



CITY OF FORT COLLINS QUIET ZONE PHASE II STUDY

FINAL REPORT

Prepared for:

City of Fort Collins
Transportation Planning & Special Projects
281 North College
Fort Collins, Colorado 80522

Prepared by:

Felsburg Holt & Ullevig
6300 South Syracuse Way, Suite 6
Centennial, Colorado
303.721.1440

Principal In Charge: Thomas Anzia, PE
QA/Traffic Analysis: Kyle Anderson, PE, PTOE / Rick Haden
Project Manager: Stephanie J. Sangaline, PE

FHU Reference No. 12-126-01
February 12, 2013



TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION -----	1
II. EXISTING CONDITIONS -----	3
A. Corridor Site Visit / Data Collection -----	3
B. Highway-Rail Grade Crossings -----	3
C. Existing Conditions Summary Sheets	
BNSF-Trilby-----	5
BNSF-Harmony-----	6
BNSF-Horsetooth-----	7
BNSF-Swallow -----	8
BNSF-Drake -----	9
BNSF-Prospect -----	10
BNSF-Lake-----	11
BNSF-Pitkin-----	12
BNSF-Pedestrian Crossing #1 -----	13
BNSF-University-----	14
BNSF-Pedestrian Crossing #2 -----	15
BNSF-Old Main/Plum-----	16
III. QUIET ZONE REQUIREMENTS-----	17
A. Quiet Zone Alternatives -----	18
B. Quiet Zone Establishment -----	20
C. Quiet Zone Improvements-----	20
IV. DEVELOPMENT OF QUIET ZONE CONCEPT IMPROVEMENTS-----	23
A. Development Procedure -----	23
B. Safety Considerations-----	24
C. Track Corridor Treatments-----	24
D. Concept Crossing Improvements	
BNSF-Trilby-----	26-28
BNSF-Harmony-----	29-31
BNSF-Horsetooth-----	32-35
BNSF-Swallow -----	36-37
BNSF-Drake -----	38-39
BNSF-Prospect -----	40-41
BNSF-Lake-----	42-43
BNSF-Pitkin-----	44-45
BNSF-Pedestrian Crossing #1 -----	46
BNSF-University-----	47-48
BNSF-Pedestrian Crossing #2 -----	49
BNSF-Old Main/Plum-----	50-51
V. IMPLEMENTATION PLAN-----	52
A. Oversight and PUC Regulated Costs-----	52
B. Funding Options-----	52

C.	Phasing of Improvements-----	55
D.	Concept Costs-----	58
E.	Conclusions and Next Steps -----	59
APPENDIX A	U.S. DOT CROSSING INVENTORY SUMMARY SHEETS	
APPENDIX B	QUIET ZONE SUMMARY FLOW CHART	
APPENDIX C	SSM TREATMENT EXAMPLE PHOTOS	

LIST OF FIGURES

	<u>Page</u>
Figure 1. Railroad Quiet Zone Study Area -----	2
Figure 2. Trilby Road at BNSF -----	5
Figure 3. Harmony Road at BNSF -----	6
Figure 4. Horsetooth Road at BNSF -----	7
Figure 5. Swallow Road at BNSF -----	8
Figure 6. Drake Road at BNSF-----	9
Figure 7. Prospect Street at BNSF -----	10
Figure 8. Lake Street at BNSF -----	11
Figure 9. Pitkin Street at BNSF-----	12
Figure 10. Pedestrian Crossing #1 at BNSF-----	13
Figure 11. University Street at BNSF-----	14
Figure 12. Pedestrian Crossing #2 at BNSF-----	15
Figure 13. Old Main/Plum Street at BNSF -----	16
Figure 14. Comparison of Train Horn vs. Wayside Horn Noise Footprint -----	19
Figure 15. Highway-Rail Crossing Equipped with Wayside Horns -----	19
Figure 16. Corridor Summary Map-----	62

LIST OF TABLES

Table 1. Existing Crossing Conditions-----	4
Table 2. Trilby Road Crossing Information -----	5
Table 3. Harmony Road Crossing Information-----	6
Table 4. Horsetooth Road Crossing Information-----	7
Table 5. Swallow Road Crossing Information -----	8
Table 6. Drake Road Crossing Information -----	9
Table 7. Prospect Street Crossing Information -----	10
Table 8. Lake Street Crossing Information-----	11
Table 9. Pitkin Street Crossing Information -----	12
Table 10. Pedestrian Crossing #1 Information -----	13
Table 11. University Street Crossing Information -----	14
Table 12. Pedestrian Crossing #2 Information -----	15
Table 13. Old Main/Plum Street Crossing Information -----	16
Table 14. Quiet Zone Concept Improvement Options -----	25
Table 15. Opinion of Conceptual Costs -----	61

I. INTRODUCTION

Felsburg Holt and Ullevig (FHU) is completing a railroad grade crossing Quiet Zone study to evaluate and recommend improvements at 10 highway-rail grade crossings located within the City of Fort Collins. The scope of the study consists of compiling an inventory of existing conditions at each at-grade crossing through field review and incorporation of elements known to be part of the construction of the Bus Rapid Transit (BRT) project to be completed in 2013. For each crossing, an analysis of crossing treatments was completed to determine viable options for Quiet Zone establishment. Concept crossing improvement exhibits are provided for each option, along with discussion of anticipated costs, possible funding sources and phasing of improvements.

The evaluation and analysis of the proposed improvements are addressed in five separate sections of this report:

- Existing Conditions Evaluation
- Quiet Zone Requirements
- Development of Quiet Zone Concept Improvements
- Evaluation of Quiet Zone Concept Improvements
- Implementation Plan

The portion of rail corridor that is the subject of this study is along the BNSF Railway (BNSF) track corridor. This BNSF line is oriented north-south, and runs down the middle of Mason Street in downtown Fort Collins. It then continues south of the City through residential, commercial and open spaces properties. There are 10 roadway-rail at-grade crossings along the BNSF tracks south of downtown Fort Collins that are the subject of this draft report. Those crossings (from south to north) are:

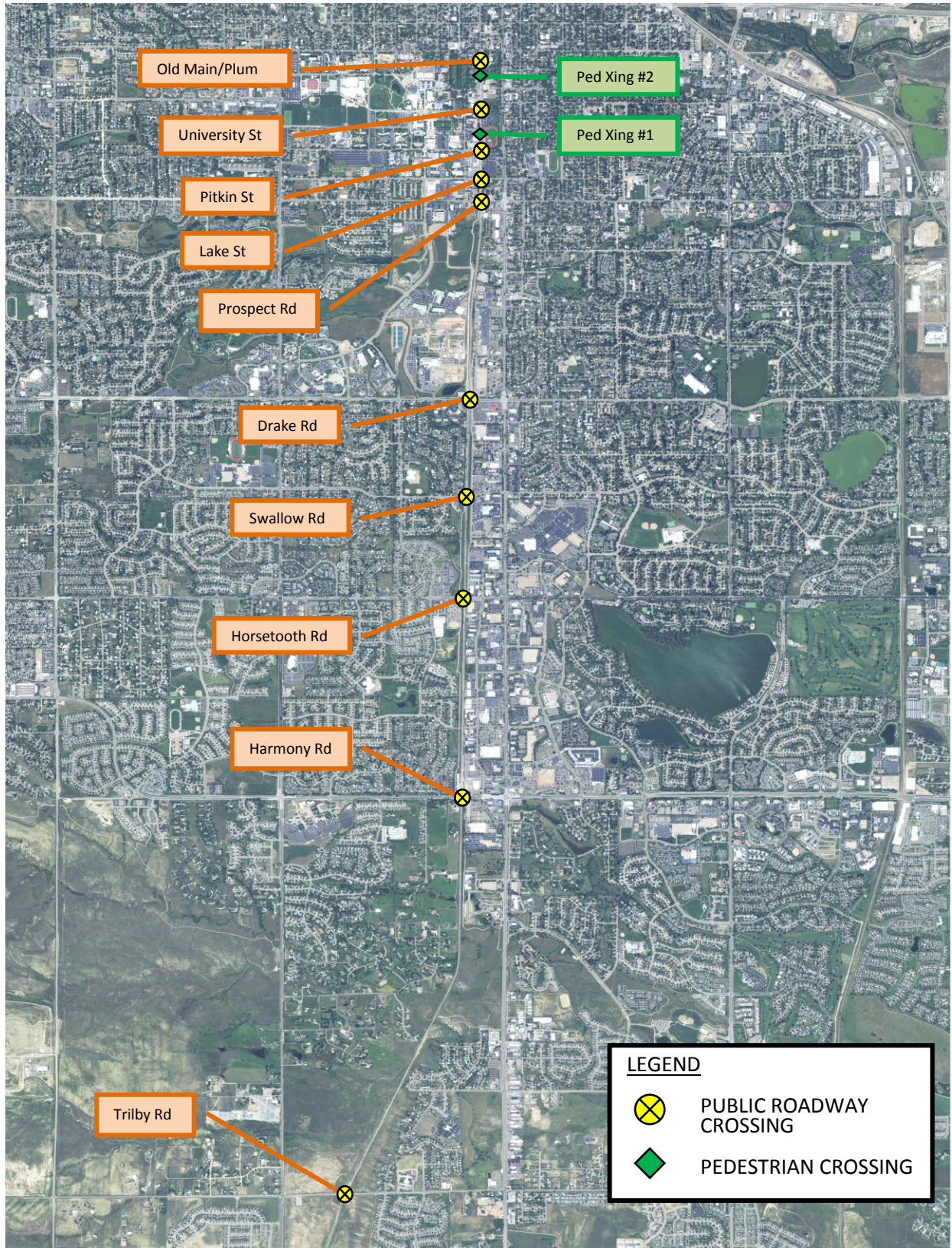
- Trilby Road
- Harmony Road
- Horsetooth Road
- Swallow Road
- Drake Road
- Prospect Road
- Lake Street
- Pitkin Street
- University Street
- Old Main Drive/Plum Street

Three of these crossings are within the campus of Colorado State University (CSU). These crossings are: Pitkin Street, University Street, and Old Main Drive/Plum Street.

Within the CSU campus portion, there are two existing at-grade pedestrian crossings of the BNSF Railway. As required by the Federal Railroad Administration (FRA) for Quiet Zone establishment, these pedestrian crossings will also be evaluated. One pedestrian crossing is located between Pitkin Street and University Street (Ped Xing 1) and the second pedestrian crossing is located between University Street and Old Main Drive/Plum Street (Ped Xing 2).

The 10 roadway-rail at-grade crossings and 2 pedestrian at-grade crossings that are part of this Phase II Study are shown on **Figure 1**.

Figure 1. Railroad Quiet Zone Study Area



II. EXISTING CONDITIONS

The BNSF Railway line runs generally north-south through Fort Collins. Within the study corridor, the tracks are predominantly adjacent to Mason Street through the CSU campus, then within BNSF Railway right-of-way south of CSU. It should be noted that the BRT project currently under construction will add a 2-lane busway along the east side of the BNSF tracks, at a distance of 25 feet (from centerline of tracks to west edge of BRT roadway) for a portion of this corridor. Along some segments, the BRT bus operations will be in mixed traffic on McClelland Drive or Mason Street, adjacent to the track corridor. Crossings of public roadways along the study corridor are generally perpendicular.

The BNSF runs as many as 15 trains per day along this line, with a maximum train speed of 49 MPH. Train speeds through CSU are restricted to no more than 20 MPH. Speeds increase south of Prospect Road to 49 MPH.

The U.S. DOT Crossing Inventory Summary Sheets for each study crossing can be found in **Appendix A**. Some of the FRA Inventory forms were updated in September 2006, with others updated more recently.

A. Corridor Site Visit / Data Collection

An initial field site review was conducted of the BNSF corridor crossings in August 2012 to collect field measurements at each of the study crossings and note current existing crossing warning devices. FHU also collected information available from the BRT project plans, including aerial mapping and Daily Traffic Volume information. Railroad corridor information was collected from the FRA and available railroad track charts, including current train movements, average train speed, and crossing circuitry.

B. Highway-Rail Grade Crossings

Table 1 summarizes the existing conditions present at each of the highway-railroad crossings and pedestrian-railroad crossings within the study area, including roadway approach photos and crossing information. The crossings of the BNSF tracks are listed from south to north.

In addition to the roadway name, the operating railroad is provided, along with the number of trains per day operating over that section of track. Also provided are the railroad milepost, railroad circuitry, existing crossing warning devices, and type of crossing surface currently in place. For any of these features that are known to be modified as part of the City's BRT project currently under construction, the updated information is provided. Each inventory indicates whether each crossing approach is equipped with a crossbuck (minimum requirement for crossings without active warning devices) and the exposure factor, which is the average daily traffic multiplied by the number of trains per day.

The northernmost crossing at Old Main/Plum Street is less than ¼ mile from the southernmost crossing (Laurel Street) that was part of the Phase I study through downtown Fort Collins. The Phase I Study, titled *Quiet Zone Study Final Report* prepared for the Downtown Development Authority and City of Fort Collins, was completed in July 2011, and included the BNSF Railway crossings from Laurel through Cherry, as well as 4 additional BNSF crossings northeast of downtown, and the two Union Pacific Railroad (UPRR) crossings at Linden and Lincoln. Because the distance between Old Main/Plum Street and Laurel is shorter than the typical length of time of the train horn sounding pattern, Old Main/Plum Street should be addressed for Quiet Zone establishment at the same time as Laurel Street.

Table 1. Existing Crossing Conditions

CROSSING	STREET	RR	M.P.	MIN. DIST BTWN XINGS (mi.)	TOTAL TRAINS	RR CIRCUITRY *	GATES/ LIGHTS	CROSSING SURFACE	NOTES
244618M	Trilby Road	BNSF	67.68	2.10	15	DC/AFO	YES	concrete	track is in low point in roadway; visibilty/speed
244620N	Harmony Road	BNSF	69.78	1.05	15	CWT	YES	concrete	BRT east of tracks @ 25 ft (inside ROW)
244622C	Horsetooth Road	BNSF	70.83	1.05	15	CWT	YES	concrete	BRT east of tracks @ 25 ft (inside ROW)
089367U	Swallow Road	BNSF	71.33	0.45	15	CWT	YES	concrete	Mason Trail west of tracks @ 35 ft (inside ROW)
244624R	Drake Road	BNSF	71.78	0.45	15	CWT	YES	concrete	Roadway east & west at 50 ft and parallel to tracks
244626E	Prospect Street	BNSF	72.78	0.12	15	CWT	YES	concrete	BRT east of tracks @ 25 ft (inside ROW)
244627L	Lake Street	BNSF	72.90	0.12	15	CWT	YES	concrete	BRT east of tracks @ 25 ft (inside ROW)
244628T	Pitkin Street	BNSF	73.05	0.15	15	CWT	YES	concrete	BRT east of tracks @ 25 ft (inside ROW)
No DOT #	Ped Xing #1	BNSF	73.16	N/A	15	None	NO	rubber	To be removed as part of BRT construction
244629A	University Street	BNSF	73.24	0.19	15	CWT	Lights	Wood (will be concrete)	BRT/Mason St east of tracks @ 25 ft (inside ROW)
244631B	Ped Xing #2	BNSF	73.40	N/A	15	None	NO	rubber	To remain; no modifications to crossing
244632H	Old Main Drive/ Plum Street	BNSF	73.46	0.08	15	None	NO	concrete	No active warning devices to be added with BRT

NOTES: Crossing treatments include installations to be completed as part of the Bus Rapid Transit (BRT) project currently under construction. These installations are considered to be the "existing" condition.

Crossings have required Constant Warning Time Circuitry (CWT) necessary for Quiet Zone establishment.

Street crossings north of Prospect through CSU do not have minimum 1/4 mile spacing and will need to be evaluated as a corridor for Quiet Zone establishment.

Crossings with a minimum 1/4 mile to the next nearest public road crossing in each direction along the tracks. Each of these crossings could, individually, be pursued for Quiet Zone establishment as funding allows.

* DC/AFO Circuitry is a fixed track circuit which does not compensate for train speed
 CWT is Constant Warning Time circuitry which compensates for varying train speed

Trilby Road Crossing Summary
US DOT Crossing #244618M

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Trilby Road is equipped with cross bucks, gates, lights, and bells. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel westbound and one thru lane in the eastbound direction. The total roadway width is approximately 32'. The roadway surface is hot mix asphalt. The speed limit on Trilby Road is posted 35 MPH east of the crossing. The pictures shown in **Figure 2** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 2**.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 2. Trilby Road Crossing Information

Roadway		Railroad	
ADT (1994)	2500	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	35	Max Train Speed (mph)	49
# of Lanes	2	# of Tracks	1
Existing Highway type	Rural Local	Crossing Surface	Concrete
Intersection			
Exposure Factor		37,500	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross bucks/Gates/Lights/Bells	
Train Detection		DC/AFO	

Exposure Factor= ADT x Trains per Day

Fig. 2. Trilby Road at BNSF



Harmony Road Crossing Summary
US DOT Crossing #244620N

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Harmony Road is equipped with cross bucks, gates, lights, and bells. One set of tracks is crossed. The roadway is configured to provide two thru lanes of travel in each direction. The total roadway width is approximately 60'. The roadway surface is hot mix asphalt. The speed limit on Harmony Road is posted at 40 MPH in the vicinity of the crossing. The pictures shown in **Figure 3** generally illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 3**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck and railroad pavement markings on each approach per MUTCD.

Fig. 3. Harmony Road at BNSF



Table 3. Harmony Road Crossing Information

Roadway		Railroad	
ADT (2008)	27,155	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	40	Max Train Speed (mph)	40
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor	407,325		
Total Train-Vehicle Accidents (5 years)	0		
Pavement Type	Hot Mix Asphalt		
Warning Devices	Cross bucks/ Gates/Lights/Bells		
Train Detection	Constant Warning Time		

Exposure Factor= ADT x Trains per Day

Horsetooth Road Crossing Summary US DOT Crossing #244622C

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Horsetooth Road is equipped with cross bucks, gates, lights, and bells. It also has one cantilever flasher on the eastbound approach. One set of tracks is crossed. The roadway is configured to provide two lanes of travel in each direction, an eastbound left turn lane, and a raised median. The roadway width is approximately 75'. The roadway surface is paved with hot mix asphalt. The speed limit on Horsetooth Road is posted at 35 MPH in the vicinity of the crossing. The pictures shown in **Figure 4** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 4**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Figure 4. Horsetooth Road at BNSF

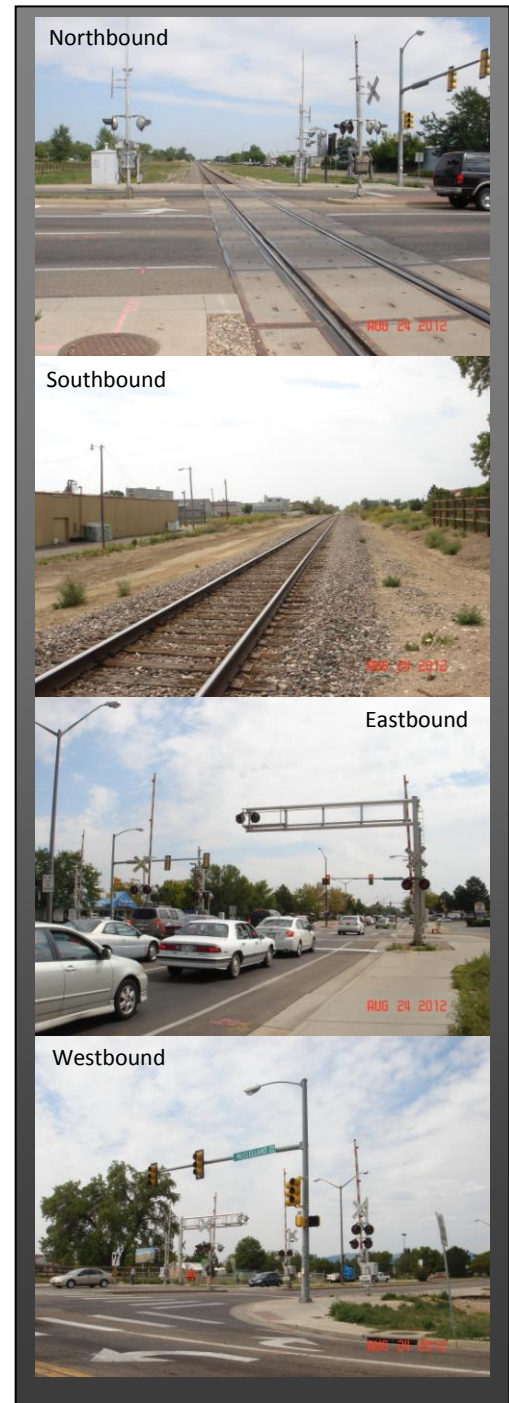


Table 4. Horsetooth Road Crossing Information

Roadway		Railroad	
ADT (2008)	27,155	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	35	Max Train Speed (mph)	40
# of Lanes	5	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor		407,325	
Total Train-Vehicle Accidents (5 years)		1	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross bucks/Cantilever/Gates/Lights/Bells	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

Swallow Road Crossing Summary
US DOT Crossing #089367U
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Swallow Road is equipped with cross bucks, gates, lights, and bells. It also has post-mounted flashers in the median on each approach. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel in each direction with a raised median. Roadway width is approximately 46'. The roadway surface is paved with hot mix asphalt. The speed limit on Swallow Road is posted at 30 MPH in the vicinity of the crossing. The pictures shown in **Figure 5** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 5**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 5. Swallow Road Crossing Information

