DOWNTOWN DEVELOPMENT AUTHORITY
CITY OF FORT COLLINS
QUIET ZONE STUDY

FINAL REPORT

Prepared for:

Downtown Development Authority
City of Fort Collins
19 Old Town Square
Fort Collins, Colorado 80524

and

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: Kyle A. Anderson, PE, PTOE
Associate/Traffic Analysis: Rick Haden
Project Manager: Stephanie J. Sangaline, PE

FHU Reference No. 08-287-02
July 6, 2011

FELSBURG HOLT & ULLEVIG

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

Felsburg Holt and Ullevig (FHU) is completing a railroad grade crossing Quiet Zone study to evaluate and recommend improvements at 12 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 an initial field review, analyzing the number of crossings to be included in a Quiet Zone establishment effort, and developing concept level plans for the crossings and between crossings along the Mason Street corridor.

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

There are two railroads operating within the City of Fort Collins: the BNSF Railway (BNSF) and the Union Pacific Railroad (UPRR). The BNSF line is oriented north-south, and runs down the middle of Mason Street from south of the City to the north end, then curves northeast and is within BNSF right-of-way. There are 7 crossings along the Mason Street corridor that are the subject of this draft report. Those crossings (from south to north) are:

- Mulberry Street
- Magnolia Street
- Olive Street
- Oak Street
- Mountain Avenue
- Laporte Avenue
- Maple Street

Three additional BNSF crossings along the northeast alignment are also included. They are:

- Cherry Street
- College Avenue
- Linden Street

The Union Pacific railroad runs northwest along the east side of Jefferson/Riverside before turning north after crossing College Avenue. The UPRR crossings included in this study are:

- Lincoln Street
- Linden Street

Due to the close proximity of the cross streets along the Mason Street corridor, this report will also discuss the next two crossings south of Mulberry along Mason, which are Myrtle Street and Laurel Street. This report will also discuss the Willow Street crossing of the connector track between the BNSF and UPRR. The 12 crossings that are part of Phase I 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 area, the tracks are within Mason Street through the downtown portion, then turn northeast passing through Cherry Street on a skew, then College and Linden as typical perpendicular crossings with those roadways.

The BNSF runs as many as 15 trains per day along this line, with a maximum train speed of 49 MPH. Train speeds through downtown are restricted to 10 MPH.

The UPRR line runs generally northwest-southeast along the east side of Jefferson/Riverside as it passes across Lincoln Avenue and Linden Street. There are 2-3 trains per day with switching operations on this line.

The U.S. DOT Crossing Inventory Summary Sheets for each study crossing can be found in **Appendix A**. It should be noted that some of the information provided on these crossing inventory sheets was last updated as long ago as 1989.

A. Corridor Site Visit / Data Collection

An initial field site review was conducted of the UPRR crossings, and along the BNSF corridor in January 2009 to collect field measurements at each of the study crossings and note current existing crossing warning devices. FHU also collected information available from other ongoing project efforts such as the Mason 2-way conversion plans and the MAX Bus Rapid Transit plans, including aerial mapping and Daily Traffic Volume information. Railroad corridor information was collected from the Federal Railroad Administration 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 within the study area, including roadway approach photos and crossing information. The highway-rail crossings are listed showing the UPRR crossings first, then the BNSF crossings northeast of downtown, following by the Mason Street crossings from north to south.

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 is the railroad milepost, railroad circuitry (identified in the Federal Railroad Administration (FRA) Crossing Inventory Reports), whether or not the crossing is currently equipped with gates and railroad flashing lights, and the type of crossing surface currently in place.

The southernmost crossings through downtown are not part of the Phase I study, but are included in this discussion because of their proximity to the downtown crossings, and the need to address crossing improvements in conjunction with the downtown corridor. Willow Street is also not part of the Phase I Study, but has been included as a result of comments received from the railroad.

