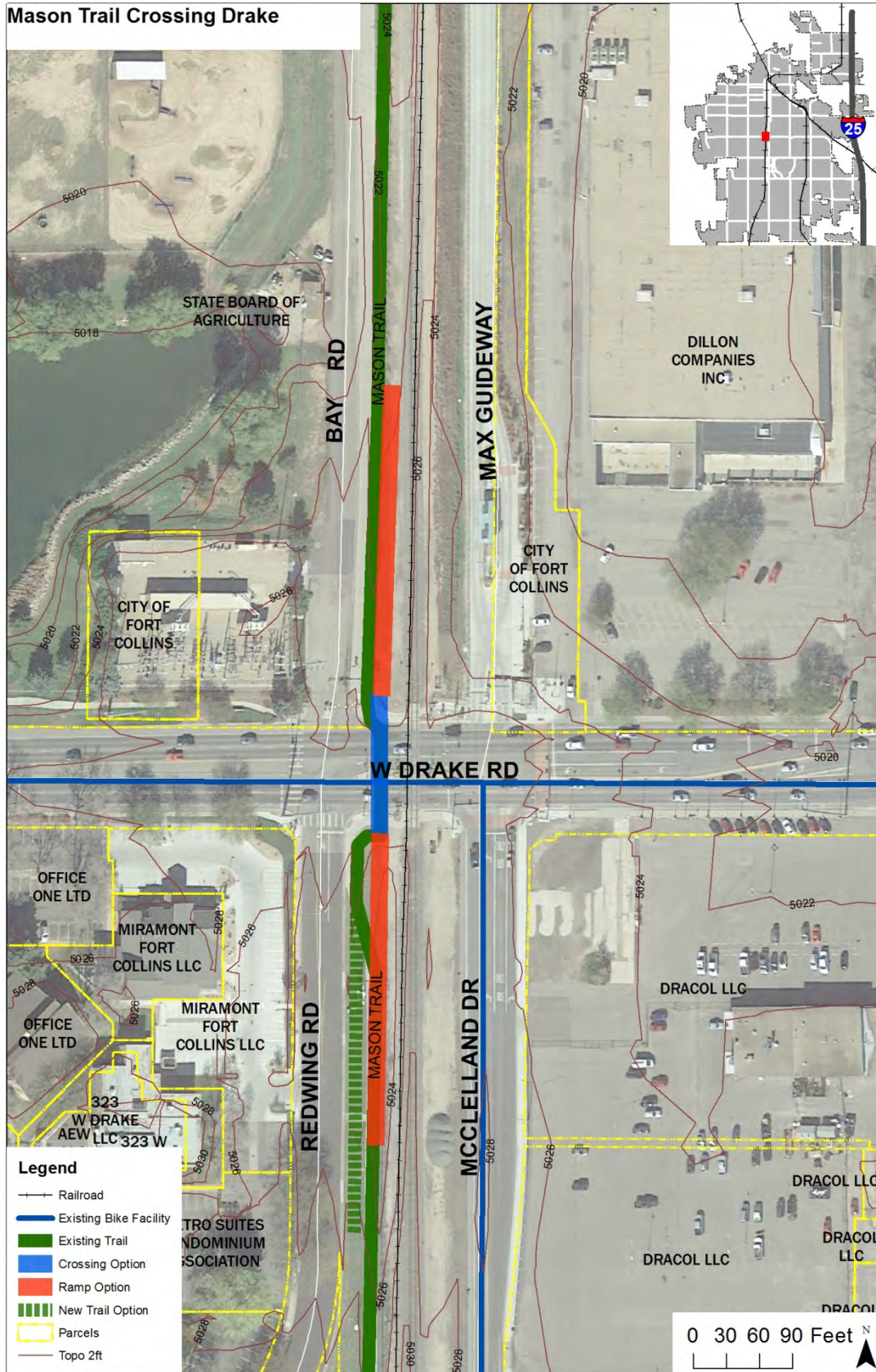


Figure 13: Mason Trail at Drake Rd

Caribou to Power Trail (RR Xing)

Bicycle and pedestrian access to the Power Trail from the neighborhoods in southern Fort Collins are limited to existing intersection crossings on the east side of the railroad. Creating a new grade separated crossing over the railroad at a location between major intersections would increase accessibility for residents and would also link together east/west on street bike routes on Caribou Drive which is located about a half mile north of Harmony Road and half a mile south of Horsetooth Road.