Roadway		Railroad	
ADT (2010)	5,510	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	30	Max Train Speed (mph)	40
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor		82,650	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross bucks/Gates/Lights/Bells	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

Figure 5. Swallow Road at BNSF



Drake Road Crossing Summary
US DOT Crossing #244624R

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Drake Road is equipped with cross bucks, gates, lights, and bells. One set of tracks is crossed. The roadway is configured to provide two lanes of travel in each direction, a westbound left turn lane, and a raised median. Roadway width is approximately 78'. The roadway surface is paved with hot mix asphalt. The speed limit on Drake Road is posted at 40 MPH in the vicinity of the crossing. The pictures shown in **Figure 6** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 6**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 6. Drake Road Crossing Information

Roadway		Railroad	
ADT (2008)	23,585	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	40	Max Train Speed (mph)	40
# of Lanes	5	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor	353,775		
Total Train-Vehicle Accidents (5 years)	0		
Pavement Type	Hot Mix Asphalt		
Warning Devices	Cross bucks/Gates/Lights/Bells		
Train Detection	Constant Warning Time		

Exposure Factor= ADT x Trains per Day

Figure 6. Drake Road at BNSF



Prospect Street Crossing Summary

US DOT Crossing #244626E

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Prospect Street is equipped with crossbucks, gates, lights, and bells. One set of tracks is crossed. The roadway is configured to provide two thru lanes of travel in each direction with a raised median. Roadway width is approximately 48'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Prospect Street is 35 MPH in the vicinity of the crossing. The pictures shown in **Figure 7** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 7**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 7. Prospect Street Crossing Information

Roadway		Railroad	
ADT (2008)	29,743	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	35	Max Train Speed (mph)	40
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Other Principal	Crossing Surface	Concrete
Intersection			
Exposure Factor		446,145	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Crossbucks/Gates/Lights/Bells	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

Fig. 7. Prospect Street at BNSF



Lake Street Crossing Summary
US DOT Crossing #244627L

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Lake Street is equipped with cross bucks, gates, lights, and bells. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel in each direction. Roadway width is approximately 32'. The roadway surface is paved with hot mix asphalt. The speed limit on Lake Street is posted at 25 MPH in the vicinity of the crossing. Lake Street is at the south boundary of the Colorado State University campus. The pictures shown in **Figure 8** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 8**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 8. Lake Street Crossing Information

Roadway		Railroad	
ADT (2010)	3,301	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	25	Max Train Speed (mph)	49
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Local	Crossing Surface	Concrete
Intersection			
Exposure Factor		49,515	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Crossbucks/Gates/Lights/Bells	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

Fig. 8. Lake Street at BNSF



Pitkin Street Crossing Summary
US DOT Crossing #244628T

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Pitkin Street is equipped with cross bucks, gates, lights, bells and cantilevers. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel in each direction. Roadway width is approximately 40'. The roadway surface is paved with hot mix asphalt. The speed limit on Pitkin Street is posted at 20 MPH in the vicinity of the crossing. Pitkin Street is within the campus of Colorado State University. The pictures shown in **Figure 9** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 9**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 9. Pitkin Street Crossing Information

Roadway		Railroad	
ADT (2010)	4,153	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	20	Max Train Speed (mph)	49
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Local	Crossing Surface	Concrete
Intersection			
Exposure Factor		62,295	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Crossbucks/Gates/Lights/Bells/Cantilevers	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

Figure 9. Pitkin Street at BNSF

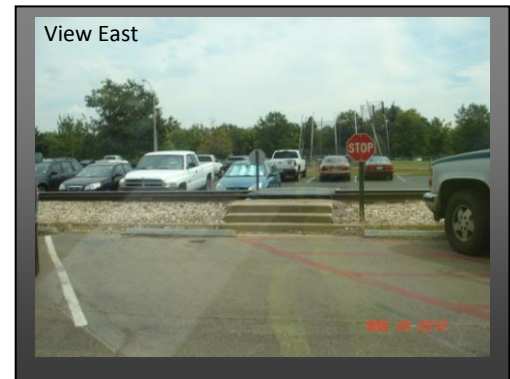


Pedestrian Crossing #1 Crossing Summary
US DOT Crossing # None

BNSF Main Line – Front Range Subdivision

There is an at-grade pedestrian crossing of the BNSF tracks (Pedestrian Crossing #1) near Jack Christiansen field on the Colorado State University (CSU) campus. This existing crossing is equipped with pedestrian scale stop signs. One set of tracks is crossed. The pedestrian crossing is approximately 8’ wide, and consists of concrete steps on either side of the tracks leading to crossing material within the tracks made of rubber. CSU campus parking exists on both sides of the tracks in this area. The picture shown in **Figure 10** illustrates the existing configuration of the pedestrian crossing. There is no US DOT number for this crossing, and therefore no crossing information from the FRA Crossing Inventory system is available. Relevant crossing information is shown in **Table 10**. It should be noted that as part of the Bus Rapid Transit construction project, this pedestrian crossing will be removed and closed. Adjacent parking to the east will be eliminated and the BRT roadway will be constructed in this location.

Figure 10. Ped Crossing #1 at BNSF



This crossing does not meet the minimum requirements for passive devices. It does not have a minimum of one cross buck on each approach per MUTCD.

Table 10. Pedestrian Crossing #1 Crossing Information

Crossing		Railroad	
ADT (2008)	N/A	Total Trains per Day	15
% Trucks	N/A	Switching Movements	0
Posted Speed (mph)	N/A	Max Train Speed (mph)	49
# of Lanes	N/A	# of Tracks	1
Existing Highway type	N/A	Crossing Surface	rubber
Crossing			
Exposure Factor		N/A	
Total Train-Vehicle Accidents (5 years)		N/A	
Pavement Type		rubber	
Warning Devices		Stop Signs	
Train Detection		None	

Exposure Factor= ADT x Trains per Day

University Street Crossing Summary
US DOT Crossing #244629A

BNSF Main Line – Front Range Subdivision

The BNSF crossing at University Street is equipped with cross bucks, lights, and bells. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel in each direction. Roadway width is approximately 42'. The roadway surface is paved with hot mix asphalt. The speed limit on University Street is posted at 20 MPH in the vicinity of the crossing. University Street is within the campus of Colorado State University. The pictures shown in **Figure 11** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 11**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

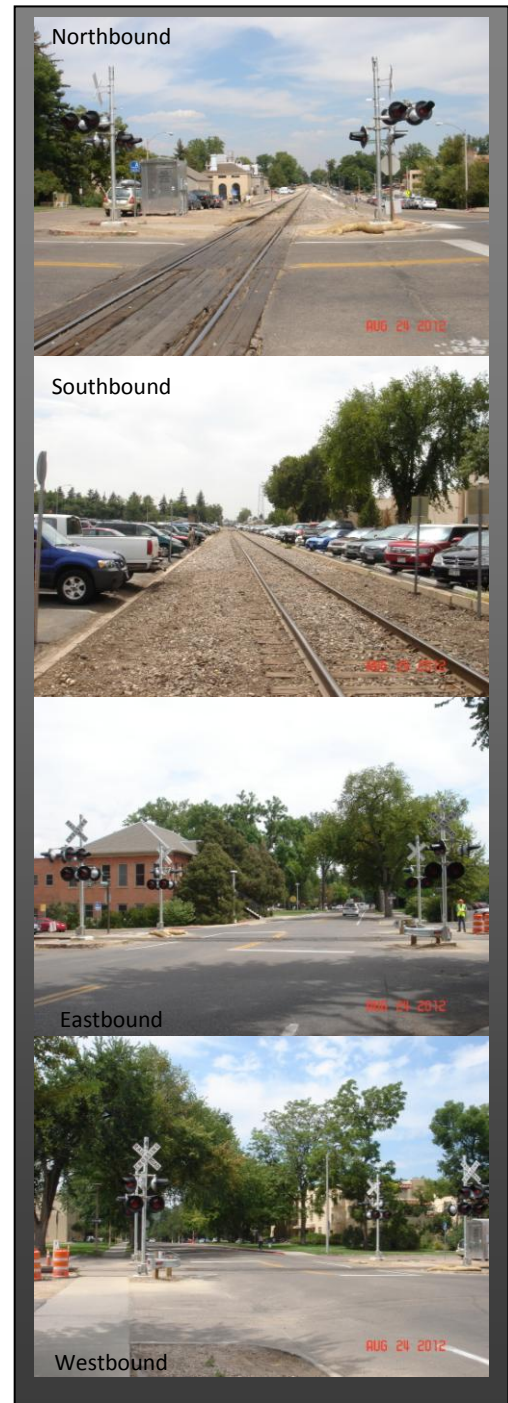
Table 11. University Street Crossing Information

Roadway		Railroad	
ADT (2010)	1,885	Total Trains per Day	15
% Trucks	0	Switching Movements	0
Posted Speed (mph)	20	Max Train Speed (mph)	49
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Local	Crossing Surface	concrete [■]
Intersection			
Exposure Factor		28,275	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross Bucks/Lights/Bells	
Train Detection		Constant Warning Time	

Exposure Factor= ADT x Trains per Day

■ Photos show wood crossing material. Concrete will be installed as part of the Bus Rapid Transit project.

Figure 11. University Street at BNSF



Pedestrian Crossing #2 Crossing Summary
US DOT Crossing #244631B

BNSF Main Line - Front Range Subdivision

There is an at-grade pedestrian crossing of the BNSF tracks (Pedestrian Crossing #2) south of Old Main Drive (Plum Street) on the Colorado State University (CSU) campus. This existing crossing is not equipped with pedestrian crossing warning signs. One set of tracks is crossed. The pedestrian crossing is approximately 8’ wide, and consists of concrete steps on either side of the tracks leading to crossing material within the tracks made of rubber. A CSU campus access road exists on the west side of the tracks. Mason Street exists on the east side of the tracks. The pictures shown in **Figure 12** illustrates the existing configuration of the pedestrian crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 12**. It should be noted that this pedestrian crossing will not be modified as part of the Bus Rapid Transit construction project, and will remain in place and functional.

This crossing does not meet the minimum requirements for passive devices. It does not have a minimum of one cross buck on each approach per MUTCD.

Figure 12. Ped Crossing #2 at BNSF



Table 12. Pedestrian Crossing #2 Crossing Information

Crossing		Railroad	
ADT (2008)	N/A	Total Trains per Day	15
% Trucks	N/A	Switching Movements	0
Posted Speed (mph)	N/A	Max Train Speed (mph)	49
# of Lanes	N/A	# of Tracks	1
Existing Highway type	N/A	Crossing Surface	rubber
Crossing			
Exposure Factor		N/A	
Total Train-Vehicle Accidents (5 years)		N/A	
Pavement Type		rubber	
Warning Devices		None	
Train Detection		None	

Exposure Factor= ADT x Trains per Day

Old Main Drive (Plum Street) Crossing Summary US DOT Crossing #244632H

BNSF Main Line – Front Range Subdivision

The BNSF crossing at Old Main Drive (Plum Street) is equipped with cross bucks and stop signs. One set of tracks is crossed. The roadway is configured to provide one thru lane of travel in each direction. Roadway width is approximately 30'. The roadway surface is paved with hot mix asphalt. The speed limit is not posted in the vicinity of the crossing. Old Main Drive is within the campus of Colorado State University. The pictures shown in **Figure 13** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 13**. Newer information known to be part of the Bus Rapid Transit construction project is provided, if available.

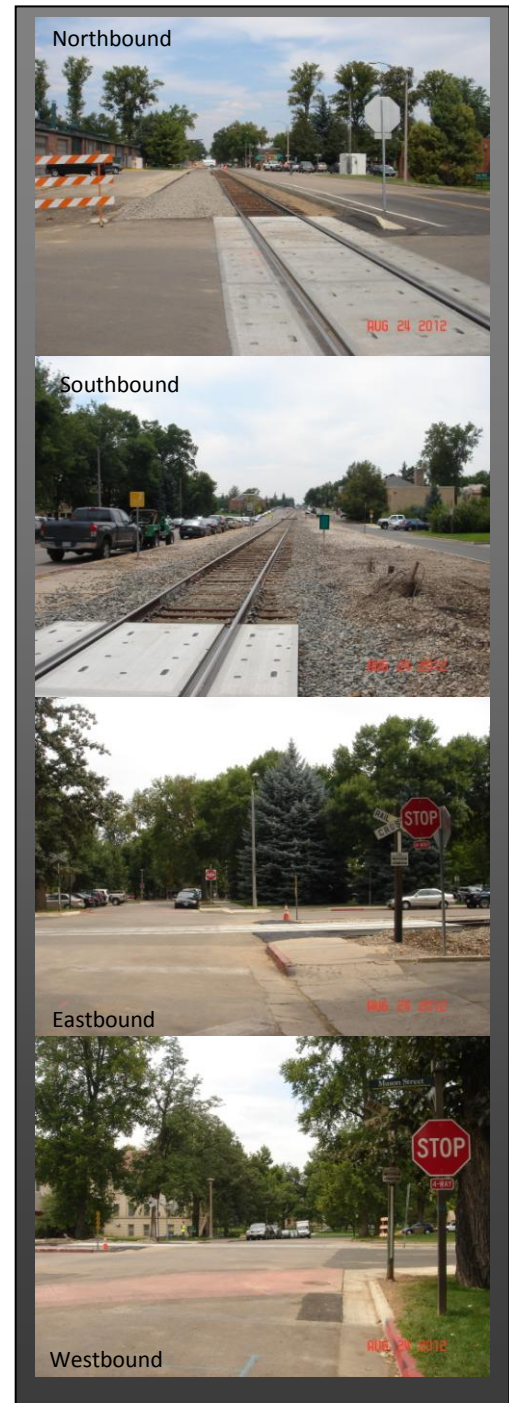
This crossing does meet the minimum requirements for passive devices with a minimum of one cross buck on each approach per MUTCD.

Table 13. Old Main Drive Crossing Information

Roadway		Railroad	
ADT (2008)	947	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	49
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Local	Crossing Surface	concrete
Intersection			
Exposure Factor		14,205	
Total Train-Vehicle Accidents (5 years)		1	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross Bucks/Stop Signs	
Train Detection		None	

Exposure Factor= ADT x Trains per Day

Figure 13. Old Main Drive at BNSF



III. QUIET ZONE REQUIREMENTS

The City of Fort Collins (City) is interested in establishing Quiet Zones along the BNSF track corridor south of downtown. This section of the report identifies the treatments necessary at the study crossings to satisfy the requirements for the establishment of a Quiet Zone.

This portion of the study is based on the criteria for the establishment of Quiet Zones as outlined in the *Final Rule on Use of Locomotive Horns at Highway-Rail Grade Crossings (Final Rule)*, which was made effective on June 24, 2005 by the Federal Railroad Administration (FRA). The *Final Rule* was last amended on August 17, 2006. On December 18, 2003, the FRA published an interim final rule that required the locomotive horn to be sounded while trains approach and enter public highway-rail crossings. The interim final rule provided exceptions to the above requirement, which enabled local communities to improve quality of life by creating “Quiet Zones” where the locomotive horn would not need to be routinely sounded if highway-rail crossings met certain conditions. The *Final Rule* facilitates the development of these Quiet Zones, requiring the implementation of Supplemental Safety Measures (SSMs) or Alternative Safety Measures (ASMs), so as to maintain safety at highway-rail crossings where locomotive horns have been silenced.

A Quiet Zone is a section of rail line that contains one or more consecutive public crossings at which locomotive horns are not routinely sounded. The *Final Rule* contains guidelines and minimum requirements for the establishment of a Quiet Zone. For the purposes of this study, all potential crossings must qualify in the New Quiet Zone category, as train horns are currently being sounded at the crossings, and the Quiet Zone would be established after the effective date of the *Final Rule*. These minimum requirements for a New Quiet Zone are as follows:

1. A New Quiet Zone must have a minimum length of ½ mile along the railroad right-of-way.
2. Each public highway-rail grade crossing within a New Quiet Zone must be equipped with active grade crossing warning devices. These devices are comprised of both flashing lights and gates which control traffic over the crossing, and must be equipped with Constant Warning Time (CWT) circuitry, if reasonably practical, and power-out indicators. Any necessary upgrades to or installation of active grade crossing warning devices must be completed before the New Quiet Zone implementation date.
3. Each highway approach to every public and private highway-rail grade crossing within a New Quiet Zone shall be equipped with a Manual on Uniform Traffic Control Devices (MUTCD) compliant advanced warning sign that advises motorists that train horns are not sounded at the crossing.
4. Each public highway-rail grade crossing within a New Quiet Zone that is subjected to pedestrian traffic and is equipped with automatic bells shall retain those bells in working condition.
5. Each pedestrian grade crossing within a New Quiet Zone shall be equipped with an MUTCD compliant advanced warning sign that advises pedestrians that train horns are not sounded at the crossing (W10-9).



W10-9

A. Quiet Zone Alternatives

The public authority that is responsible for the safety and maintenance of the roadway that crosses the rail corridor is the only entity that can apply for the establishment of a Quiet Zone. Private companies, citizens, or neighborhood associations cannot create or apply for the establishment of a Quiet Zone independent of local roadway authorities.

The focus of this study is to determine if Supplemental Safety Measures (SSMs), Alternative Safety Measures (ASMs), or Wayside Horns should be used to fully compensate for the absence of the train horn. These measures may be used to mitigate the silencing of locomotive horns at highway-rail grade crossings and reduce the risk below the National Significant Risk Threshold (NSRT) and the Risk Index With Horns (RIWH) as defined in the *Final Rule*.

The SSMs to be considered, as identified in the *Final Rule*, include the following:

- Temporary Closure (used with a nighttime-only quiet zone)
- Four-Quadrant Gate System
- Gates with Raised Medians or Channelization Devices
- Conversion to One-Way Street with Gates across the roadway
- Permanent Crossing Closure

SSMs are recognized measures that do not require further FRA review or approval prior to implementation. Photos showing these SSM treatments are provided in **Appendix C**. Alternative Safety Measures (ASMs) consist of improvements that fall outside the scope of SSMs, and may be proposed to FRA for consideration and approval. ASMs include Modified SSMs, Non-engineering ASMs, and Engineering ASMs. The effectiveness rate of ASMs must be determined prior to FRA approval; it should be noted that the implementation of several ASMs may be required in order to reduce the risk below the threshold for the silencing of train horns.

Wayside Horns are FRA approved devices that may be used in lieu of locomotive horns at individual or multiple highway-rail grade crossings, including those within Quiet Zones. The wayside horn is a stationary horn located at a highway-rail grade crossing, designed to provide audible warning to oncoming motorists of the approach of a train. As per the *Final Rule*, a highway-rail grade crossing with a wayside horn shall be considered in the same manner as a crossing treated with an SSM. A comparison of train horn and wayside horn noise footprints are depicted in **Figure 14**. A highway-rail crossing with a wayside horn installation is shown in **Figure 15**.

Figure 14. Comparison of Train Horn vs. Wayside Horn Noise Footprint

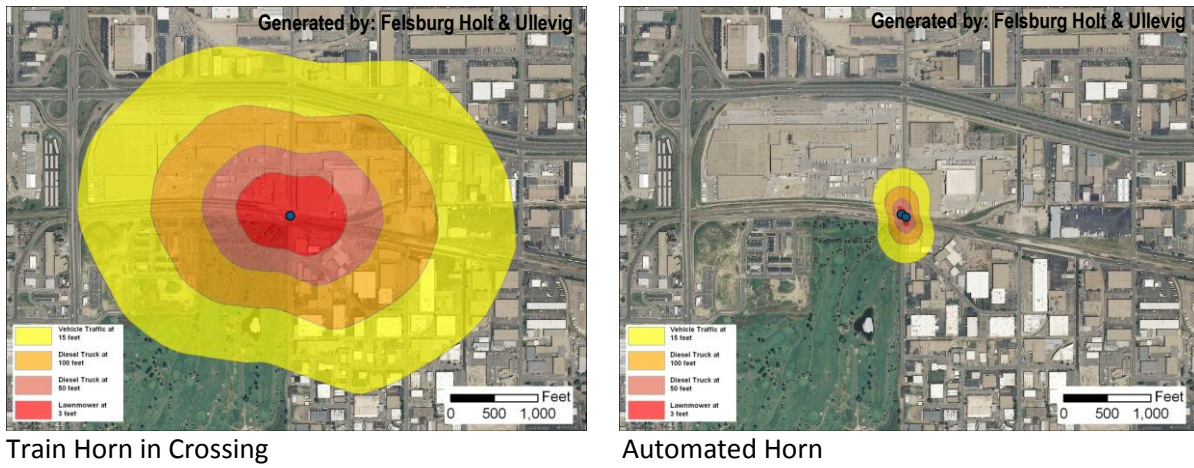


Figure 15. Highway-Rail Crossing Equipped with Wayside Horns



B. Quiet Zone Establishment

Per the *Final Rule*, there are two different methods for establishing Quiet Zones; public authority designation and FRA approval. In the public authority designation method, an SSM is applied at every public grade crossing within the proposed Quiet Zone. In this method, the governmental entity establishing the Quiet Zone would be required to designate the perimeters of the Quiet Zone, install the SSMs, and comply with various notice and information requirements set forth in the rule.

The FRA approval method provides a governmental entity greater flexibility in using SSMs and ASMs to address the crossings of interest. This method allows FRA to consider Quiet Zones that do not have SSMs at every crossing, as long as implementation of the proposed SSMs and ASMs in the Quiet Zone as a whole would cause a reduction in risk to compensate for the absence of routine sounding of the locomotive horn.

In either method, a series of notices must be sent out to interested parties. These notices include the Notice of Intent to Create a Quiet Zone, and the Notice of Quiet Zone Establishment. Flowcharts depicting the procedure for the establishment of Quiet Zones can be found in **Appendix B**.