Table 1. Existing Crossing Conditions

CROSSING	STREET	RR	M.P.	MIN. DIST BTWN XINGS (mi.)	TOTAL TRAINS	RR CIRCUITRY	GATES/ LIGHTS	CROSSING SURFACE	NOTES
906295A	Lincoln Ave	UPRR	31.72	0.21	3	DC/AFO	YES	concrete	
906296G	Linden Street	UPRR	31.93	0.21	2	DC/AFO	YES	concrete	
244857M (unconfirmed)	Willow Street	BNSF	74.75	0.34	2	DC/AFO	YES	concrete	connector track between UPRR & BNSF
244644C	Linden Street	BNSF	75.09	0.46	15	DC/AFO	YES	rubber	
244643V	College Avenue	BNSF	74.63	0.11	15	CWT	YES	concrete	has req'd circuitry for Quiet Zone
244642N	Cherry Street	BNSF	74.52	0.10	15	CWT	YES	concrete	has req'd circuitry for Quiet Zone
244641G	Maple Street	BNSF	74.42	0.10	15	DC/AFO	Lights	concrete	
244640A	Laporte Avenue	BNSF	74.30	0.12	15	DC/AFO	Lights	concrete	Simultaneous preempt w traffic lights
244639F	Mountain Avenue	BNSF	74.16	0.10	15	DC/AFO	Lights	concrete	Simultaneous preempt w traffic lights
244638Y	Oak Street	BNSF	74.06	0.09	15	None		HMA	Simultaneous preempt w traffic lights
244637S	Olive Street	BNSF	73.97	0.09	15	DC/AFO	Lights	HMA	Simultaneous preempt w traffic lights
244636K	Magnolia Street	BNSF	73.87	0.09	15	None		HMA	
244635D	Mulberry Street	BNSF	73.78	0.09	15	DC/AFO	Lights	HMA	Simultaneous preempt w traffic lights
244634W	Myrtle Street	BNSF	73.68	0.10	15	None		HMA	
244633P	Laurel Street	BNSF	73.54	0.14	15	DC/AFO	Lights	HMA	Cantilever lights also

NOTES: Crossings on Mason Street do not have minimum 1/4 mile spacing and will need to be evaluated as a corridor for Quiet Zone establishment.

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

Street crossings along Mason Street where BNSF tracks run down the middle of Mason.

Lincoln Avenue Crossing Summary
US DOT Crossing #906295A
UPRR – Fort Collins Branch Line

The UPRR crossing at Lincoln Avenue is equipped with cross bucks, gates, lights, and bells. One set of tracks are crossed. The roadway is configured to provide two thru lanes of travel westbound with one dedicated left turn lane. There is one thru lane in the eastbound direction. The total roadway width is approximately 65'. The roadway surface is hot mix asphalt. The speed limit on Lincoln Ave is posted 35 MPH in the vicinity 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.

Fig. 2. Lincoln Avenue at UPRR

Table 2. Lincoln Street Crossing Information

Roadway		Railroad	
ADT (1994)	4850	Total Trains per Day	3
% Trucks	13	Switching Movements	1
Posted Speed (mph)	35	Max Train Speed (mph)	10
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Collector	Crossing Surface	Concrete
Intersection			
Exposure Factor		14,550	
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

Linden Street Crossing Summary
US DOT Crossing #906296G
UPRR – Fort Collins Branch Line

The UPRR crossing at Linden Street is equipped with cross bucks, gates, lights, and bells. One set of tracks are crossed. The roadway is configured to provide one thru lane of travel in each direction and dedicated right turn and left turn lanes in the westbound direction. The total roadway width is approximately 53'. The roadway surface is hot mix asphalt. The speed limit on Linden Street is not posted 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**.

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. Linden Street at UPRR

Table 3. Linden Street Crossing Information

Roadway		**Railroad**	
ADT (1994)	2800	Total Trains per Day	2
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	10
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Collector	Crossing Surface	Concrete
Intersection			
Exposure Factor		5,600	
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

Linden Street Crossing Summary
US DOT Crossing #244644C
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Linden Street is equipped with cross bucks, gates, lights, and bells. One set of tracks are crossed. The roadway is configured to provide one lane of travel in each direction with a roadway width of approximately 35'. The roadway surface is paved with hot mix asphalt. The speed limit on Linden Street is posted at 30 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**.

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

Figure 4. Linden Street at BNSF

Table 4. Linden Street Crossing Information

Roadway		**Railroad**	
ADT (1989)	1,550	Total Trains per Day	15
% Trucks	9	Switching Movements	0
Posted Speed (mph)	30	Max Train Speed (mph)	20
# of Lanes	2	# of Tracks	1
Existing Highway type	Urban Collector	Crossing Surface	Rubber
Intersection			
Exposure Factor		23,250	
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

North College Avenue Crossing Summary
US DOT Crossing #244643V
BNSF Main Line – Front Range Subdivision

The BNSF crossing at College Avenue is equipped with cross bucks, gates, lights, and bells. One set of tracks are crossed. The roadway is configured to provide two thru lanes of travel in each direction with a raised median. Roadway width is approximately 60'. The roadway surface is paved with hot mix asphalt. The speed limit on College Avenue is posted at 25 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**.