Figure 14: View from Caribou Dr Looking West Towards Railroad

The underpass concept explored with this concept includes a ramp on the east side of the railroad in between the buildings and a ramp on the west side of the railroad immediately extending north until it meets the Power Trail at grade.

Caribou to Power Trail (RR Xing) Assumptions:

- Assume 12 foot high by 16 foot wide by 76 foot long
- Assume 1 foot slab and wall thickness
- Assume 6-ft of cover (RR to Top of Structure)
- Assume west and east approaches are 360 feet and 320 feet; respectively
- Structure excavation is computed in accordance with the CDOT M&S standard specifications

Caribou to Power Trail (RR Xing) Challenges:

- West retaining walls parallel to railroad tracks may require shoring, need to be designed to accommodate E80 railroad live load surcharge loading and will have significant cost impacts
- Limited right of way along the east trail approach may require non-conventional retaining wall and will likely increase project costs
- Right of way/easement requirements likely needed from railroad

Caribou to Power Trail (RR Xing) Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate

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Caribou to Power Trail Underpass

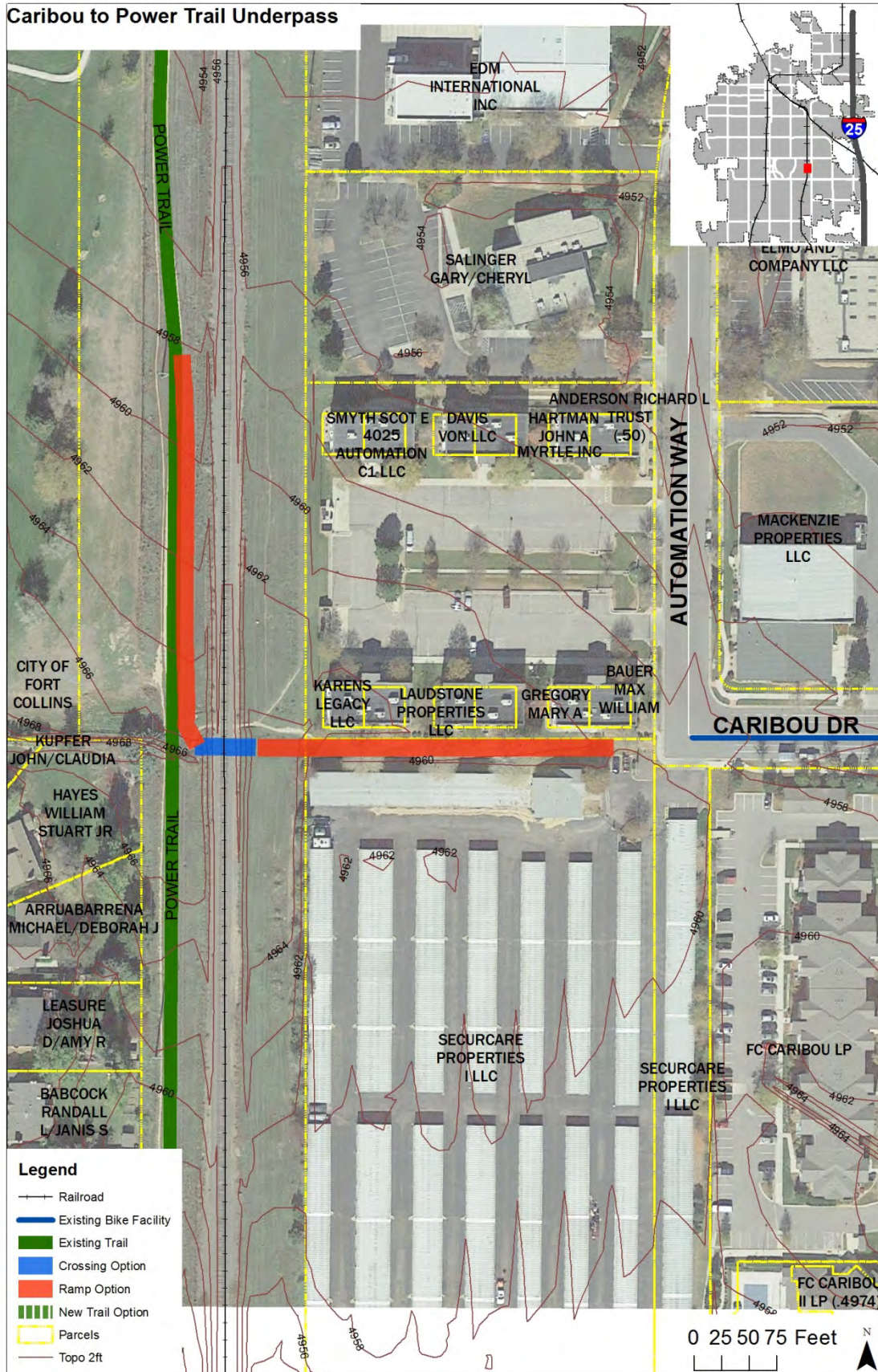


Figure 15: Caribou to Power Trail Crossing

Power Trail Connection over UPRR

The UPRR presents a significant barrier to access of the Fort Collins trail system. The area east of the RR and south of Harmony Road does not have safe access to Fort Collins recreational trail access. In addition, this crossing would be the only bike/ped crossing of the railroad in a 2-mile stretch. Several unprotected "social crossings" of the tracks, with steep embankments, are evident in this area and indicate the need for a safer crossing. Additional development currently underway in the area will only add to this crossing pressure.