C. Quiet Zone Improvements

Each highway-rail grade crossing within the Phase II study area south of the City of Fort Collins was evaluated for the implementation of a Quiet Zone.

Trilby to Drake -

The crossings from Trilby (south end of study corridor) up to Drake can be addressed individually because those crossings each have the full ¼ mile in each direction along the tracks from the cross street where there are no other public at-grade crossings. The improvements associated with the BRT project will incorporate upgraded circuitry at Harmony, Horsetooth, Swallow and Drake. These improvements provide additional circuitry which will assist with Quiet Zone establishment. Each of these crossings can be treated with standard SSM improvements, as the roadway-railroad crossing is a typical single roadway crossing of one track that is within railroad right-of-way.

Prospect and Lake -

The BNSF crossings at Prospect and Lake are public roadway crossings under the roadway jurisdiction of the City of Fort Collins. However these crossings are 1/8 mile apart, and would need to be addressed together for Quiet Zone establishment. These two crossings can also be treated with standard SSM improvements, as the roadway-railroad crossings are typical single roadway crossings of one track that are within a railroad right-of-way.

Pitkin to Old Main/Plum Street -

The BNSF crossings from Pitkin to Old Main/Plum Street, including the two pedestrian-railroad at-grade crossings are within the limits of the CSU campus. The road authority for these roadways is CSU. The crossings at Pitkin Street through Old Main/Plum Street are within ¼ mile of each other, and therefore need to be addressed as a corridor in order to achieve a Quiet Zone through the limits of the campus. The need for the campus corridor to be addressed as a whole is in compliance with conditions of the *Final Rule*, which indicates that all crossings in a Quiet Zone need to be contiguous.

Supplemental Safety Measures Evaluation -

The concept evaluation of Supplemental Safety Measures (SSMs) focused initially on the construction of raised medians on the roadway approaches to the crossing. Other than permanent or temporary closure, this is typically the most cost effective SSM for the establishment of a Quiet Zone. In order to meet the requirements of a Quiet Zone, the installation of raised medians needs to meet several criteria. The median must extend 100' from the gate arm unless there is a driveway or intersection, in which case the median must extend at least 60' from the gate arm. The median must be at least 3' wide (4' is desirable), with a 6" barrier curb. For those locations where the construction of raised medians is not practical or feasible, wayside horns were considered as an alternative solution.

- These options worked well for the BNSF crossings at Trilby, Harmony, Horsetooth, Swallow, Drake and Prospect, as each of these crossings has, or could be widened to include, enough roadway width for a raised median. Because the BRT roadway will be 25 feet east of the tracks at the Harmony, Horsetooth, and Prospect crossings, a minimum 60-foot median would not be achievable. However, the median option could be considered for the west approach at each of these crossings, and utilized in combination with another SSM treatment on the east to form a Modified SSM solution.
- Swallow Road has McClelland Drive to the east and parallel to the track corridor. However sufficient distance is present to for a minimum 60-foot median and would allow for the option of a raised median with approach gate SSM at this crossing.
- Drake Road also has McClelland Drive to the east and parallel to the track corridor, which becomes the exclusive BRT roadway north of Drake. To the west of the crossing, Bay Farm Road to the north of Drake, and Redwing Drive to the south are aligned parallel to the track corridor and in close proximity to the crossing. This particular crossing is limited in the viable SSM treatments because of the close proximity parallel roadway corridors on both approaches.
- The crossings at Lake, Pitkin, University and Old Main/Plum are generally 2-lane roadway crossings of the tracks, one lane in each direction. At Lake, Pitkin and University, the BRT roadway will be 25 feet to the east and parallel to the track corridor. At Old Main/Plum Street, Mason Street is immediately to the east and parallel to the tracks. Each of these crossings has at least one close proximity access or public roadway to the west. Therefore none of these crossings can be treated with raised medians and approach gates as an SSM. The most viable SSM options for each of these crossings are 4-quadrant gates or wayside horns.

There are two pedestrian-railroad at-grade crossings within the CSU length of the corridor.

- Between Pitkin and University, the southern pedestrian crossing (Ped Xing 1) will be closed as part of the BRT project construction. A BRT station is to be constructed just south of University. As a result, this pedestrian crossing location is designed to be closed, with guardrail installed along the east side of the tracks to prevent trespassing and block future use. This is a permanent closure treatment, which will silence any historic train horn sounding at this location, because the crossing will no longer exist.
- The second pedestrian-railroad at-grade crossing (Ped Xing 2) is between University and Old Main/Plum Street, approximately 1/10 mile south of Old Main/Plum Street. This at-grade

crossing was formalized many years ago because it is a direct connection between the network of campus sidewalks to the west, and the sidewalk access to parking on the east. This crossing will need to be treated, at a minimum, with crossing signage per the 2009 Manual on Uniform Traffic Control Devices (MUTCD) to include a crossbuck, stop or yield sign, and (optional) LOOK sign. As with all other crossings, an advanced warning sign indicating train horns are not sounded, would need to be installed upon Quiet Zone establishment.

Following an initial review by the City, concept improvements for each of these crossings were refined. A formal Field Diagnostic Review should be held following completion of the BRT installed improvements, and when the City's pursuit of Quiet Zone establishment at one or more of these crossings is imminent. This will allow the agencies and railroad to review the crossings with the BRT constructed features in place, and provide any further refinements to the concepts.

IV. DEVELOPMENT OF QUIET ZONE CONCEPT IMPROVEMENTS

A. Development Procedure

The development of the various concepts identified in this report started with a review of the existing street configuration at each crossing and review of the existing crossing warning devices. Additionally, completed plans for the Bus Rapid Transit project currently under construction were reviewed to determine upcoming modifications to the crossing warning devices, roadway features to be constructed for the busway, and traffic signing, striping and signals to be installed. A field review was then conducted to identify the location of existing railroad crossing passive and active control, as well as pedestrian activity, adjacent land use, and physical features.

Supplementary Safety Measures (SSM) contained in the *Final Rule* were tested and screened for appropriateness at each location. Refinements were then made to those SSMs which passed the initial screening to maximize their benefits and/or reduce their impacts. Where SSMs did not fit a particular location or unduly penalized operations, modified SSMs were reviewed and evaluated.

It should be noted that Modified SSMs are treated as Engineering Alternative Safety Measures (ASM) by the Federal Railroad Administration (FRA). Unlike the process for SSMs, where the local public authority can designate a Quiet Zone using the pre-approved measures, ASMs follow a separate procedure whereby an application is made to the FRA for consideration and approval before a Quiet Zone can be implemented. The FRA has the authority and responsibility to decide whether a proposed ASM is as safe as the current situation with train horns sounding. Following is a brief description of each of the measures available to the crossings along the BNSF Railway track corridor south of downtown Fort Collins in accordance with the Final Rule:

Active Controls- For each crossing area certain basic active warning devices must be in place to establish a Quiet Zone. These include flashing lights and gates with constant warning circuitry to provide a consistent message to drivers along the roadway when on approach to a crossing.

Raised Medians- Raised medians are the lowest cost measure for preventing higher risk behavior of drivers going around the gate arms. Medians should be used wherever possible.

Wayside Horns- The wayside horns are considered a one for one trade for the locomotive horn without application to FRA for approval. Wayside horns provide a sharp cut-off of the horn sound beyond the immediate approaches to the crossing. These are shown where other SSMs are not deemed feasible and where residential land uses are not in proximity of the crossing.

4-Quadrant Gates- These are placed on both sides of the tracks to prevent vehicles from either intentionally or unintentionally entering the track area while a train is approaching. A 4-quadrant gates installation is typically the most costly of the SSM measures.

Closed Crossing- The safest and least costly treatment is to physically close a crossing whenever possible and where adequate alternate routes are available for circulation. These are generally proposed on cross streets having the lowest through traffic volumes and least continuity across the community.

B. Safety Considerations

The crossings that are the subject of this study can generally be categorized into three different crossing scenarios.

Semi-Rural/Suburban Crossing – Trilby Road exhibits characteristics of a typical semi-rural or suburban crossing. Land use in the immediate vicinity on all four quadrants is agricultural or open space with very little mature vegetation. Residential development begins approximately 800 feet to the east of the crossing, with residential to the west beginning west of Shields Street. Trilby is a 2-lane roadway with shoulders. No sidewalks and no street lighting are present near the crossing. The topography of the area is rolling, with the track crossing at a low point in Trilby Road. Consideration of possible Quiet Zone treatments must consider actual vehicle speeds, sight distance between an approaching vehicle and an approaching train, and possible effects of introducing any vertical obstructions, such as curb and gutter, to this crossing which currently has a uniform pavement elevation across the approaches to the crossing.

Developed Corridor Crossing – Crossings with 2 or more lanes, and development along each side of the railroad tracks adjacent to the railroad right-of-way constitute a more developed corridor type of crossing. These crossings have commercial or residential development on all four quadrants of the crossing. There are sidewalks and street lighting, and the terrain is relatively flat in all directions. Consideration of possible Quiet Zone treatments must consider the volume and behavior of vehicular traffic, the regular use of the crossing by sidewalk users, and the necessary coordination with closely spaced accesses or parallel roadways with or without signalization. Crossings in this category include Harmony, Horsetooth, Swallow, Drake and Prospect.

Urban/Campus Crossing – Crossings with 2 or more lanes of lower speed in densely developed areas and in very close proximity to the tracks are more urban in nature. In this case, the Colorado State University campus, located immediately south of downtown Fort Collins, continues the urban feel with close proximity parking, accesses and activity. Crossings in this category include Lake, Pitkin, University and Old Main. Consideration of possible Quiet Zone treatments must consider the variety of crossing users. While vehicle use may be lower, pedestrian and bicycle use may be substantially higher. The start of service of the Bus Rapid Transit system will also contribute to pedestrian and bike user numbers in the vicinity of one or more of the campus crossings. For establishment of a Quiet Zone, pedestrian and bike movements must be restricted to designated crossing locations along the corridor. Pedestrians and bicycles crossing in non-designated areas undermines the effort toward silencing train horns. Locomotive engineers are required to sound the horn if any person or hazard is identified within the track envelope, even in a designated Quiet Zone.

C. Track Corridor Treatments

Table 14 identifies the concept level options that were considered for each crossing within the Phase II Study Area. Following the table are concept crossing improvement exhibits for each crossing shown on aerial base maps to show identifying landmarks.

A Corridor Summary Map is provided in **Figure 16** (fold-out map) showing the entire corridor. For each crossing, a list of concept options, opinion of probable costs and notes regarding possible prioritization of improvements to the crossings are provided.

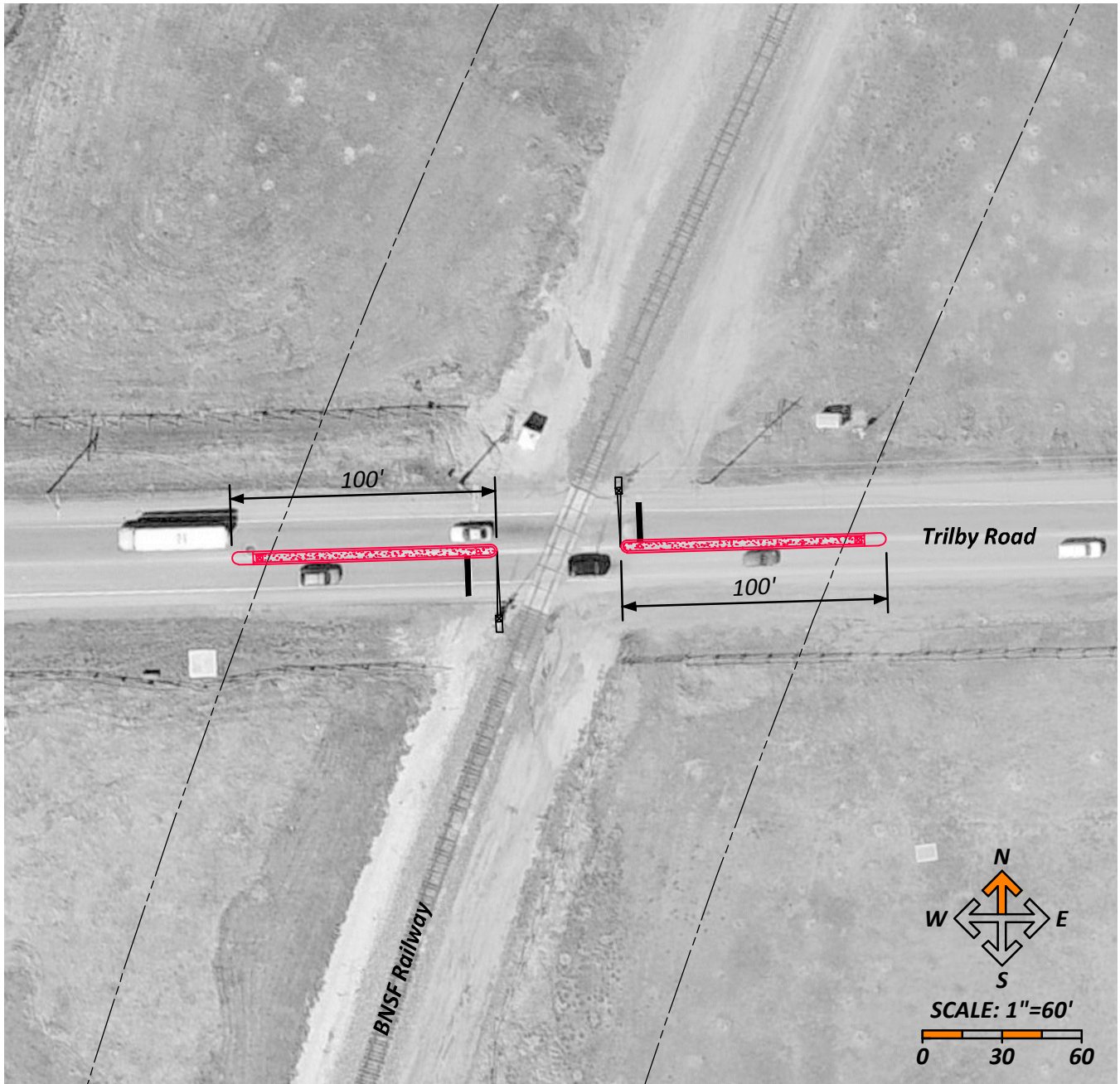
Table 14. Quiet Zone Concept Improvement Options

TYPE	STREET	RR	RR CIRCUITRY	GATES/LIGHTS	CROSSING SURFACE	SSM Alternatives				Modified SSM Alternatives		NOTES/ISSUES
						RAISED MEDIANS	ONE-WAY STREET	4-QUAD GATES	WAYSIDE HORNS	CLOSURE	RAISED MEDIAN/WAYSIDE HORN	
Semi-Rural/ Suburban	Trilby Road	BNSF	DC/AFO	YES	conc	X						Consider launch issue with vehicle speeds; drainage/snow plow issues
								X				Minimal construction; not a totally silent crossing
								X				Requires short medians to close gap between gates; will be most expensive option
Developed Corridor	Harmony Road	BNSF	CWT	YES	conc					X		Median would work west where residential is close; wayside horn east toward commercial area; not silent to the east
											X	Median would work west where residential is close; exit gate east toward commercial area; silent crossing
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
	Horsetooth Road	BNSF	CWT	YES	conc					X		BRT project will include Mason Trail crossing within 60 feet of the tracks to the west. Median breaks for trails are allowed with bollards, per FRA.
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
								X				Wayside horns would not produce a completely silent crossing, but require minimal construction/installation
	Swallow Road	BNSF	CWT	YES	conc	X						There is room for a 60-foot median to the east; Mason Trail crossing is within 60 feet. Median breaks for trails are allowed with bollards, per FRA.
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
	Drake Road	BNSF	CWT	YES	conc			X				Close proximity roadways east and west limit options; 4-quadrant gates will work
									X			Wayside horns may be an option, as close proximity residential is on SW quadrant only. This would require minimal construction/installation.
	Prospect Road	BNSF	CWT	YES	conc				X			Wayside horns may be an option, as surrounding land use is commercial. This would require minimal construction.
										X		BRT project will include Mason Trail crossing within 60 feet of the tracks to the west. Median breaks for trails are allowed with bollards, per FRA. NW access will be closed.
Urban/Campus	Lake Street	BNSF	CWT	YES	conc				X			Within CSU, some audible may still be desirable. Wayside horns would require minimal construction/installation.
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
	Pitkin Street	BNSF	CWT	YES	conc				X			Within CSU, some audible may still be desirable. Wayside horns would require minimal construction/installation.
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
	Ped Crossing #1	BNSF	None	No	rubber					X		BRT project will close this crossing to pedestrian use.
	University Street	BNSF	CWT	Lights	conc				X			Within CSU, some audible may still be desirable. Wayside horns would require minimal installation at this crossing. Post-mounted flashers on the approaches would need to be replaced with railroad gates.
								X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
	Ped Crossing #2	BNSF	None	No	rubber							Signage per 2009 MUTCD would be required to be installed on each approach.
	Old Main/Plum St	BNSF	None	No	conc			X				4-Quadrant gates are most expensive option; silences crossing; notification process only (standard SSM)
									X			Within CSU, some audible may still be desirable. Wayside horns would require minimal installation at this crossing. Railroad approach gates with bungalow/circuitry would need to be installed. Because of the proximity of this crossing to Laurel, there may be other options for minimal treatment at this crossing, when evaluated with other downtown treatments.



Trilby Road
 US DOT 244618M
 Main Line Front Range Subdivision
 SSM: Raised Medians with Approach Gates (Option 1)

Concept Crossing Improvements



NOTES:

1. Requires upgrade to CWT Circuitry and new bungalow.
2. Agricultural land use on NE, SE and SW quadrants. Open Space on NW quadrant.
3. Median width is typically 3' (face of curb to face of curb) for sign placement.

LEGEND:

- | | | | |
|--|-----------------------|--|--------------------------|
| | Existing Gate | | Proposed Gate |
| | Existing Median | | Proposed Median |
| | Existing Stop Bar | | Proposed Curb and Gutter |
| | Existing Cantilever | | Proposed Wayside Horn |
| | Existing Sign | | Proposed Sign |
| | Railroad Right-of-Way | | |



Trilby Road
 US DOT 244618M
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 2)

Concept Crossing Improvements



NOTES:

1. Requires upgrade to CWT Circuitry and new bungalow.
2. Agricultural land use on NE, SE and SW quadrants. Open Space on NW quadrant.

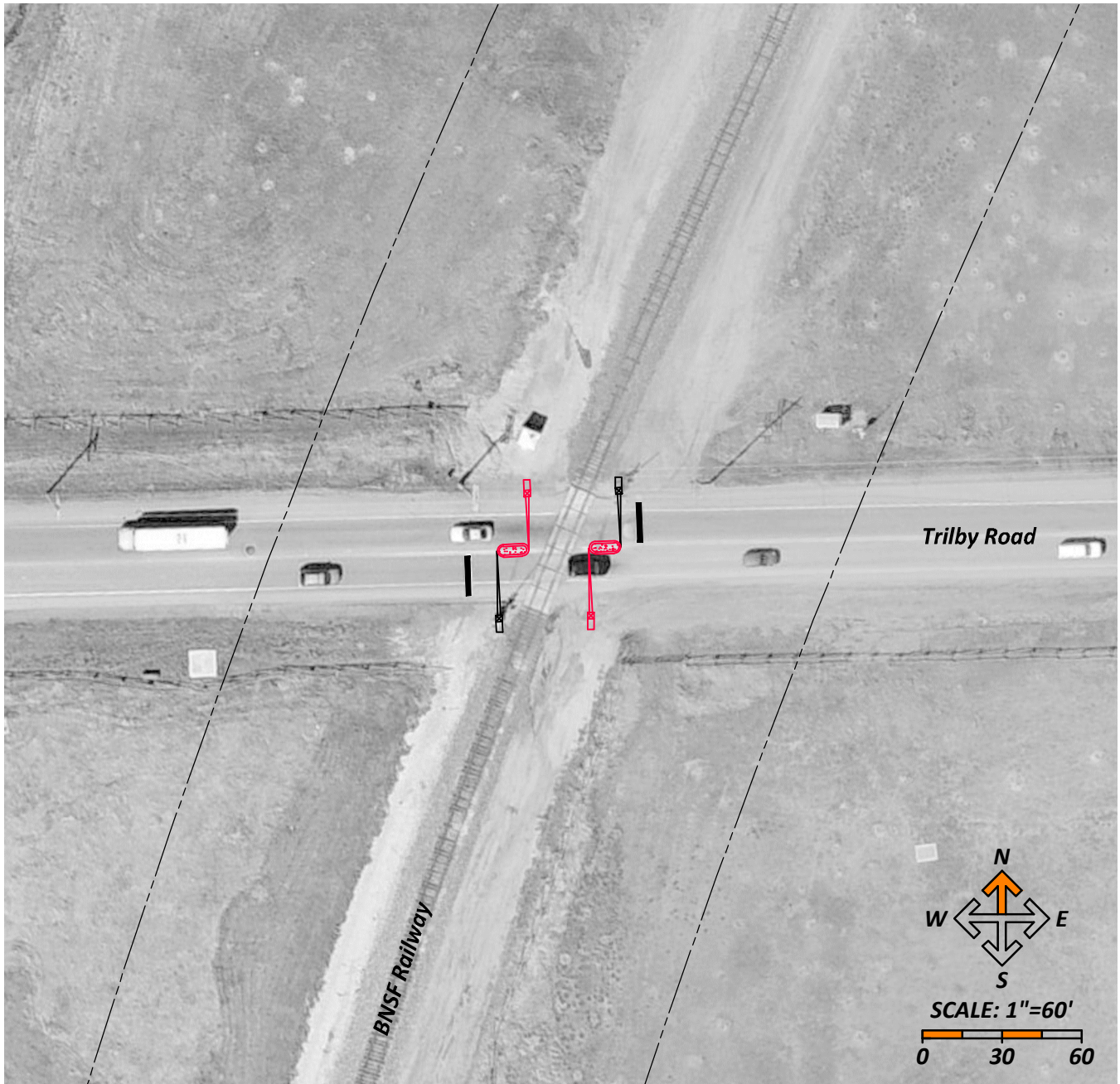
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Trilby Road
 US DOT 244618M
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 3)

Concept Crossing Improvements



NOTES:

1. Requires upgrade to CWT Circuitry and new bungalow.
2. Agricultural land use on NE, SE and SW quadrants. Open Space on NW quadrant.
3. Requires short medians (12-ft) to close gap between gate tips in down position.