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

Figure 5. College Ave at BNSF

Table 5. College Avenue Crossing Information

Roadway		Railroad	
ADT (1996)	20,800	Total Trains per Day	15
% Trucks	9	Switching Movements	0
Posted Speed (mph)	25	Max Train Speed (mph)	49
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Principal Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor		312,000	
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

Cherry Street Crossing Summary
US DOT Crossing #244642N
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Cherry Street is equipped with cross bucks, gates, lights, and bells. One set of tracks are crossed. The roadway is configured to provide two thru lanes eastbound and one thru lane westbound with a raised median. Roadway width is approximately 56'. The roadway surface is paved with hot mix asphalt. The speed limit on Cherry Street is not posted 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**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 6. Cherry Street at BNSF

Table 6. Cherry Street Crossing Information

Roadway		Railroad	
ADT (2008)	9,900	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not posted	Max Train Speed (mph)	49
# of Lanes	3	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor		148,500	
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

Maple Street Crossing Summary
US DOT Crossing #244641G
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Maple Street is equipped with cross bucks and stop signs. One set of tracks are crossed. The roadway is configured to provide one thru lane of travel in each direction along Maple. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Maple has a roadway width of approximately 54', with diagonal parking along the curbline. The roadway surface is hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted 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**.

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

Fig. 7. Maple Street at BNSF

Table 7. Maple Street Crossing Information

Roadway		Railroad	
ADT (2008)	2,850	Total Trains per Day	15
% Trucks	0	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		42,750	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Stop signs/Cross bucks/Lights	
Train Detection		DC/AFO	

Exposure Factor= ADT x Trains per Day

Laporte Avenue Crossing Summary
US DOT Crossing #244640A
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Laporte Avenue is equipped with traffic signals, cross bucks and lights. One set of tracks are crossed. The roadway is configured to provide two thru lanes eastbound, one thru lane westbound, and dedicated left turn lanes eastbound and westbound. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Laporte has a roadway width is approximately 56'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. 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**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Fig. 8. Laporte Avenue at BNSF

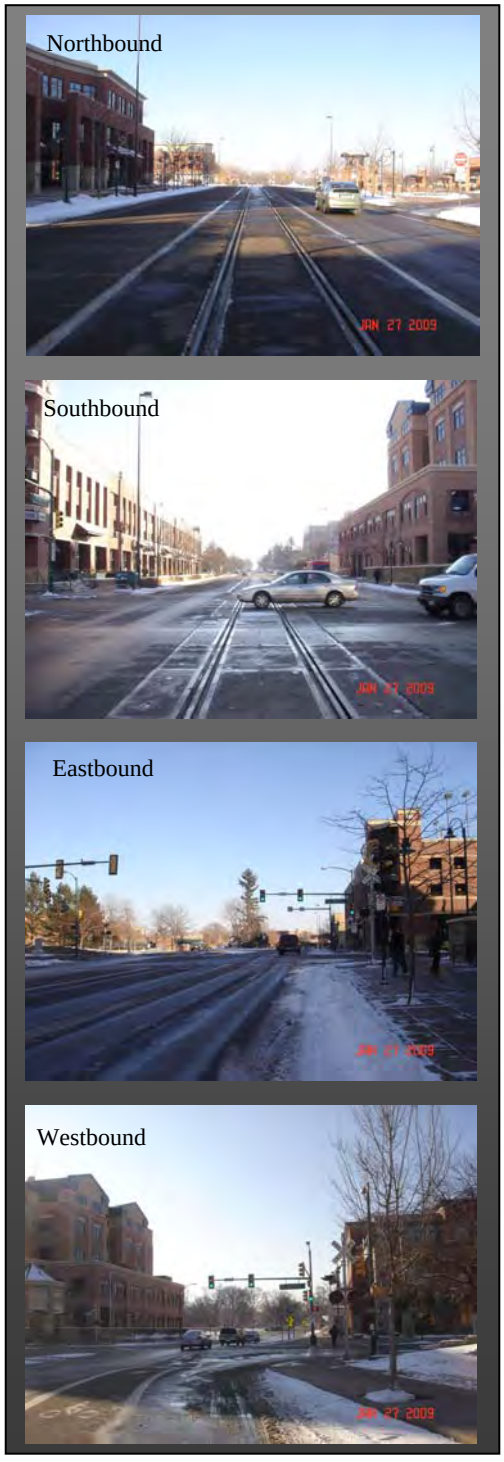


Table 8. Laporte Avenue Crossing Information

Roadway		Railroad	
ADT (2008)	5,750	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	49
# of Lanes	3	# of Tracks	1
Existing Highway type	UrbanMinor Arterial	Crossing Surface	Concrete
Intersection			
Exposure Factor		86,250	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Traffic Signal/Cross Bucks/ Lights	
Train Detection		DC/AFO & Simul Preempt	