A detailed feasibility study for several crossings of the UPRR around this location to access the Power Trail from the east side of the railroad was completed by Michael Baker International on April 29, 2016. Several locations and structure types were studied in the two-mile corridor west of Timberline Road to find a solution that provides the best combination of user convenience and least impact on the surrounds. The three general locations studied for possible grade separated crossings of the UPRR included:

- Keenland Underpass – at the Keenland Drive/Battlecreek Drive intersection
- Siphon Overpass – at the Mail Creek Ditch siphon crossings of the UPRR
- South Overpass – two sites north of Trilby Road

Based on the result of the study, the City would like to proceed with Siphon Overpass due to the central location between Harmony Road and Trilby Road (1 mile from each), likelihood of reducing illegal at grade crossings of UPRR, and alignment with the Trail Master Plan to the east along Mail Creek Ditch. Five concepts were developed at this location, but for the purposes of this evaluation, Siphon Overpass Concept 3 was selected as the most viable concept that could re-utilize an existing 160 foot bridge that was removed from a different location.

Power Trail Connection over UPRR Assumptions:

- Assumes ramp and stairway access only (i.e. no elevators)
- Assumes rehabilitation and relocation of the Mulberry Pedestrian Bridge.
- Stairway assumes a rise height of 7-inch
- Assumed a lower bridge cost (according to email, there is potentially an existing bridge 'saved' for this)
- Assume a required 25 feet of vertical clearance over UPRR tracks
- Assume structure dimensions of 16 feet x160 feet
- Assume a ramp width of 16 feet and a length of 129 feet to the west and 158 feet to the east
- Use Siphon option 3 from feasibility study

Power Trail Connection over UPRR Challenges:

- Potential visual impacts to existing homes and future development to the east
- Coordination with ditch company
- Overhead transmission lines may present construction and permanent challenges
- Right of way/easement requirements likely needed from railroad