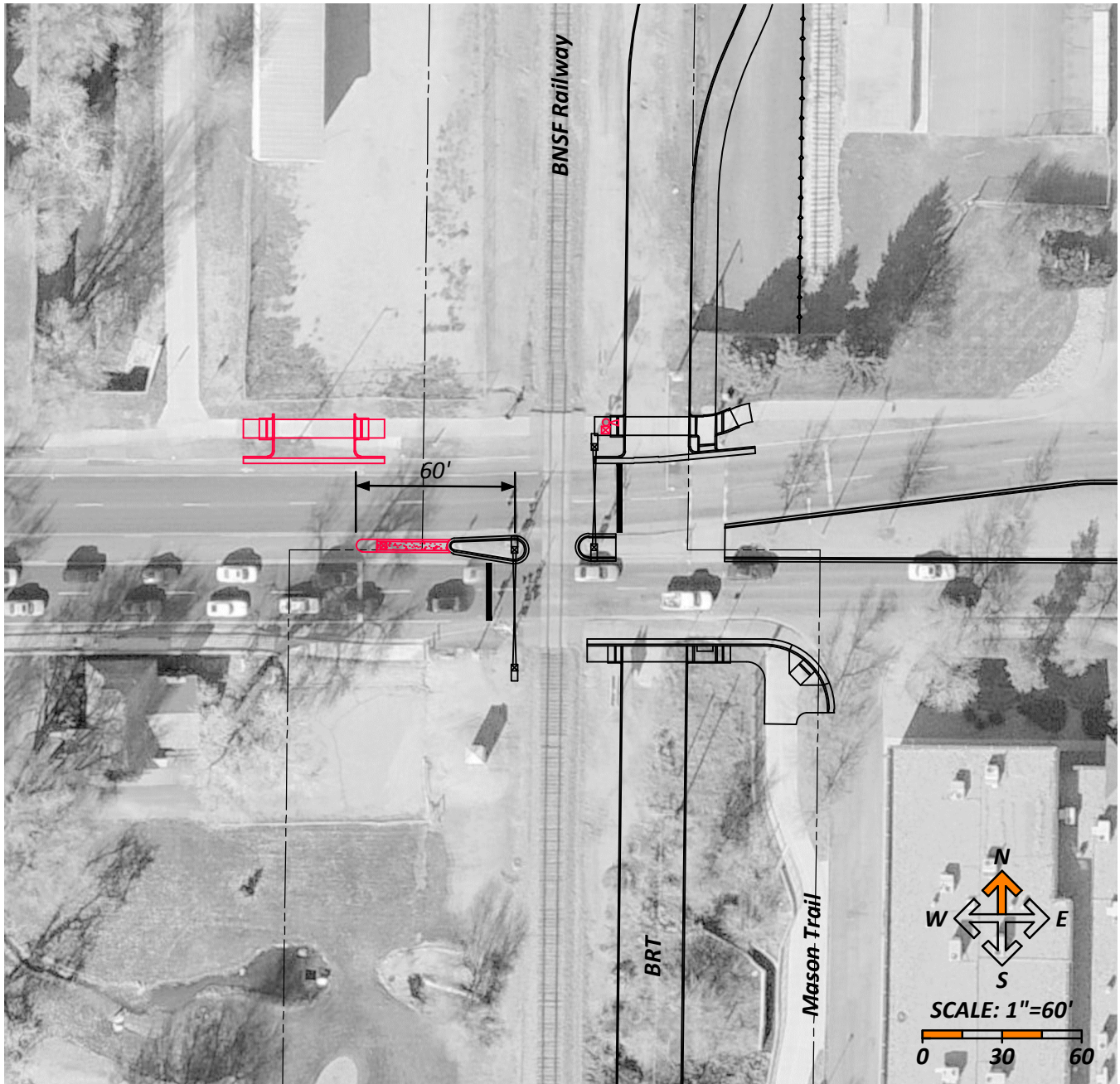
LEGEND:

- | | | | |
|--|-----------------------|--|--------------------------|
| | Existing Gate | | Proposed Gate |
| | Existing Median | | Proposed Median |
| | Existing Stop Bar | | Proposed Curb and Gutter |
| | Existing Cantilever | | Proposed Wayside Horn |
| | Existing Sign | | Proposed Sign |
| | Railroad Right-of-Way | | |



Harmony Road
 US DOT 244620N
 Main Line Front Range Subdivision
 Modified SSM: Raised Median (West)/Wayside Horn (East)(Option 1)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Residential land use (west); Commercial land use (east).
3. Commercial access on NW quadrant requires relocation to 60 feet from the approach gate arm.

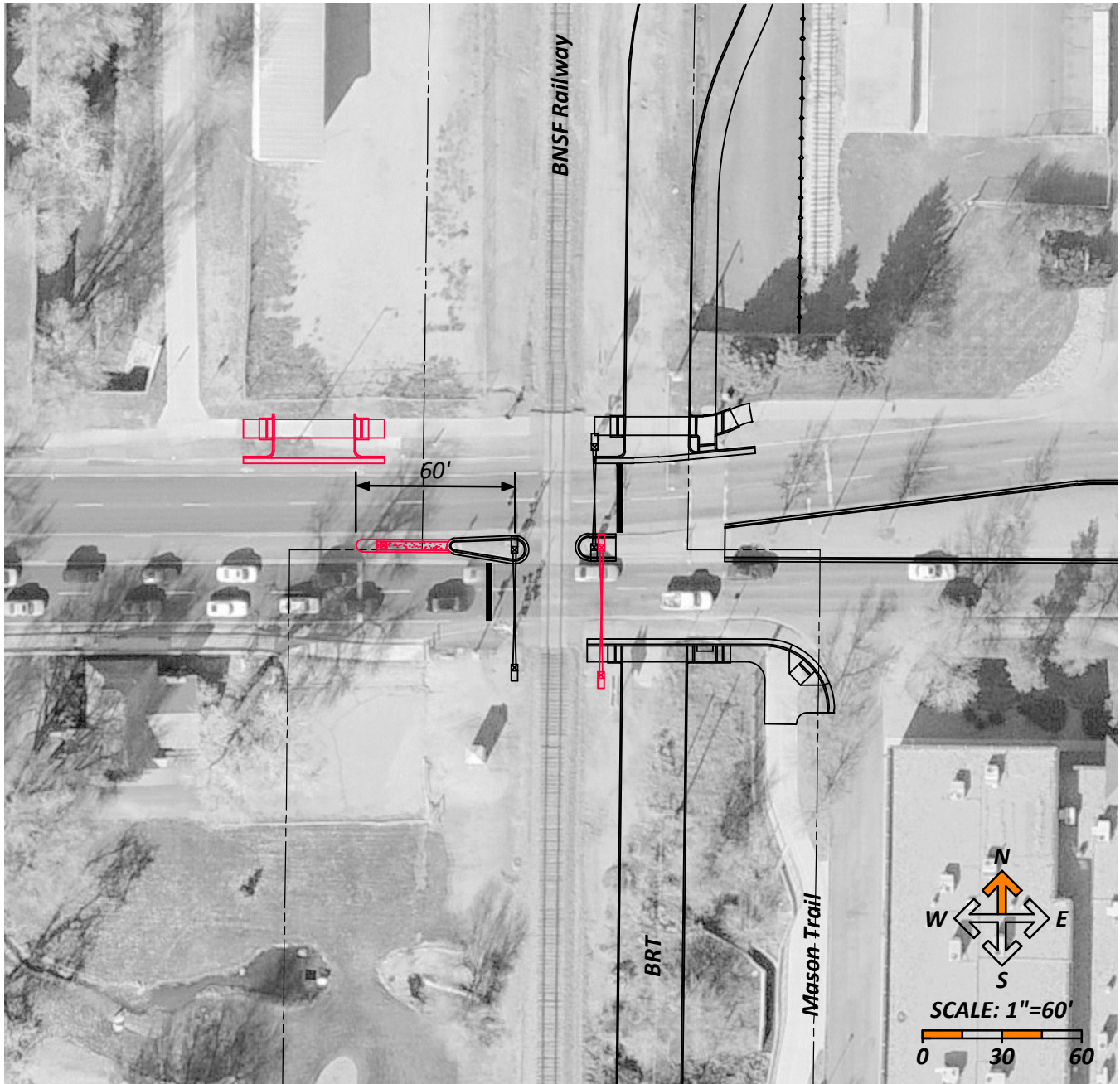
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Harmony Road
 US DOT 244620N
 Main Line Front Range Subdivision
 Modified SSM: Raised Median (West)/Exit Gate (East)(Option 2)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gate.
2. Residential land use (west); Commercial land use (east).
3. Commercial access on NW quadrant requires relocation to 60 feet from the approach gate arm.

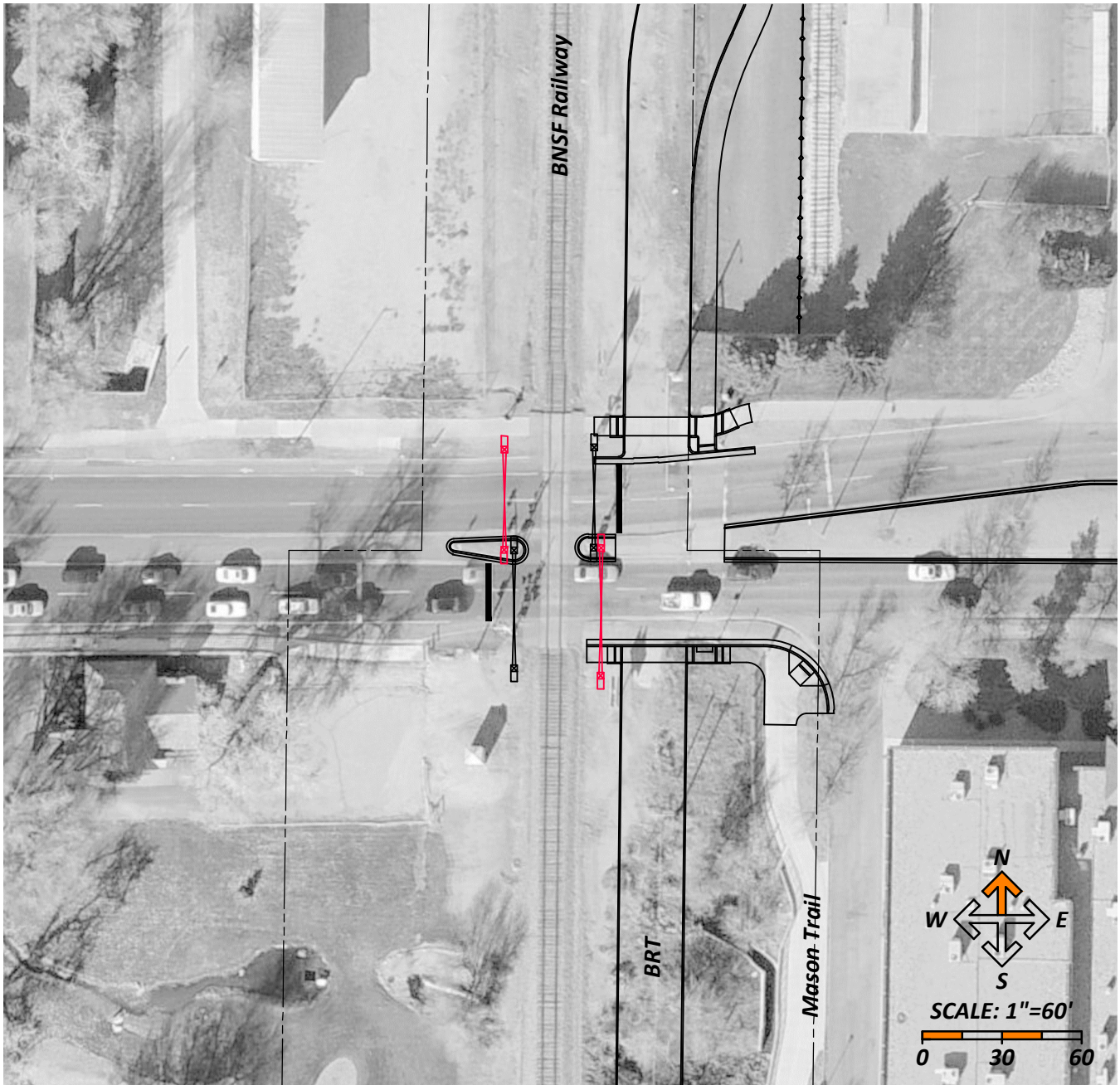
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Harmony Road
 US DOT 244620N
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 3)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gates.
2. Residential land use (west); Commercial land use (east).

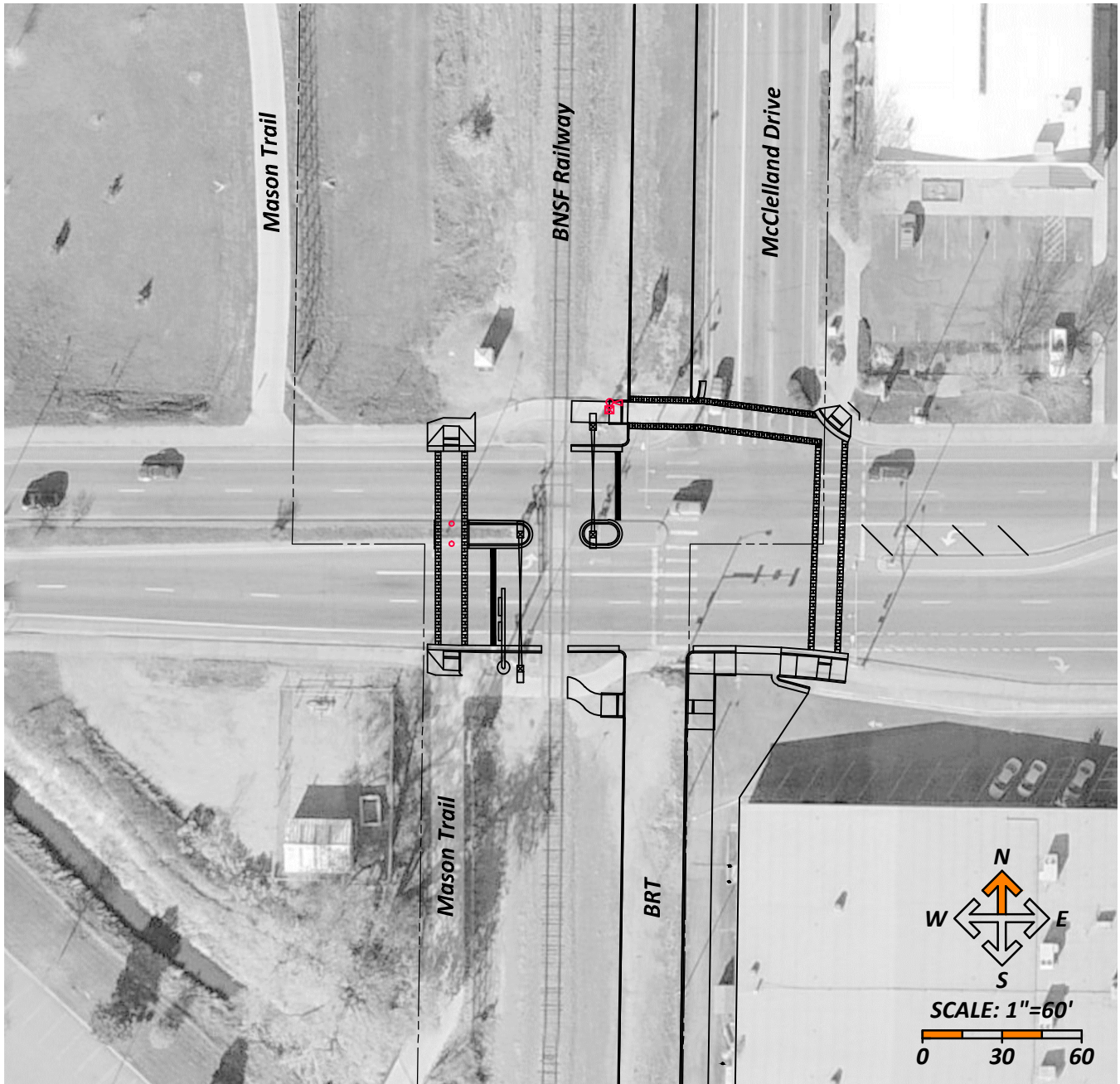
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Horsetooth Road
 US DOT 244622C
 Main Line Front Range Subdivision
 Modified SSM: Raised Median (West)/Wayside Horn (East)(Option 1)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Residential land use (west); Commercial land use (east).
3. Median break for Mason Trail may be 10 feet with a bollard at the midpoint of the trail along each curbline of the median, per FRA.

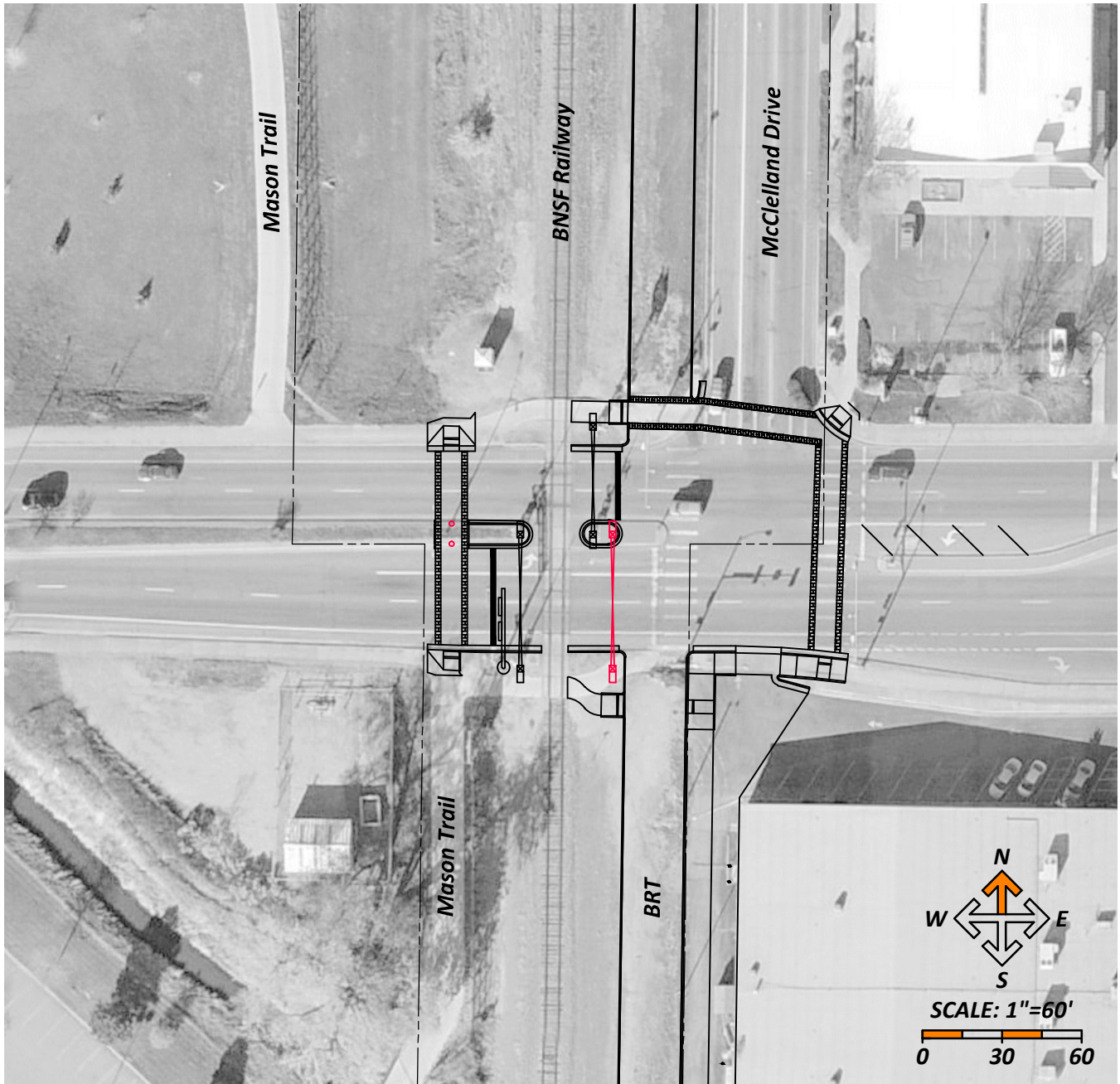
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		Proposed Bollard



Horsetooth Road
 US DOT 244622C
 Main Line Front Range Subdivision
 Modified SSM: Raised Median (West)/Exit Gate (East)(Option 2)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gate.
2. Residential land use (west); Commercial land use (east).
3. Median break for Mason Trail may be 10 feet with a bollard at the midpoint of the trail along each curbline of the median, per FRA.