Exposure Factor= ADT x Trains per Day

Mountain Avenue Crossing Summary
US DOT Crossing #244639F
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Mountain Avenue is equipped with traffic signals, cross bucks and lights. One set of tracks are crossed. The roadway is configured to provide two thru lanes of travel eastbound and westbound and center diagonal parking on Mountain. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Mountain has a roadway width of approximately 65' at its narrowest point. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. 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**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 9. Mountain Avenue at BNSF

Table 9. Mountain Avenue Crossing Information

Roadway		Railroad	
ADT (2008)	8,500	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	49
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Collector	Crossing Surface	Concrete
Intersection			
Exposure Factor		127,500	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Traffic Signal/Cross Bucks/ Lights	
Train Detection		DC/AFO	

Exposure Factor= ADT x Trains per Day

Oak Street Crossing Summary
US DOT Crossing #244638Y
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Oak Street is equipped with traffic signals, cross bucks and lights. One set of tracks are crossed. The roadway is configured to provide one thru lane of travel in each direction on Oak. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Oak has a roadway width of approximately 28' at its narrowest point. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. The pictures shown in **Figure 10** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 10**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 10. Oak Street at BNSF

Table 10. Oak Street Crossing Information

Roadway		Railroad	
ADT (2008)	1,300	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	HMA
Intersection			
Exposure Factor		19,500	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Traffic Signal/Cross Bucks/ Lights	
Train Detection		None & Simul Preempt	

Exposure Factor= ADT x Trains per Day

Olive Street Crossing Summary
US DOT Crossing #244637S
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Olive Street is equipped with traffic signals, cross bucks and lights. One set of tracks are crossed. The roadway is configured to provide one thru lane eastbound and westbound on Olive. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Olive has a roadway width of approximately 54'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. 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**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 11. Olive Street at BNSF

Table 11. Olive Street Crossing Information

Roadway		**Railroad**	
ADT (2008)	4,250	Total Trains per Day	15
% Trucks	0	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	HMA
Intersection			
Exposure Factor		63,750	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Traffic Signal/Cross Bucks/ Lights	
Train Detection		DC/AFO & Simul Preempt	

Exposure Factor= ADT x Trains per Day

Magnolia Street Crossing Summary
US DOT Crossing #244636K
BNSF Main Line - Front Range Subdivision

The BNSF crossing at Magnolia Street is equipped with stop signs and cross bucks. One set of tracks are crossed. The roadway is configured to provide one thru lane eastbound and westbound on Magnolia. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Magnolia has a roadway width of approximately 54'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. The pictures shown in **Figure 12** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 12**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 12. Magnolia Street at BNSF

Table 12. Magnolia Street Crossing Information

Roadway		Railroad	
ADT (2008)	4,900	Total Trains per Day	15
% Trucks	10	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	HMA
Intersection			
Exposure Factor		73,500	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Stop Signs/Cross Bucks	
Train Detection		None	

Exposure Factor= ADT x Trains per Day

Mulberry Street Crossing Summary
US DOT Crossing #244635D
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Mulberry Street is equipped with traffic signals, cross bucks and lights. One set of tracks is crossed. The roadway is configured to provide two thru lanes of travel eastbound and westbound, with one dedicated left turn lane in each direction. The BNSF tracks also reside in the middle of Mason Street, which is currently one-way northbound, with one lane of travel along each side and parallel to the tracks. Mulberry has a roadway width of approximately 56'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. 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**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Figure 13. Mulberry Street at BNSF

Table 13. Mulberry Street Crossing Information

Roadway		**Railroad**	
ADT (2008)	20,500	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	49
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	HMA
Intersection			
Exposure Factor		307,500	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Traffic Signal/Cross Bucks/ Lights	
Train Detection		DC/AFO & Simul Preempt	

Exposure Factor= ADT x Trains per Day

Myrtle Street Crossing Summary
US DOT Crossing #244634W
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Myrtle Street is equipped with stop signs. One set of tracks is crossed. The roadway is configured to provide one thru lane eastbound and westbound on Myrtle. The BNSF tracks also reside in the middle of Mason Street, which is one-way northbound north of Myrtle, and two-way south of Myrtle, with one lane of travel along the east side and two lanes along the west side, all parallel to the tracks. Myrtle has a roadway width of approximately 60', with diagonal parking along the curbline. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. The pictures shown in **Figure 14** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 14**. Roadway and traffic data is updated, where available, from current City traffic counts.