Power Trail Connection over UPRR Concept level cost detail

- See cost estimate sheet for a preliminary cost estimate

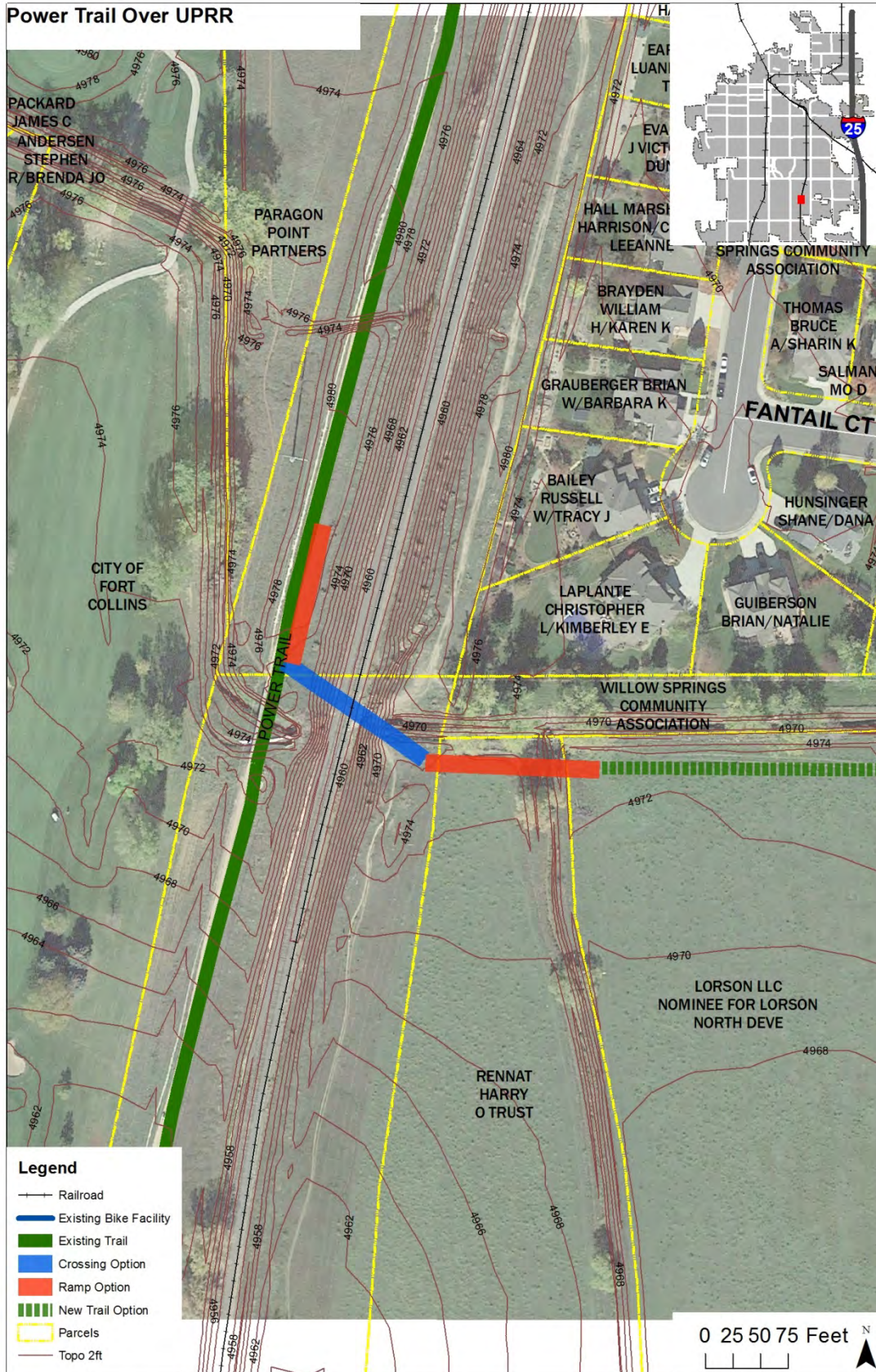


Figure 16: UPRR Connection to Power Trail

6. Next Steps

This prioritization study resulted in an organized prioritized list that can be used by the City moving forward as decisions are made about funding new capital investments. Immediate next steps to be undertaken by the city include:

- Focus on designing and funding the top six locations identified in this study. Discuss options to advance the options with City leadership, including City Council.
- Present all 25 concepts and the prioritization process to the public as part of the Transportation Master Plan (TMP) public process. Feedback received at this level can be added back to the prioritization tool to further refine the prioritization. This process could move popular projects that are prioritized lower towards the top of the list.
- In addition or potentially in lieu of presenting all options, present the top level concepts that were explored in this report to gather additional feedback. This type of feedback could inform City staff as to which option should be next in line for public investment.
- In the long term, explore the additional 19 bicycle and pedestrian grade separated crossing locations at a deeper concept level in a similar way the top six were explored in this report.