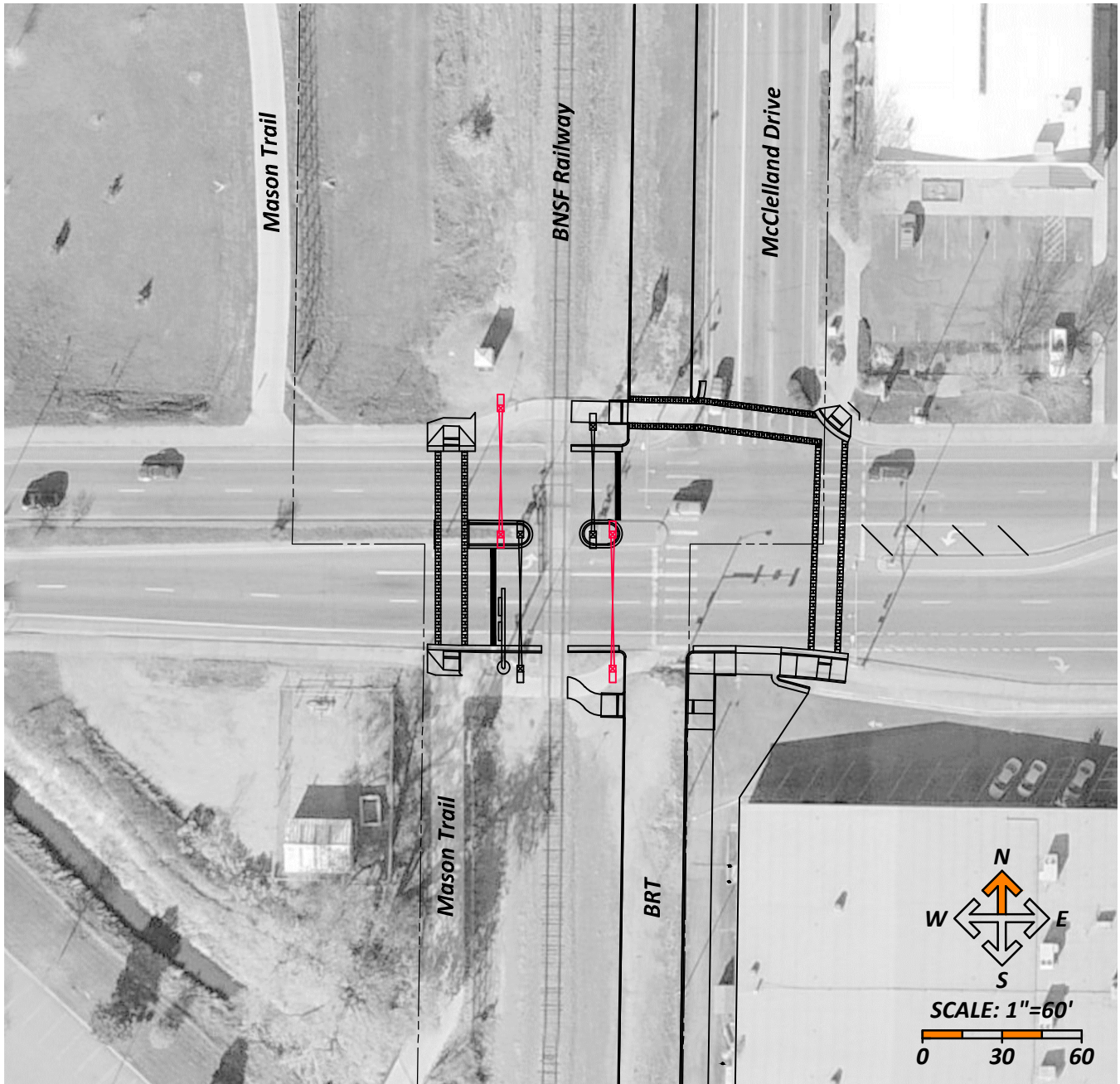
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		Proposed Bollard



Horsetooth Road
 US DOT 244622C
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 3)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gates.
2. Residential land use (west); Commercial land use (east).

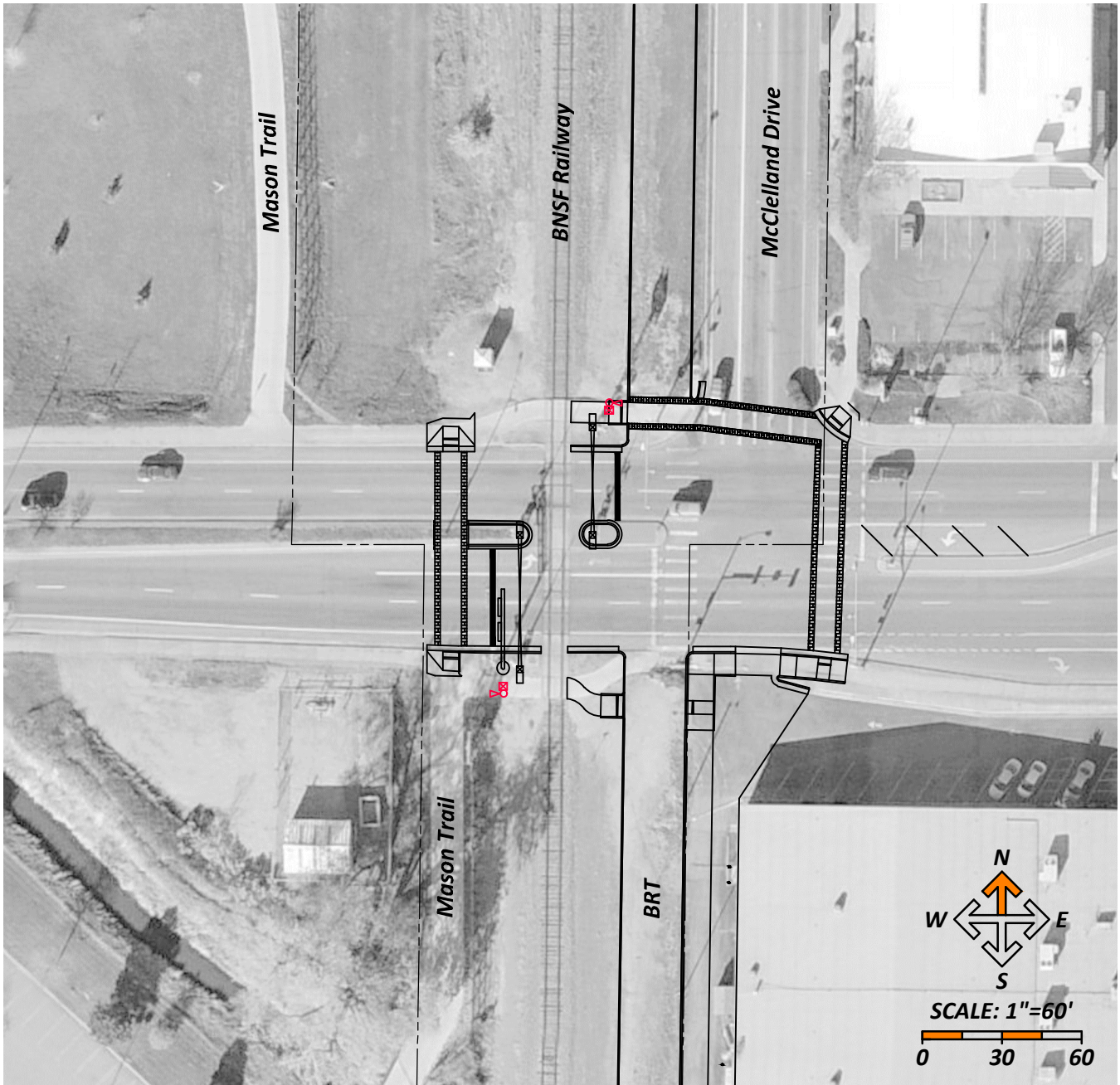
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Horsetooth Road
 US DOT 244622C
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 4)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Residential land use (west); Commercial land use (east).

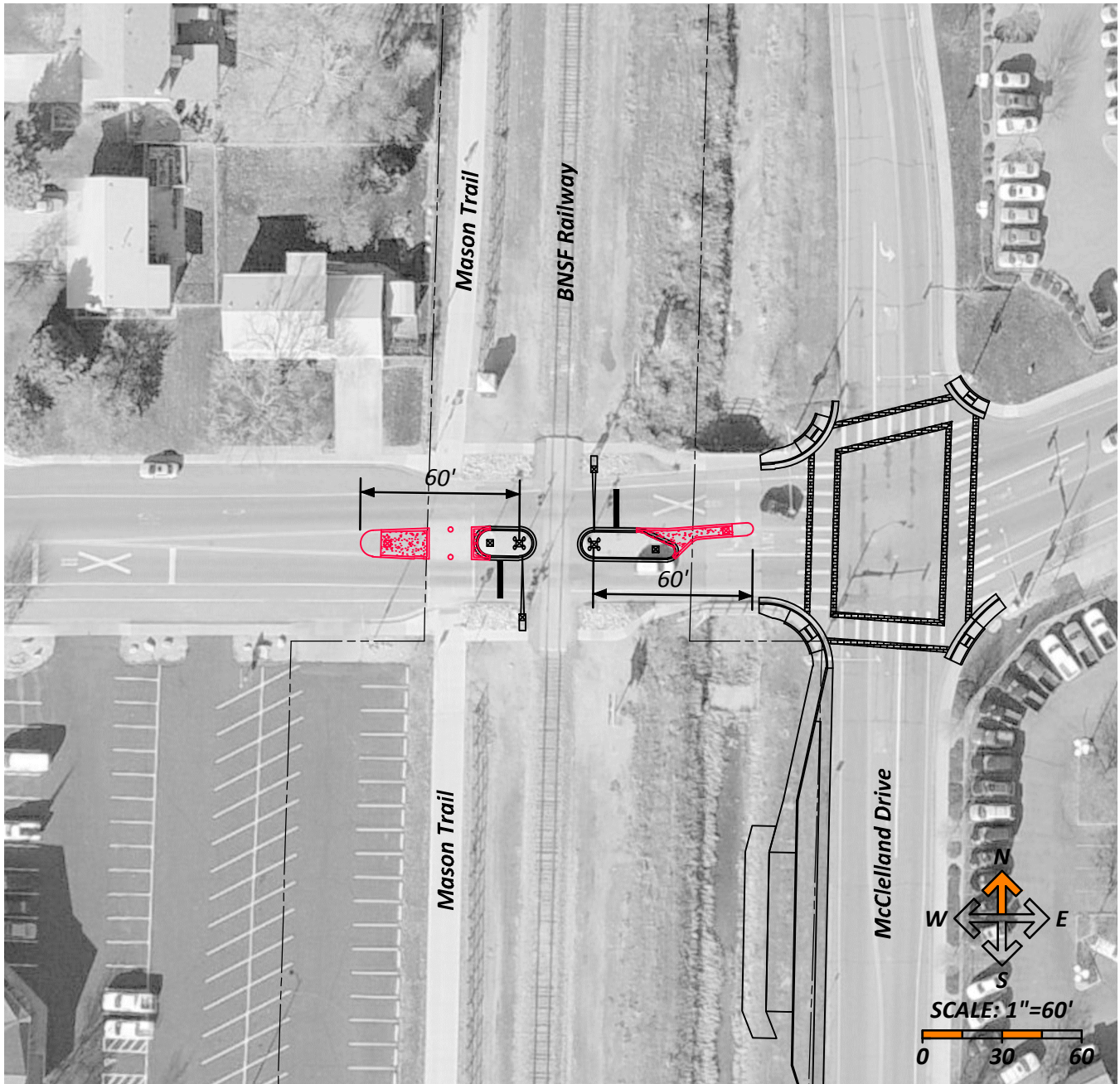
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Swallow Road
 US DOT 089367U
 Main Line Front Range Subdivision
 SSM: Raised Medians with Approach Gates (Option 1)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gate.
2. Residential land use (west); Commercial land use (east).
3. Median break for Mason Trail may be 10 feet with a bollard at the midpoint of the trail along each curbline of the median, per FRA.

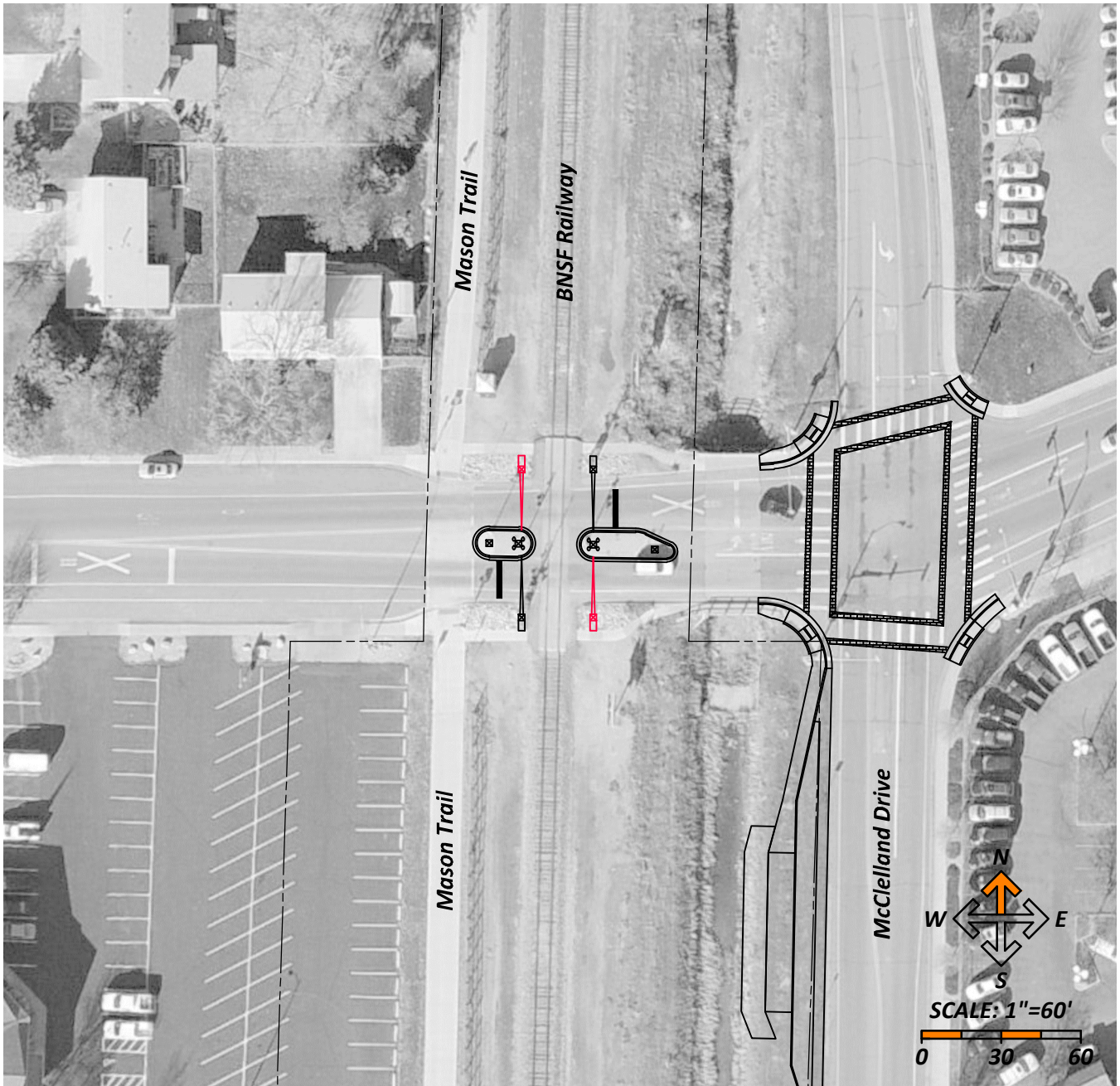
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Existing Post Mounted Flasher		Proposed Bollard
	Railroad Right-of-Way		



Swallow Road
 US DOT 089367U
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gate.
2. Residential land use (west); Commercial land use (east).

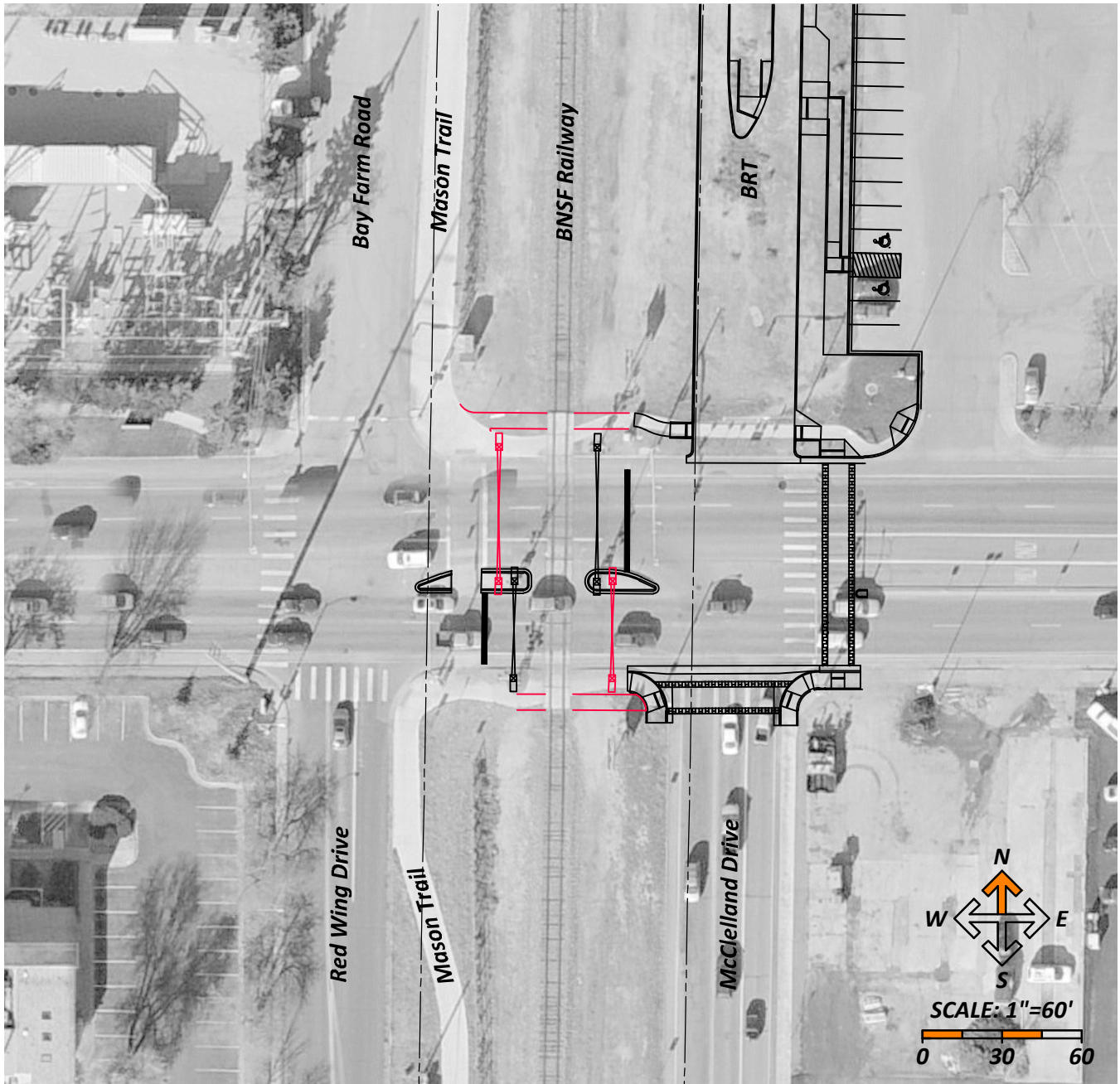
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Existing Post Mounted Flasher		
	Railroad Right-of-Way		



Drake Road
 US DOT 244624R
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gates.
2. Industrial/Commercial land use on NW, NE and SE quadrants. Commercial/Residential land use on SW quadrant.
3. Properties east of McClelland and the BRT alignment are potential redevelopment sites.