Appendix A Cost Estimate Details

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Summary of Estimated Project Worksheets			
Concept/Location	Type	Subtotal of Construction Costs	Total Program Cost
Power Trail Underpass at Harmony	Underpass	\$ 5,499,006	\$ 7,123,758
Caribou to Power Trail RR Underpass	Underpass	\$ 4,004,872	\$ 5,256,090
Mason Trail Underpass at Prospect	Underpass	\$ 4,954,421	\$ 6,318,027
Mason Trail Underpass at Drake	Underpass	\$ 5,787,958	\$ 7,234,948
Mason Trail Overpass at Horsetooth	Underpass	\$ 3,957,760	\$ 5,072,200
Power Trail Connection over UPRR	Bridge	\$ 1,394,275	\$ 1,900,843

Estimated Project Worksheet Harmony & Power Trail Underpass				
	UNITS	QUANTITY	UNIT COST	TOTAL COST
Clearing & Grubbing	SY	2175	\$5.00	\$10,874
Structure Excavation (and backfill)	CY	5476	\$50.00	\$273,778
Embankment Material	CY	135	\$25.00	\$3,384
Underpass Structure	SF	3600	\$250.00	\$900,000
Trail Section (6 inch)	SY	10283	\$25.00	\$257,067
Retaining Walls	SF	7200	\$75.00	\$540,000
Roadway Pavement Removal	SY	383	\$10.00	\$3,827
HMA Pavement	TON		\$125.00	\$0
PCCP Pavement	SY	352	\$75.00	\$26,367
Guardrailing	LF	40	\$50.00	\$2,000
Temporary RR Signals	EA	1	\$100,000.00	\$100,000
	% RANGE	% USED	COST	
Project Construction Bid Items	Project Dependent	N/A		\$2,117,297 (A)
Contingencies	(10% - 30%) of (A)	30%		\$635,189 (B)
Urban Design	(6-10%) of (A+B) Default = 5%	15%		\$317,595
ITS/Lighting	(6-10%) of (A+B) Default = 6%	3%		\$82,575 (C)
Utility Relocation	(3-10%) of (A+B) Default = 6%	20%		\$550,497 (D)
Drainage/Erosion Control/SWMP	(1-5%) of (A+B) Default = 5%	10.0%		\$275,249 (E)
Construction Signing and Traffic Control (Railroad Coordination)	5 to 25% of (A+B) Default = 20%	20%		\$550,497 (F)
Mobilization	(4 to 10%) of (A+B+C+D+E+F) Default = 7%	7%		\$294,791 (G)
Total of Construction Bid Items	(A+B+C+D+E+F+G)			\$4,823,690 (H)
Force Account - Utilities	(1 to 2%) of (H) Default = 2%	2%		\$96,474 (I)
Force Account - Misc.	(10 to 15%) of (H) Default = 12%	12%		\$578,843 (J)
Subtotal of Construction Cost	(H+I+J)			\$5,499,006 (K)
ROW Requirements		SF	UNIT COST	
		10000	\$ 25.00	\$250,000
Designer Fee	(10%) of (K)		10%	\$549,901
Constr Mngt/Inspection	(10 to 25%) of (K)		15%	\$824,851
Total Program Cost				\$7,123,758

- Str. Length 200 ft
 - Span 16 ft
 - Wall Thickness 1 ft
 - Total Width 18 ft

 - Height 12 ft
 - Top Slab 1 ft
 - Cover 3 ft
 - Total Height 16 ft

 - Approach A 364 ft
 - Approach B 368 ft

 - Retaining Walls
 - Approx. Length 240 ft
 - Area 1800 sf/wall

 - PCCP Pavement 8 in
 - Roadway 113 ft
- \$500 may have been based on total project cost
- A
 - Top Elevation 4970
 - Culvert Trail Elevatio 4954
 - End Elevation 4966
 - Approach A 240 ft

 - B
 - Top Elevation 4970
 - Culvert Trail Elevatio 4954
 - End Elevation 4966
 - Approach B 240 ft

\$ 1,527.50 per square foot 4852

Assumptions:
 Assume 12 ft high by 16 ft wide by 200 ft long
 Assume 1 ft slab and wall thickness
 Assume 3-ft of cover (Roadway to Top of Structure)
 Assume 8" of PCCP Pavement
 Treat median as another lane for pavement calcs
 Structure excavation is equal to total width of CBC +1.5' on either side+length of the approaches
 Of the 3 ft of cover, 2' is embankment material - only used on either side of roadway
 Retaining walls are treated as triangles along a straight 5% grade between the bottom of the underpass to the same elevation as the roadway
 Assume north and south approaches are 240 ft and 240 ft; respectively.
 Assumes 4850 linear feet of trailway required to connect with existing trails

*include excavation and backfill

**Estimated Project Worksheet
Caribou to Power Trail RR Underpass**

	UNITS	QUANTITY	UNIT COST	TOTAL COST
Clearing & Grubbing	SY	1577	\$5.00	\$7,887
Structure Excavation	CY	4839	\$50.00	\$241,967
Embankment Material	CY	296	\$25.00	\$7,389
Underpass Structure	SF	1368	\$350.00	\$478,800
Trail Section (6 inch)	SY	1202	\$50.00	\$60,089
Retaining Walls	SF	9860	\$100.00	\$986,000
Roadway Pavement Removal	SY	152	\$10.00	\$1,520
HMA Pavement	TON		\$125.00	\$0
PCCP Pavement	SY		\$75.00	\$0
Guardrailing	LF		\$50.00	\$0
		% RANGE	% USED	COST
Project Construction Bid Items	Project Dependent	N/A		\$1,783,652 (A)
Contingencies	(10% - 30%) of (A)	30%		\$535,096 (B)
Urban Design	(6-10%) of (A+B) Default = 5%	5%		\$89,183
ITS/Lighting	(6-10%) of (A+B) Default = 6%	2%		\$46,375 (C)
Utility Relocation	(3-10%) of (A+B) Default = 6%	6%		\$139,125 (D)
Drainage/Erosion Control/SWMP	(1-5%) of (A+B) Default = 5%	10%		\$231,875 (E)
Construction Signing and Traffic Control (Railroad Coordination)	5 to 25% of (A+B) Default = 20%	20%		\$463,750 (F)
Mobilization	(4 to 10%) of (A+B+C+D+E+F) Default = 7%	7%		\$223,991 (G)
Total of Construction Bid Items	(A+B+C+D+E+F+G)			\$3,513,045 (H)
Force Account - Utilities	(1 to 2%) of (H) Default = 2%	2%		\$70,261 (I)
Force Account - Misc.	(10 to 15%) of (H) Default = 12%	12%		\$421,565 (J)
Subtotal of Construction Cost	(H+I+J)			\$4,004,872 (K)
ROW Requirements (Easment)		SF	UNIT COST	
		5000	\$ 50.00	\$250,000
Designer Fee	(10%) of (K)		10%	\$400,487
Constr Mmgt/Inspection	(10 to 25%) of (K)		15%	\$600,731
Total Program Cost				\$5,256,090

Str. Length	76 ft
Span	16 ft
Wall Thickness	1 ft
Total Width	18 ft
Height	10 ft
Top Slab	1 ft
Cover	6 ft
Total Height	17 ft
Retaining Walls	
Average Length	290 ft
Area	2465 sf/wall
PCCP Pavement	8 in
Roadway	0 ft

A	
Top Elevation	4960
Culvert Trail Elevation	4943
End Elevation	4959
Approach A	320 ft
B	
Top Elevation	4962
Culvert Trail Elevation	4945
End Elevation	4959
Approach B	280 ft

\$ 2,927.54 per square foot

Assumptions:

Assume 10 ft high by 16 ft wide by 76 ft long. Unit cost for underpass increased for tight ROW constrain
 Assume 1 ft slab and wall thickness
 Assume 6-ft of cover (RR to Top of Structure)
 Assume west and east approaches are 360 ft and 320 ft long; respectively.
 Structure excavation is equal to total width of CBC +1.5' on either side
 Assume retaining wall can be 10 ft shorter than the average approach due to sloping nearby ground
 ROW requirements warranted from RR to Caribou Drive. Obtaining additional easements from RR could be difficult.

DRAFT

The background of the page features a dark blue gradient with white silhouettes of people. In the upper left, two figures are walking towards the right. In the lower right, a larger silhouette shows a person riding a bicycle towards the left.

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