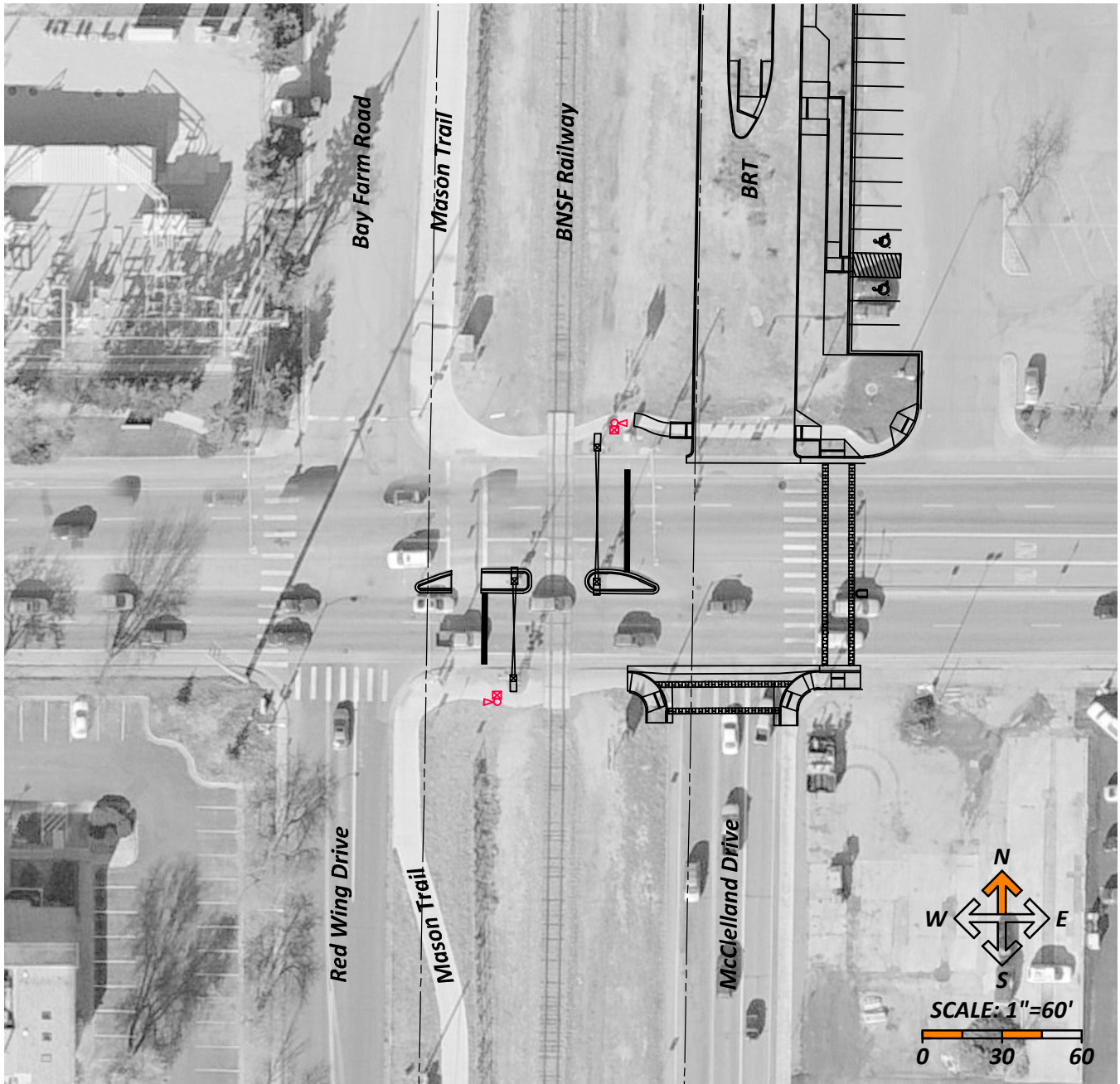
LEGEND:

- | | | | |
|--|-----------------------|--|--------------------------|
| | Existing Gate | | Proposed Gate |
| | Existing Median | | Proposed Median |
| | Existing Stop Bar | | Proposed Curb and Gutter |
| | Existing Cantilever | | Proposed Wayside Horn |
| | Existing Sign | | Proposed Sign |
| | Railroad Right-of-Way | | |



Drake Road
 US DOT 244624R
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 2)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Industrial/Commercial land use on NW, NE and SE quadrants. Commercial/Residential land use on SW quadrant.
3. Properties east of McClelland and the BRT alignment are potential redevelopment sites.

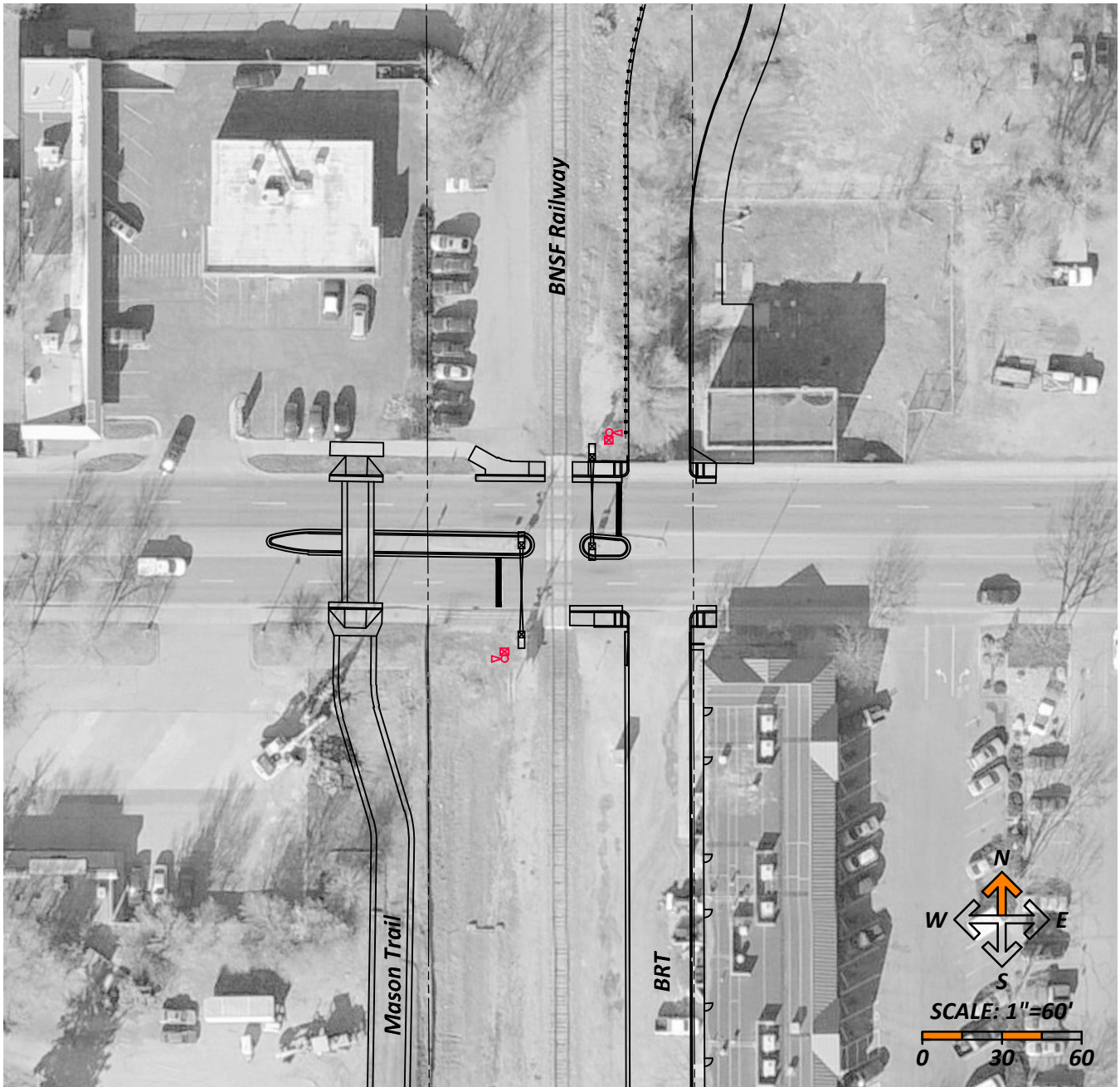
LEGEND:

- | | | | |
|--|-----------------------|--|--------------------------|
| | Existing Gate | | Proposed Gate |
| | Existing Median | | Proposed Median |
| | Existing Stop Bar | | Proposed Curb and Gutter |
| | Existing Cantilever | | Proposed Wayside Horn |
| | Existing Sign | | Proposed Sign |
| | Railroad Right-of-Way | | |



Prospect Road
 US DOT 244626E
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 1)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Commercial land use on all four quadrants.

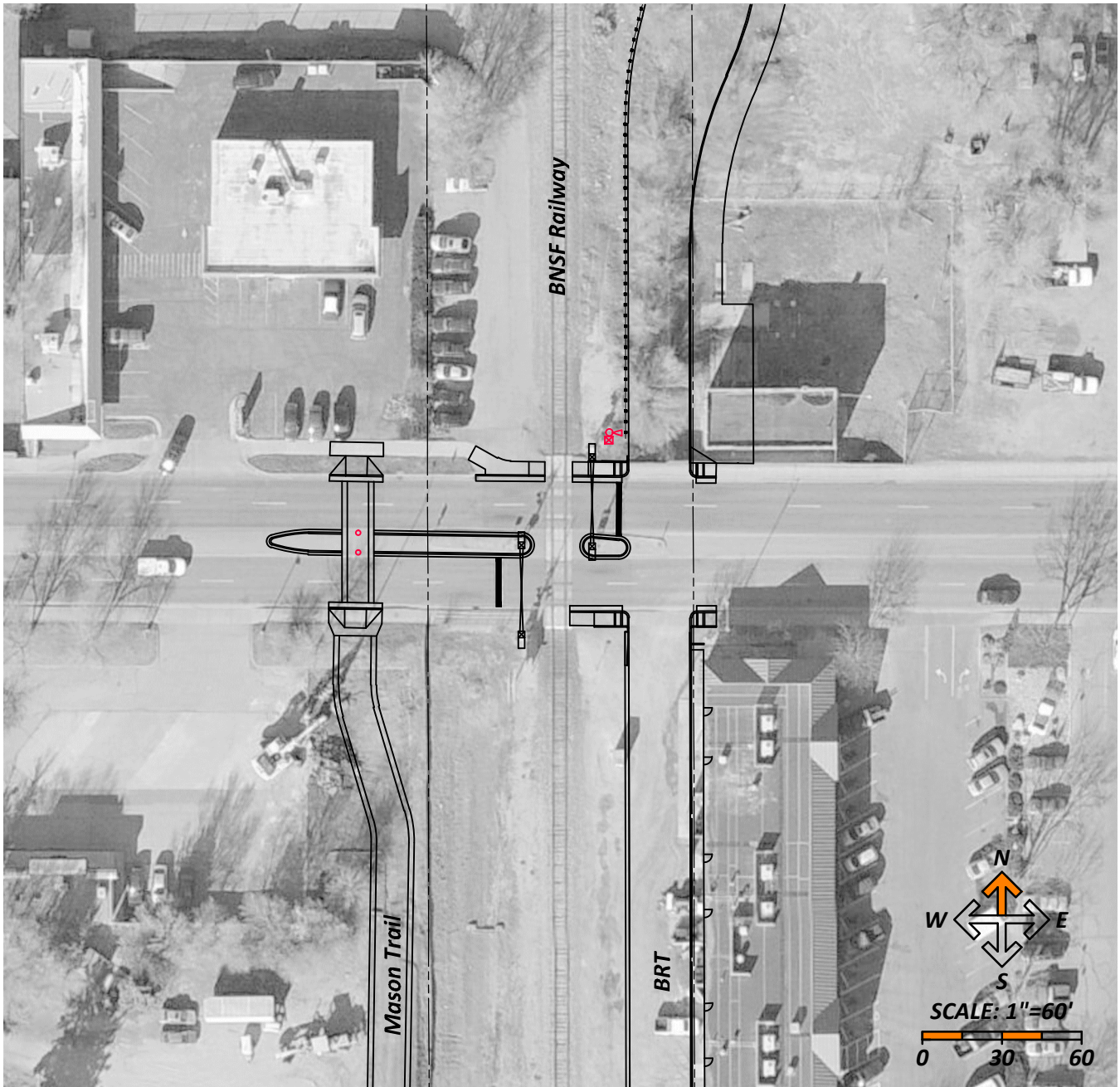
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Prospect Road
 US DOT 244626E
 Main Line Front Range Subdivision
 Modified SSM: Raised Median (West)/Wayside Horns (East)(Option 2)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. Commercial land use on all four quadrants.
3. Median break for Mason Trail may be 10 feet with a bollard at the midpoint of the trail along each curbline of the median, per FRA.

LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		Proposed Bollard



Lake Street
 US DOT 244627L
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 1)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. CSU buildings west of tracks; CSU parking on NE quadrant; Student Housing on SE quadrant.

LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Lake Street
 US DOT 244627L
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gates.
2. Access on NW quadrant requires relocating to accommodate exit gate.
3. CSU buildings west of tracks; CSU parking on NE quadrant; Student Housing on SE quadrant.

LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Pitkin Street
 US DOT 244628T
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 1)

Concept Crossing Improvements



NOTES:

1. No Circuitry upgrade needed following BRT construction.
2. CSU facilities and parking on all four quadrants.

LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Pitkin Street
 US DOT 244628T
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements



NOTES:

1. May need additional Circuitry and new bungalow for exit gates.
2. CSU facilities and parking on all four quadrants.
3. Curb and gutter is required in front of exit gates.

LEGEND:

- | | | | |
|--|--|--|--------------------------|
| | Existing Gate | | Proposed Gate |
| | Existing Median | | Proposed Median |
| | Existing Stop Bar | | Proposed Curb and Gutter |
| | Existing Cantilever | | Proposed Wayside Horn |
| | Existing Sign | | Proposed Sign |
| | Approximate centerline of road or railway (where needed for reference) | | |



Ped Xing 1
US DOT None
Main Line Front Range Subdivision
Treatment: Closure

Concept Crossing Improvements



NOTES:

1. CSU facilities and parking on all four quadrants.
2. Ped Crossing will be closed as part of the BRT construction.

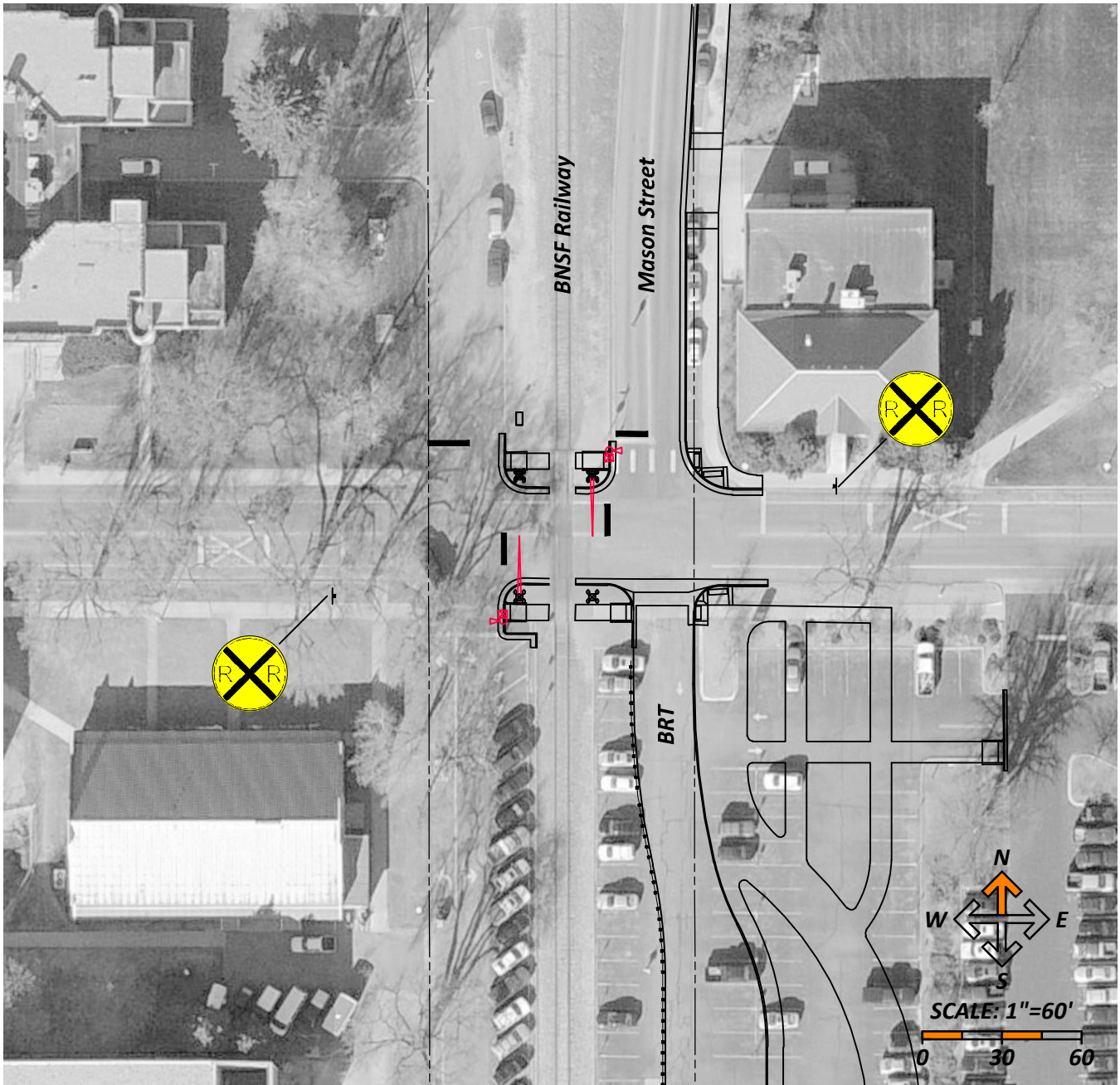
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



University Street
 US DOT 244629A
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 1)

Concept Crossing Improvements



NOTES:

1. Will need additional Circuitry and upgraded bungalow for gates.
2. CSU facilities and parking on all four quadrants.

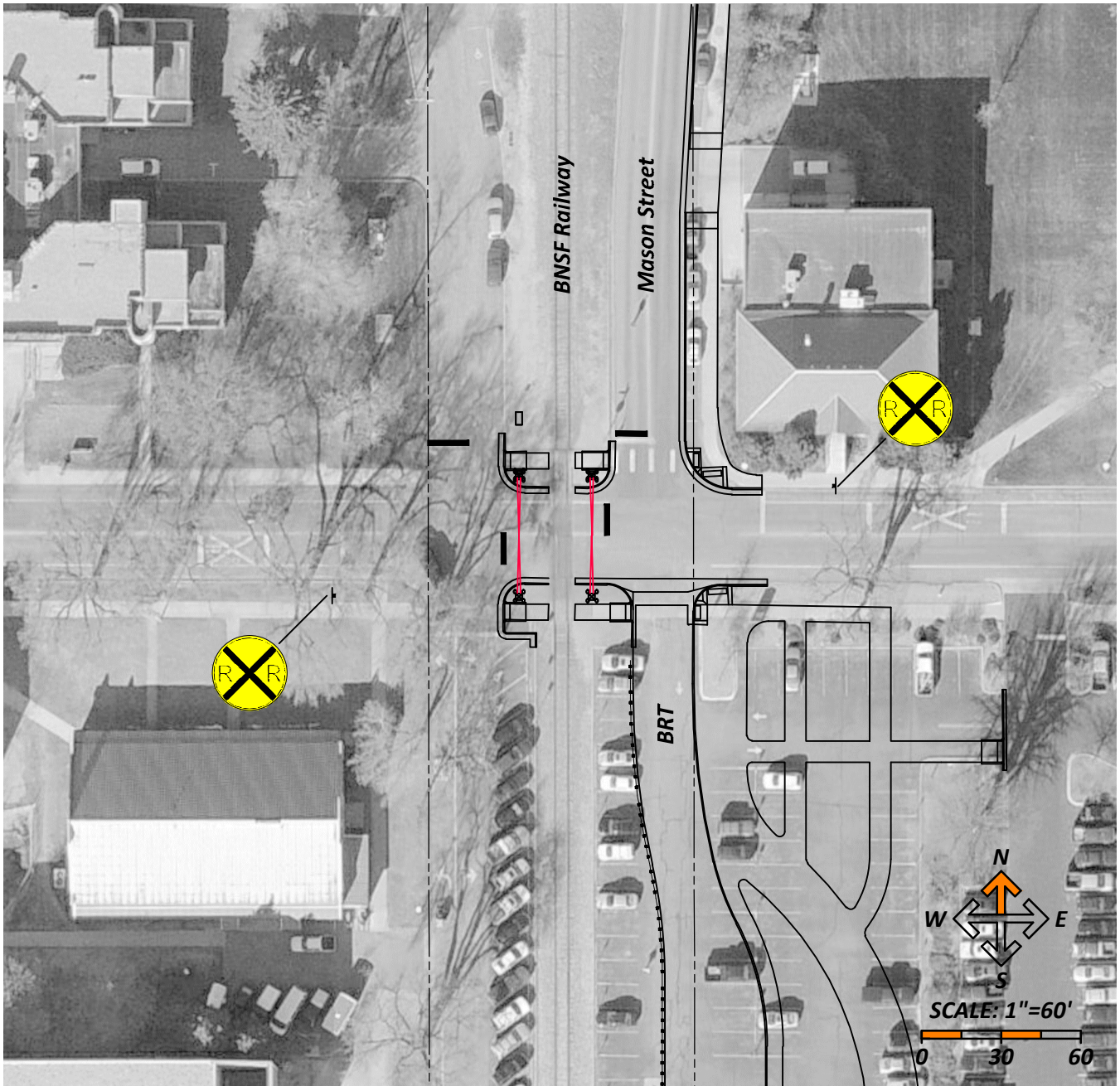
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Existing Post Mounted Flasher		
	Railroad Right-of-Way		



University Street
 US DOT 244629A
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements



NOTES:

1. Requires replacement of post mounted flashers with railroad gates and upgraded bungalow.
2. CSU facilities and parking on all four quadrants.

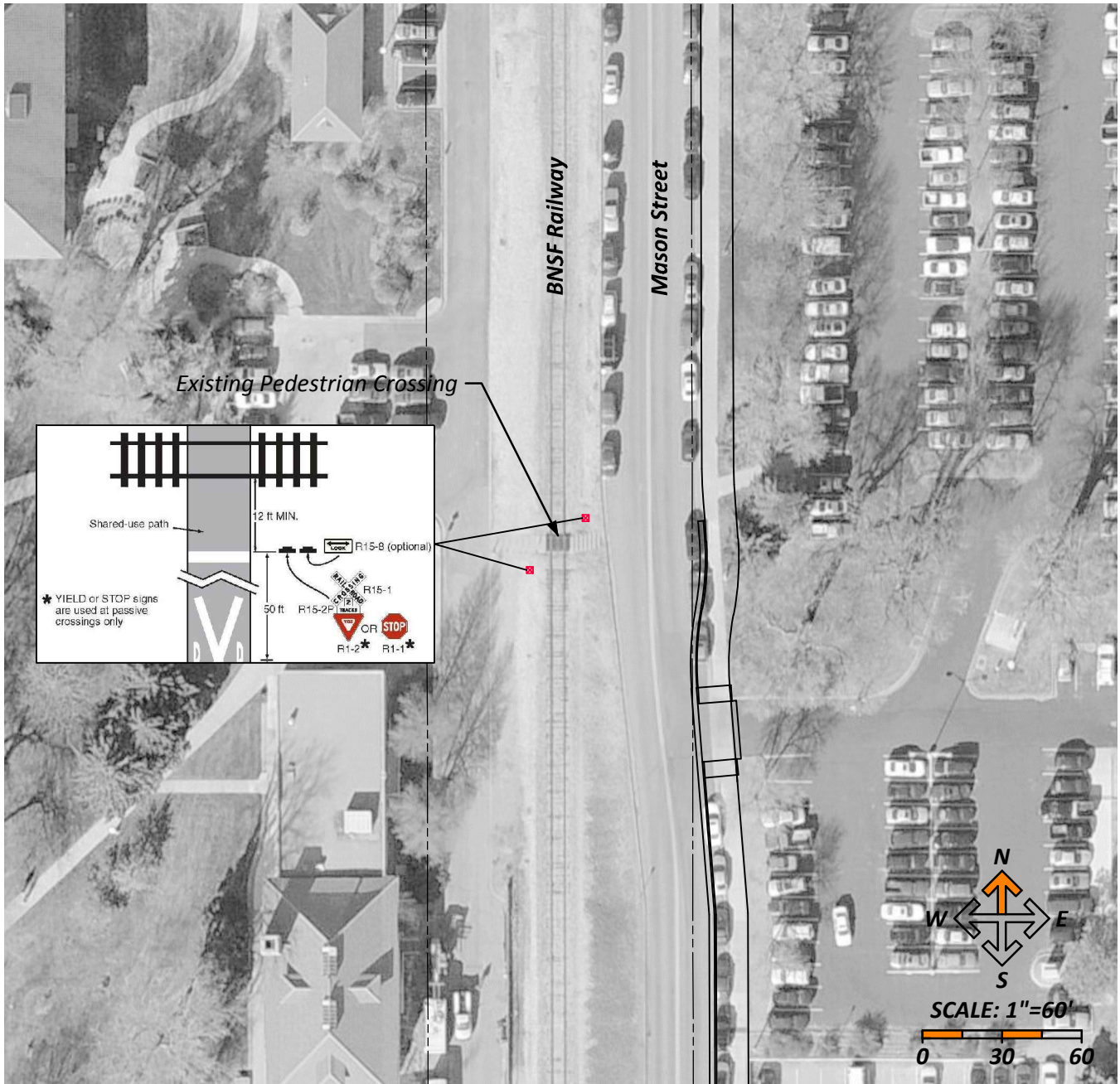
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Existing Post Mounted Flasher		
	Railroad Right-of-Way		



Ped Xing 2
US DOT 244631B
Main Line Front Range Subdivision
Treatment: Stop Sign/Cross Buck/"Look" Sign (MUTCD Fig. 8D-1)

Concept Crossing Improvements



NOTES:

1. CSU facilities and parking on all four quadrants.
2. Install signage on each side of tracks.

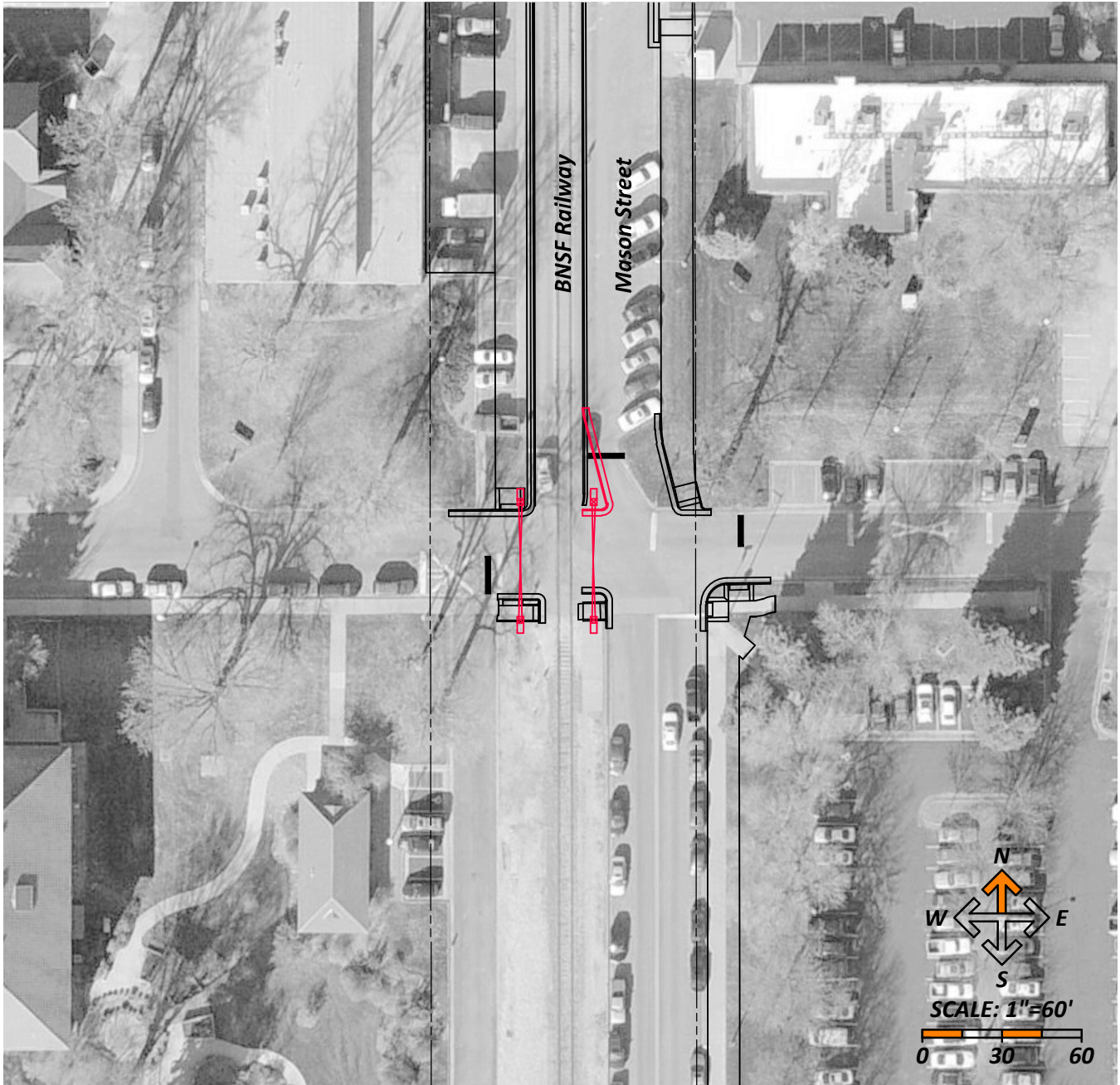
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Old Main Drive/Plum Street
 US DOT 244632H
 Main Line Front Range Subdivision
 SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements



NOTES:

1. Requires additional Circuitry and new bungalow for gates.
2. CSU facilities and parking on all four quadrants.

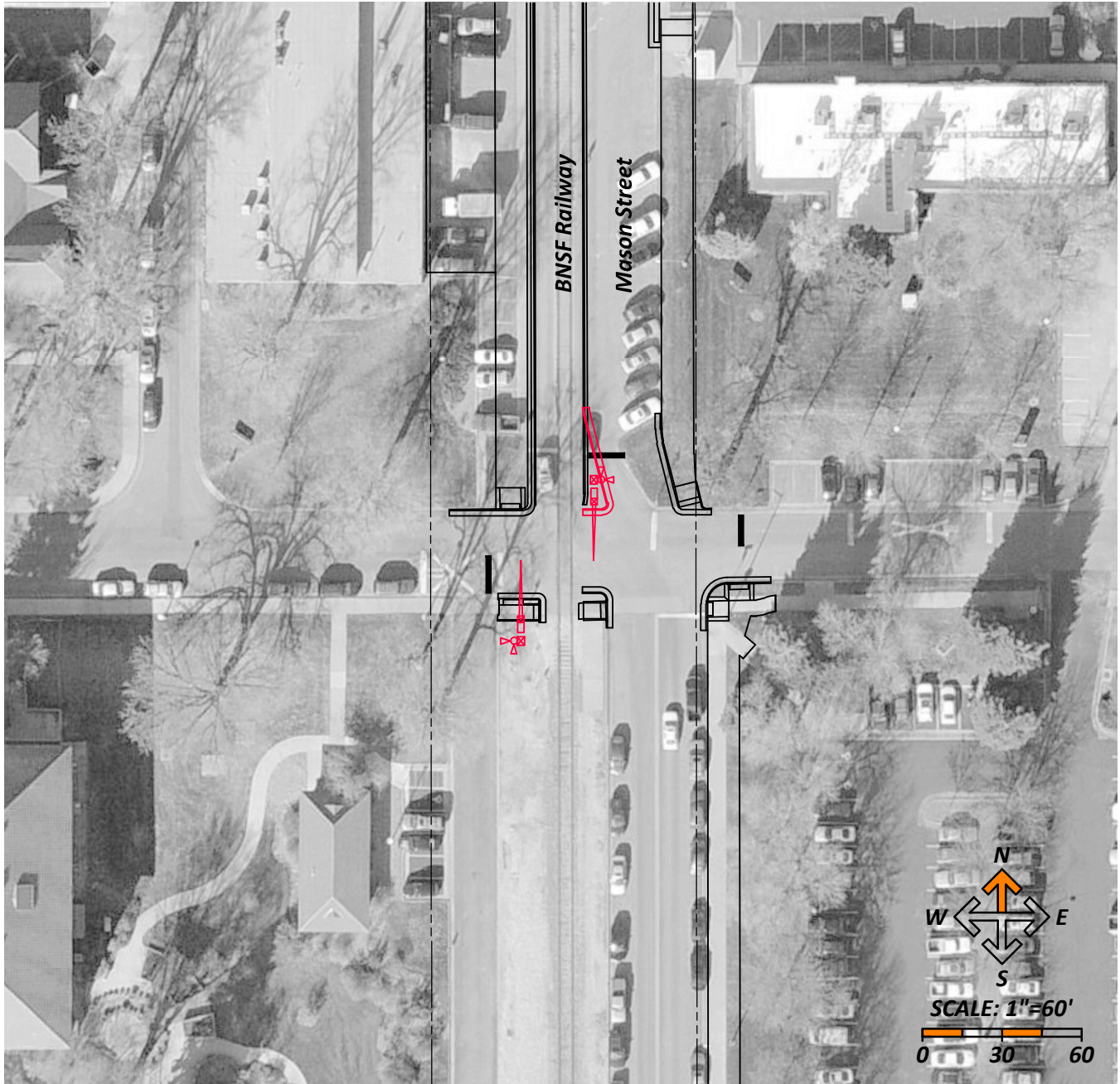
LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		



Old Main Drive/Plum Street
 US DOT 244632H
 Main Line Front Range Subdivision
 SSM: Wayside Horns (Option 2)

Concept Crossing Improvements



NOTES:

1. Requires additional Circuitry and new bungalow for gates.
2. CSU facilities and parking on all four quadrants.
3. Each wayside post has two horns to face approaching traffic.

LEGEND:

	Existing Gate		Proposed Gate
	Existing Median		Proposed Median
	Existing Stop Bar		Proposed Curb and Gutter
	Existing Cantilever		Proposed Wayside Horn
	Existing Sign		Proposed Sign
	Railroad Right-of-Way		

V. IMPLEMENTATION PLAN

A. Oversight and PUC Regulated Costs

State jurisdiction over railroad safety is extremely broad, however most areas have been preempted by the federal government. The Public Utilities Commission (PUC) of Colorado has primary jurisdiction over all public highway-rail crossings, including the opening and closing of at-grade crossings, upgrading of crossings, overpasses or underpasses, and the allocation of costs for grade separations, if requested. All economic jurisdiction over railroads that are part of the national railroad system come under the jurisdiction of the Surface Transportation Board.

Typically, applications to the PUC are required for highway-railroad crossings if the roadway is being widened, if additional crossing elements (such as pedestrian walkways, bike trails, etc.) are being added to a crossing, or if there are operational changes on the part of the railroad. The following activities do not require a PUC application:

1. Replacement of the roadway crossing surface material (provided the surface is not being lengthened to widen the roadway)
2. Placement or replacement of approach signing or striping in accordance with MUTCD standards
3. Slight raising or lowering of the crossing to match approaches for smoothness

According to PUC regulations, costs for improvements to at-grade crossings are allocated to the road authority and railroad as follows:

1. Surfacing
 - a. Road Authority
 - i. Crossing material and maintenance
 - ii. Road approach material, labor and maintenance
 - b. Railroad
 - i. Labor to install crossing material
 - ii. Track, tie, ballast, subballast material, labor and maintenance
2. Signing, Striping and Signals
 - a. Road Authority
 - i. Approach warning signs and pavement striping in accordance with MUTCD
 - ii. Signal improvements if the road authority is the project proponent
 - b. Railroad
 - i. Crossing sign (cross bucks)

B. Funding Options

Federal and State Funding

There is no specific funding mechanism at the Federal or State level that is in place to fund Quiet Zone improvements. Federal and State funds are in place for a variety of improvements related to crossing safety. There are also other funding mechanisms, such as the Safe Routes to School Program, which could be applied to crossing improvements at crossings meeting the conditions of the funding program.

Possible funding sources include:

1. Categorical Section 130 funds. These funds are specific to the elimination of hazards at existing highway-rail at-grade crossings. Activities eligible for the use of Section 130 safety funds are as follows:
 - a. Crossing consolidations (including the funding of incentive payments up to \$15,000 on a 50-percent matching basis to local jurisdictions for crossing closures)
 - b. Installation of grade separations at crossings or repair of existing grade separations
 - c. Signing
 - d. Pavement marking
 - e. Illumination
 - f. New highway-railroad grade crossing signals
 - g. Upgraded highway-railroad grade crossing signals or circuits
 - h. Improved crossing surfaces
 - i. Traffic signal interconnection/preemption
 - j. Sight distance or geometric improvements
 - k. Data improvements (up to 2 percent of apportionment)
2. Other categorical safety programs, such as the Safe Routes to School Program. School districts and local governments are eligible to apply for Safe Routes to School infrastructure and non-infrastructure funds. With MAP-21 (the new transportation bill) Safe Routes to School projects require a 20 percent funding match. Minimum funding for infrastructure projects is set at \$50,000 with maximum funding at \$250,000. Minimum funding for non-infrastructure projects is set at \$3500.
3. Regular federal-aid highway funds may be used for safety improvements such as the installation of standard signs and pavement markings; the installation or upgrading of active traffic control devices; crossing illumination; crossing approach and surface improvements; new grade separations and the reconstruction of existing grade separations; crossing closures or the removal of existing crossings; and crossing closures by the relocation of highways and/or the relocation of railroads.”

Colorado Section 130 Funds

The Federal Section 130 railroad/highway hazard elimination program (Section 130 Funding) is a source of federal funds available for crossing safety improvements. CDOT allocates the Federal Section 130 money for the State of Colorado for at-grade crossings and grade separated crossings.

CDOT has historically received approximately \$1.4 to \$1.5 million in funding from the Federal government each year for Section 130 at-grade crossings. There are approximately 1875 grade crossings in Colorado. Every three to four years, CDOT distributes applications to all local governments in the state, all municipal planning organizations, and all CDOT region offices. A rating is calculated for each application filed using a Federal Railroad Administration software program called GradeDec that incorporates several factors including average daily traffic, number of school buses, number of heavy trucks, number of hazardous material movements, crossing angle, etc. This program calculates a cost benefit ratio and an accident reduction factor to allow ranking of projects.

Although the FHWA Section 130 Safety Funds are not usually used to directly establish Quiet Zones, these funds can be used to upgrade the active warning devices if necessary for safety reasons, thereby reducing the costs for a community that later expresses its intent to establish a Quiet Zone at the same crossing. The improvements installed at the Lake Street crossing of BNSF were funded using Section 130 funds due to safety concerns at that crossing.

Other Funding

Other potential funding sources include local General Fund, Sales Tax revenue, Special Districts, Tax Increment Financing (TIF), Street Maintenance Funds, Development/Redevelopment Impact Fees and Federal earmarks. Some States have also been successful in pursuing use of Federal Stimulus Funding over the last several years to be used for safety improvements which also positioned those crossings for Quiet Zone establishment. Use of federal funding does trigger compliance with the National Environmental Policy Act (NEPA). The cost to perform NEPA studies are not included in the estimates provided.

Many communities experiencing redevelopment around or in close proximity to railroad crossings have considered implementation of developer impact fees directly associated with anticipated increased use of the railroad crossing. These fees can be used for crossing improvement study and design, safety improvements, and/or Quiet Zone assessment and establishment.

Railroad Rehabilitation & Improvement Financing (RRIF) Program

The Railroad Rehabilitation & Improvement Financing (RRIF) Program provides direct federal loans and loan guarantees to finance development of railroad infrastructure. Under this program the Federal Railroad Administration (FRA) Administrator is authorized to provide direct loans and loan guarantees up to \$35.0 billion. Up to \$7.0 billion is reserved for projects benefiting freight railroads other than Class I carriers.

The funding may be used to:

1. Acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, components of track, bridges, yards, buildings and shops;
2. Refinance outstanding debt incurred for the purposes listed above; and
3. Develop or establish new intermodal or railroad facilities

Direct loans can fund up to 100% of a railroad project with repayment periods of up to 35 years and interest rates equal to the cost of borrowing to the government. Eligible borrowers include railroads, state and local governments, government-sponsored authorities and corporations, joint ventures that include at least one railroad, and limited option freight shippers who intend to construct a new rail connection. In Colorado, this loan program was successfully pursued by the Denver Union Station Project Authority in 2010 for \$155 million for station improvements associated with RTD's Fastraks projects.

C. Phasing of Improvements

South Crossings

Many communities interested in Quiet Zone establishment prioritize and phase crossing improvements over a period of time to allow for budgeting, planning and design, and to spread the costs out, making the overall pursuit more affordable.

The crossings on the south end of the corridor have adequate spacing on each side to be pursued individually as Quiet Zones. Each of the crossings from Trilby through Drake has several options available for Quiet Zone establishment. Any one of these crossings could be improved individually as a test crossing to gauge process, actual costs, timeline and community reaction to silencing train horns.

Trilby Road –

Trilby Road is south of the Bus Rapid Transit project limits, and will not receive any improvements to railroad infrastructure as part of that project. Railroad equipment at Trilby is likely to be older than equipment further north along the track corridor, as improvements or upgrades may not have been needed or prioritized by the railroad due to the rural nature of the crossing. The roadway could accommodate a narrow median or raised channelizing devices along with upgraded circuitry and approach gates for Quiet Zone establishment. A standard 3-foot wide raised median could be installed for this treatment, but would require widening of the roadway in order to maintain both vehicular and bike lanes through the crossing. Either approach gates with raised medians/channelizing devices or wayside horns would be the most cost effective treatments at this crossing.

Harmony Road –

Harmony Road is receiving upgraded railroad circuitry, advance preemption associated with the traffic signal for the BRT and the pedestrian actuated signal, and upgraded flashers to LED as part of the Bus Rapid Transit project. This crossing will have the BRT roadway 25 feet east of the BNSF tracks, and within an easement on railroad right-of-way. The presence of the BRT roadway in close proximity to the tracks does not allow for a 60 foot median on the east approach. However, there is sufficient room for a 60 foot median on the west approach. This crossing could be treated with a 4-quadrant gate system, which would require upgrades to the circuitry to accommodate the operation of the exit gates. This crossing also could be fitted with two halves of standard SSM treatments to form an Engineered Alternative Safety Measure (ASM). A raised median with approach gate on the west approach could be combined with either a wayside horn or an exit gate on the east approach. Note that combining two standard SSMs into a Modified SSM requires an application process with the FRA for approval. However, the fact that the treatments are engineered solutions taken from standard SSM treatments, increases the likelihood of streamlined approval by FRA.

Horsetooth Road –

Horsetooth Road is receiving upgraded railroad circuitry, advance preemption associated with the traffic signals for the BRT, McClelland Drive and pedestrian crossing, and upgraded flashers to LED as part of the Bus Rapid Transit project. This crossing will have the BRT roadway 25 feet east of the BNSF tracks, and within an easement on railroad right-of-way. The presence of the BRT roadway in close proximity to the tracks does not allow for a 60 foot median on the east approach. However, currently there is a raised median in excess of the preferred 100 feet on the west approach to the crossing. This crossing could be treated with a 4-quadrant gate system, which would require upgrades to the circuitry to

accommodate the operation of the exit gates. This crossing also could be fitted with two halves of standard SSM treatments to form an Engineered Alternative Safety Measure (ASM). The raised median with approach gate currently on the west approach could be combined with either a wayside horn or an exit gate on the east approach. Similar to the Harmony crossing, the combination of two standard SSMs into a Modified SSM requires an application process with the FRA for approval. However, treatment with engineered solutions taken from standard SSM treatments, increases the likelihood of streamlined approval by FRA.

Swallow Road –

Swallow Road is receiving upgraded railroad circuitry, advance preemption associated with the traffic signals for McClelland Drive and upgraded flashers to LED as part of the Bus Rapid Transit project. At Swallow Road, the BRT is not exclusive, and will operate in mixed traffic along McClelland Drive. This allows room east and west of the BNSF tracks for a minimum 60 foot median on each approach. Therefore, an SSM installation of raised medians with approach gates would work at this crossing. It should be noted that the Mason Trail crosses Swallow Road approximately 30 feet west of the BNSF tracks. A break in the west median could be provided to maintain the trail crossing. The FRA allows for a 5 foot width opening through a raised median where needed for a pedestrian crossing. Wider openings fitted with bollards may be allowed with FRA and railroad approval. Another SSM treatment which would silence train horns at this location would be a 4-quadrant gate system.

Drake Road –

Drake Road is receiving upgraded railroad circuitry, advance preemption associated with traffic signals at McClelland Drive to the east, and Red Wing Drive/Bay Farm Road to the west, and upgraded flashers to LED as part of the Bus Rapid Transit project. The BRT will operate in mixed traffic along McClelland Drive south of Drake. North of Drake, and in line with McClelland Drive, the BRT roadway will be constructed as an exclusive busway not open to general traffic. Because of the close proximity parallel roadways east and west of the BNSF tracks, median options are not viable on Drake Road. SSM options are limited to 4-quadrant gates for a silenced crossing, or wayside horns for a lower decibel sound directed at approaching vehicles. While the current land use is commercial to the east, and industrial on the northwest quadrant, there is existing residential housing on the southwest quadrant. The potential for redevelopment of the properties to the east which may include residential development, may make the wayside horn option less desirable.

North Crossings

The crossings on the north end of the corridor do not have adequate spacing on each side to be pursued individually as Quiet Zones. Each of the crossings from Prospect through Old Main/Plum has several options available for Quiet Zone establishment. However, because each of these crossings are within ¼ mile of the next consecutive crossing, the typical locomotive horn pattern and timing is such that the horn pattern may overlap when moving along the corridor. In other words, the typical train horn pattern for one crossing may end in such close proximity to where the horn pattern in advance of the next crossing needs to begin, that the sound may seem continuous.

Additionally, Prospect and Lake are City owned and maintained roadways. Pitkin, University and Old Main/Plum, as well as the one pedestrian at-grade crossing to remain, are maintained by CSU. Therefore, there would need to be a combined effort between the City and CSU in order to pursue a Quiet Zone designation for the corridor from Prospect to Old Main/Plum.

Prospect Road –

Prospect Road is receiving upgraded railroad circuitry, advance preemption associated with the BRT roadway to the east, and the Mason Trail crossing to the west, and upgraded flashers to LED as part of the Bus Rapid Transit project. This crossing will have the BRT roadway 25 feet east of the BNSF tracks, and within an easement on railroad right-of-way. The presence of the BRT roadway in close proximity to the tracks does not allow for a 60 foot median on the east approach. A 95 foot raised median is proposed for the west approach. It should be noted that the Mason Trail will cross Prospect Road through a break in the west median, which will be within 60 feet of the west approach gate arm. The FRA allows for a 5 foot width opening through a raised median where needed for pedestrian crossing. Wider openings fitted with bollards may be allowed with FRA and railroad approval, particularly since the start of the median break is approximately 55 feet from the gate arm. This would allow for a Modified SSM treatment of raised median with approach gate on the west, with an exit gate on the east. Because the land use surrounding this crossing is predominantly commercial in nature, wayside horns would be a less costly option.

Lake Street –

Lake Street received crossing upgrades prior to the BRT project, and will not receive any additional signal or railroad upgrades. This crossing will have the BRT roadway 25 feet east of the BNSF tracks, and within an easement on railroad right-of-way. The presence of the BRT roadway in close proximity to the tracks does not allow for a 60 foot median on the east approach. The BRT will be stop controlled at Lake Street, with buses waiting for gaps in traffic in order to cross Lake Street within the exclusive busway. Lake Street is along the south edge of the Colorado State University campus, and has campus buildings and parking on all quadrants of the crossing. A CSU building access on the northwest quadrant is within 60 feet of the crossing to the west. Neither approach can be fitted with raised medians. The viable SSM treatments at this crossing are wayside horns or 4-quadrant gates. Wayside horns, while still providing horn noise, would be the less costly alternative at this crossing.

Pitkin Street –

Pitkin Street received additional crossing surfacing along the north side of the crossing to accommodate a wider sidewalk. This crossing also received upgraded railroad circuitry, advance preemption associated with the BRT roadway to the east, and upgraded flashers to LED as part of the Bus Rapid Transit project. This crossing will have the BRT roadway 25 feet east of the BNSF tracks, and within an easement on railroad right-of-way. To the west of this crossing at a distance of 25 feet are north-south access roads for CSU buildings. The presence of the BRT roadway in close proximity to the tracks to the east, and the CSU access roads to the west, do not allow for a 60 foot median on either approach. The BRT will be stop controlled at Pitkin Street, with buses waiting for gaps in traffic in order to cross Pitkin Street within the exclusive busway. Pitkin Street is within the Colorado State University campus, and has campus buildings and parking on all quadrants of the crossing. The viable SSM treatments at this crossing are wayside horns or 4-quadrant gates. Wayside horns, while still providing horn noise, would be the less costly alternative at this crossing.

Pedestrian Crossing #1 –

This at-grade pedestrian crossing of the BNSF tracks provides direct crossing from the heart of the CSU campus to Jack Christiansen field to the east of the tracks. As part of the BRT project, a bus station will be constructed just north of Christiansen field, eliminating parking along the east side of the BNSF tracks and a portion of the parking associated with the athletic field. Additionally, guardrail will be installed

from Pitkin Street on the south to University Street on the north, and east of the BNSF tracks, between the tracks and the BRT exclusive busway. The BRT project will remove the pedestrian crossing at this location, and the guardrail, bus activity, and removal of parking will further deter historic crossing patterns as well as eliminate the need for crossing at this location.

University Street –

University Street received new railroad circuitry, post mounted flashers with LED on each quadrant of the crossing, and audible bells as part of the Bus Rapid Transit project. This crossing will have the exclusive BRT roadway 25 feet east of the BNSF tracks to the south of University Street. North of University, the buses will enter mixed traffic and travel along existing Mason Street. To the west of this crossing at a distance of 25 feet are north-south access roads for CSU buildings. The presence of the BRT roadway in close proximity to the tracks to the east, and the CSU access roads to the west, do not allow for a 60 foot median on the either approach. The BRT will be stop controlled at University Street, with buses waiting for gaps in traffic in order to cross University Street between the exclusive busway and Mason Street. University Street is within the Colorado State University campus, and has campus buildings and parking on all quadrants of the crossing. The viable SSM treatments at this crossing are wayside horns or 4-quadrant gates. Wayside horns, while still providing horn noise, would be the less costly alternative at this crossing.

Pedestrian Crossing #2 –

This at-grade pedestrian crossing of the BNSF tracks provides direct crossing from the heart of the CSU campus to the west, to student parking on the east side. The buses operating as part of the Bus Rapid Transit system will be operating in mixed traffic on Mason Street along the east side of the BNSF tracks. This pedestrian crossing is to remain, and at a minimum, would need to be treated with crossing warning signs consistent with the 2009 version of the Manual on Uniform Traffic Control Devices. This includes cross bucks, stop or yield sign, and an optional “LOOK” sign. At the time of Quiet Zone establishment, this crossing would also need signing indicating that train horns are not sounded. Additional warning features may be required as a result of a field diagnostic review which should be held when Quiet Zone establishment is being pursued.

Old Main Drive/Plum Street –

Old Main Drive/Plum Street is a passive crossing with no active warning devices. There were no additional crossing warning devices added as part of the BRT project. This crossing is the northernmost crossing within the CSU campus. In order to pursue Quiet Zone establishment at this crossing with standard SSM treatments, minimum active warning devices including approach gates and flashers with constant warning time circuitry would be needed. In addition to these basic active warning devices, either wayside horns or exit gates (for a 4-quadrant gate system) could be installed for Quiet Zone compliance. It should be noted that this crossing is less than ¼ mile from Laurel Street to the north. Because of the proximity of this crossing to Laurel and the subsequent closely spaced crossings further north through downtown, Old Main Drive/Plum Street could be assessed as part of the downtown crossing Quiet Zone corridor, with CSU and City oversight.

D. Concept Costs

Conceptual costs for each alternative were generated using current unit costs for roadway items available from CDOT, as well as from recent bid tabulations from local contractors for similar work. Estimates for railroad items were taken from similar recent work estimates, or from conversations with

railroad representatives. All opinions of conceptual costs are provided for information only and are intended for use in comparison with various improvement options by the reader.

Table 15 provides the Opinion of Conceptual Costs for each concept improvement. Costs shown are for installations in addition to those being installed as part of the Bus Rapid Transit project.

E. Conclusions and Next Steps

The City has options for initiating pursuit of a Quiet Zone in Fort Collins. There are several crossings that can be pursued independently, and several crossings that will need to be pursued as a corridor, due to proximity.

Generally, the following steps outline the order of tasks for the City moving forward with a Quiet Zone in the state of Colorado:

1. Determine which crossing or crossings the City would like to pursue for Quiet Zone establishment
2. Coordinate a Field Diagnostic Review with the Railroad, FRA, PUC, City and CDOT (if necessary) to confirm the current crossing warning devices, discuss safety issues, and review the crossing improvements proposed for Quiet Zone establishment
3. Design any street-related improvements, signing, striping and adjacent traffic signal timing (if needed). Formally request a railroad work items cost estimate from the railroad for crossing warning devices, circuitry or signal work that would need to be completed by the railroad for Quiet Zone compliance
4. Submit a Public Utilities Commission application for the crossing(s) improvements and await the process to final ruling from the Commission (typically about 60 days for uncontested applications).
5. Send the Notice of Intent to Create a Quiet Zone (for SSM installations) or an Application (for ASM installations) to the Federal Railroad Administration, with copies to the Railroad, PUC and CDOT for review.

The SSM Notice review period is 60 days. Allowing time for receipt of comments and response to comments, if necessary, a reasonable estimate of total time is 90 days. Note that the SSM Notice of Intent can be sent concurrent with the PUC application if the PUC, Railroad and City are in agreement regarding the crossing improvements at a given crossing.

Timelines for ASM installations vary greatly depending upon the ASM proposed. Modified SSM installations are processed as ASMs and can take 9 months for review and approval by the FRA. These installations do require ongoing monitoring and reporting. There are no Quiet Zones currently that have been successfully established using Non-Engineering ASM solutions. Therefore, a timeframe for FRA review and approval for this process is unknown.

6. Following completion of the PUC application/ruling and the FRA notice/application process, the City must construct the approved crossing improvements and/or implement the approved safety measures, and the Railroad must install the approved railroad warning devices.
7. Following completion of construction and warning device testing, the Notice of Quiet Zone Establishment is sent by the City to the FRA. Following receipt of this notice, trains horns will cease sounding at the designated crossings 21 days following FRA's receipt of the notice.

SSM installations are complete once construction is finished, and require only an Affirmation letter every 5 years to the FRA indicating that the crossing warning devices remain in place, are operating properly and the crossing remains compliant.

ASM installations have more frequent monitoring and reporting requirements to the FRA, depending upon the ASM installed. ASM installations may also require subsequent additional safety measures at the discretion of the FRA.

SSM installations that do not require railroad work can achieve Quiet Zone establishment in as little as 3-4 months. SSM installations that do require railroad work can achieve Quiet Zone establishment in 9-18 months.

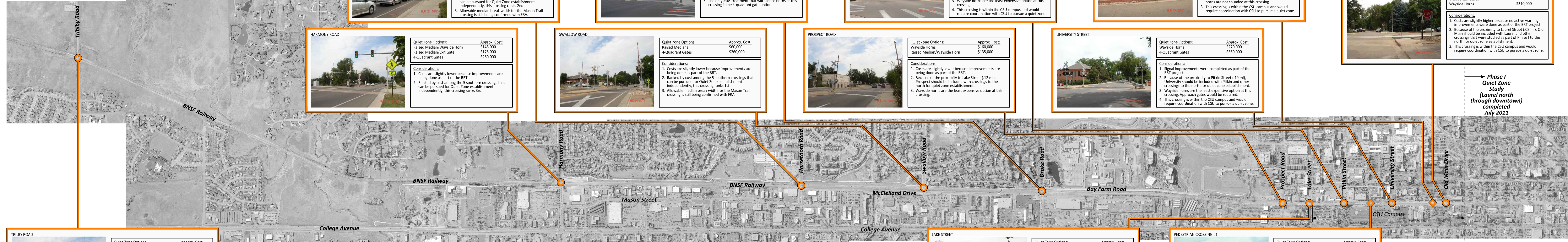
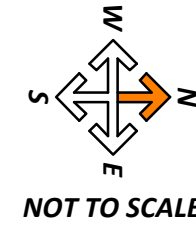
Modified SSM installations are processed as ASMs through an application. Depending upon the review and approval timeline of the FRA, these crossings can take 1-2 years to Quiet Zone establishment. There is no known timeline to Quiet Zone establishment for Non-Engineering ASM solutions.

Table 15. Opinion of Conceptual Costs

STREET	RR CIRCUITRY	GATES/LIGHTS	CROSSING SURFACE	SSM Alternatives				Modified SSM Alternatives		Concept Level Costs by Option							Opinion of Construction Cost			
				RAISED MEDIANS	ONE-WAY STREET	4-QUAD GATES	WAYSIDE HORNS	CLOSURE	RAISED MEDIUM WAYSIDE HORN	RAISED MEDIUM EXIT GATE	CWT Circuitry /New Bungalow	Upgraded Circuitry	Raised Medians	One-way Street	Approach Gates/ Flashers/ Bells	4-Quad Gates		Wayside Horns		
Tribly Road	DC/AFO	YES	conc	X									\$100,000		\$25,000		\$80,000			\$205,000
							X						\$100,000					\$100,000		\$200,000
						X							\$100,000		\$15,000			\$300,000		\$415,000
Harmony Road	CWT	YES	conc						X				\$60,000	\$35,000				\$50,000		\$145,000
										X			\$60,000	\$35,000			\$80,000			\$175,000
						X							\$60,000				\$200,000			\$260,000
Horsetooth Road	CWT	YES	conc						X				\$60,000	\$25,000				\$50,000		\$135,000
											X		\$60,000	\$25,000			\$80,000			\$165,000
						X							\$60,000				\$200,000			\$260,000
							X						\$60,000					\$100,000		\$160,000
Swallow Road	CWT	YES	conc	X										\$60,000						\$60,000
						X							\$60,000				\$200,000			\$260,000
Drake Road	CWT	YES	conc			X							\$60,000				\$330,000			\$390,000
							X						\$60,000					\$100,000		\$160,000
Prospect Road	CWT	YES	conc				X						\$60,000					\$100,000		\$160,000
								X					\$60,000	\$25,000				\$50,000		\$135,000
Lake Street	CWT	YES	conc				X						\$60,000					\$100,000		\$160,000
						X							\$60,000				\$150,000			\$210,000
Pitkin Street	CWT	YES	conc				X						\$60,000					\$100,000		\$160,000
						X							\$60,000				\$165,000			\$225,000
Ped Crossing #1	None	No	rubber					X												\$0
University Street	CWT	Lights	conc				X						\$60,000			\$110,000		\$100,000		\$270,000
						X							\$60,000				\$300,000			\$360,000
Ped Crossing #2	None	No	rubber																	\$20,000
Old Main/ Plum Street	None	No	conc			X							\$100,000				\$330,000			\$430,000
							X						\$100,000				\$110,000	\$100,000		\$310,000

Cost Range:		
	Low	High
Tribly through Lake (City crossings)	\$995,000	\$1,955,000
Pitkin through Old Main (CSU crossings)	\$760,000	\$1,035,000
Corridor Total (Tribly thru Old Main)	\$1,755,000	\$2,990,000

Note: The cost of medians where breaks are anticipated to accommodate the Mason Trail are increased slightly to include the cost of bollards. At crossings where 4-quadrant gates require sidewalk, curb & gutter, or access work, the cost of the gates is increased by 10%.



HORSETOOTH ROAD

Quiet Zone Options:	Approx. Cost:
Raised Median/Wayside Horn	\$135,000
Raised Median/Exit Gate	\$165,000
4-Quadrant Gates	\$260,000
Wayside Horns	\$160,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Ranked by cost among the 5 southern crossings that can be pursued for Quiet Zone establishment independently, this crossing ranks 2nd.
- Allowable median break width for the Mason Trail crossing is still being confirmed with FRA.

DRAKE ROAD

Quiet Zone Options:	Approx. Cost:
4-Quadrant Gates	\$390,000
Wayside Horns	\$160,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Ranked by cost among the 5 southern crossings that can be pursued for Quiet Zone establishment independently, this crossing ranks 4th.
- The only SSM treatment that will silence horns at this crossing is the 4-quadrant gate option.

PITKIN STREET

Quiet Zone Options:	Approx. Cost:
Wayside Horns	\$160,000
4-Quadrant Gates	\$260,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Because of the proximity to Lake Street (.15 mi), Pitkin should be included with Lake and other crossings to the north for quiet zone establishment.
- Wayside horns are the least expensive option at this crossing.
- This crossing is within the CSU campus and would require coordination with CSU to pursue a quiet zone.

PEDESTRIAN CROSSING #2

Quiet Zone Options:	Approx. Cost:
Upgraded Signage	\$20,000

Considerations:

- At-grade pedestrian crossings located within a corridor proposed for quiet zone establishment must be treated in accordance with the recommendations of a diagnostic team.
- Typical treatment (in accordance with the 2009 MUTCD) includes a stop or yield sign, crossbucks, a LOOK sign (optional) and a placard indicating train horns are not sounded at this crossing.
- This crossing is within the CSU campus and would require coordination with CSU to pursue a quiet zone.

OLD MAIN DRIVE (PLUM STREET)

Quiet Zone Options:	Approx. Cost:
4-Quadrant Gates	\$430,000
Wayside Horns	\$310,000

Considerations:

- Costs are slightly higher because no active warning improvements were done as part of the BRT project.
- Because of the proximity to Laurel Street (.08 mi), Old Main should be included with Laurel and other crossings that were studied as part of Phase I to the north for quiet zone establishment.
- This crossing is within the CSU campus and would require coordination with CSU to pursue a quiet zone.

HARMONY ROAD

Quiet Zone Options:	Approx. Cost:
Raised Median/Wayside Horn	\$145,000
Raised Median/Exit Gate	\$175,000
4-Quadrant Gates	\$260,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Ranked by cost among the 5 southern crossings that can be pursued for Quiet Zone establishment independently, this crossing ranks 3rd.

SWALLOW ROAD

Quiet Zone Options:	Approx. Cost:
Raised Medians	\$60,000
4-Quadrant Gates	\$260,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Ranked by cost among the 5 southern crossings that can be pursued for Quiet Zone establishment independently, this crossing ranks 1st.
- Allowable median break width for the Mason Trail crossing is still being confirmed with FRA.

PROSPECT ROAD

Quiet Zone Options:	Approx. Cost:
Wayside Horns	\$160,000
Raised Median/Wayside Horn	\$135,000

Considerations:

- Costs are slightly lower because improvements are being done as part of the BRT.
- Because of the proximity to Lake Street (.12 mi), Prospect should be included with crossings to the north for quiet zone establishment.
- Wayside horns are the least expensive option at this crossing.

UNIVERSITY STREET

Quiet Zone Options:	Approx. Cost:
Wayside Horns	\$270,000
4-Quadrant Gates	\$360,000

Considerations:

- Signal improvements were completed as part of the BRT project.
- Because of the proximity to Pitkin Street (.19 mi), University should be included with Pitkin and other crossings to the north for quiet zone establishment.
- Wayside horns are the least expensive option at this crossing. Approach gates would be required.
- This crossing is within the CSU campus and would require coordination with CSU to pursue a quiet zone.

TRILBY ROAD

Quiet Zone Options:	Approx. Cost:
Raised Medians/Approach Gates	\$205,000
Wayside Horns	\$200,000
4-Quadrant Gates	\$415,000

Considerations:

- Costs are slightly higher because no improvements are being done as part of the BRT.
- Ranked by cost among the 5 southern crossings that can be pursued for Quiet Zone establishment independently, this crossing ranks 5th.

LAKE STREET

Quiet Zone Options:	Approx. Cost:
Wayside Horns	\$160,000
4-Quadrant Gates	\$210,000

Considerations:

- Costs are slightly higher because no improvements are being done as part of a safety project.
- Because of the proximity to Prospect Street (.12 mi), Lake should be included with Prospect and other crossings to the north for quiet zone establishment.
- Wayside horns are the least expensive option at this crossing.

PEDESTRIAN CROSSING #1

Quiet Zone Options:	Approx. Cost:
Closure	\$0

Considerations:

- This pedestrian crossing will be removed as part of the BRT project. Therefore train horns will cease sounding at this location because the crossing will no longer exist.

Phase I
 Quiet Zone
 Study
 (Laurel north
 through downtown)
 completed
 July 2011

Phase II
 Quiet Zone
 Study
 (Old Main Drive
 to Trilby Road)