This crossing does not meet the minimum requirements for passive devices. This crossing should be equipped with a minimum of one cross buck on each approach per MUTCD.

Figure 14. Myrtle Street at BNSF

Table 14. Myrtle Street Crossing Information

Roadway		Railroad	
ADT (2008)	2,600	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	HMA
Intersection			
Exposure Factor		39,000	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Stop Signs	
Train Detection		None	

Exposure Factor= ADT x Trains per Day

Laurel Street Crossing Summary
US DOT Crossing #244633P
BNSF Main Line – Front Range Subdivision

The BNSF crossing at Laurel Street is equipped with cross bucks and cantilever lights. One set of tracks are crossed. The roadway is configured to provide two thru lanes of travel eastbound and westbound on Laurel. The BNSF tracks also reside in the middle of Mason Street. From Myrtle to Laurel, Mason is a 2-lane, 2-way roadway on the west side of the tracks and a single lane in the northbound direction on the east side of the tracks. Laurel has a roadway width of approximately 60'. The roadway surface is paved with hot mix asphalt. The posted speed limit on Mason Street is 25 MPH. The cross street speed limit is not posted in the vicinity of the crossing. The pictures shown in **Figure 15** illustrate the existing roadway and railway approaches to the crossing. Crossing information from the FRA Crossing Inventory system is shown in **Table 15**. Roadway and traffic data is updated, where available, from current City traffic counts.

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

Fig. 15. Laurel Street at BNSF

Table 15. Laurel Street Crossing Information

Roadway		Railroad	
ADT (2008)	14,200	Total Trains per Day	15
% Trucks	5	Switching Movements	0
Posted Speed (mph)	Not Posted	Max Train Speed (mph)	49
# of Lanes	4	# of Tracks	1
Existing Highway type	Urban Minor Arterial	Crossing Surface	HMA
Intersection			
Exposure Factor		213,000	
Total Train-Vehicle Accidents (5 years)		0	
Pavement Type		Hot Mix Asphalt	
Warning Devices		Cross bucks/Cantilever Lights	
Train Detection		DC/AFO	

Exposure Factor= ADT x Trains per Day

III. QUIET ZONE REQUIREMENTS

The Downtown Development Authority (DDA) and City of Fort Collins (City) are interested in establishing Quiet Zones along the track corridors near Old Towne Fort Collins and through downtown. This section of the report will identify the requirements 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.

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*.

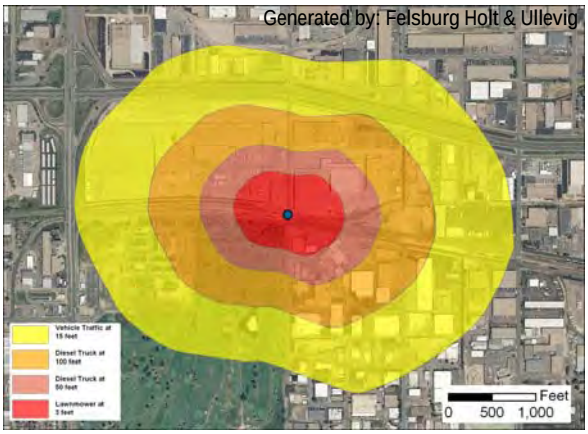
The SSMs to be considered, as identified in the *Final Rule*, include the following:

- 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. 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 16**. A highway-rail crossing with a wayside horn installation is shown in **Figure 17**.

Figure 16. Comparison of Train Horn vs. Wayside Horn Noise Footprint



Train Horn in Crossing

Automated Horn

Figure 17. 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 problem crossings. 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 also be found in **Appendix B.**

C. Quiet Zone Improvements

Each highway-rail grade crossing within the Phase I study area of the City of Fort Collins was evaluated for the implementation of a Quiet Zone. The group of crossings to the northeast of downtown can be addressed separately from downtown because those crossings are sufficiently far away that proximity is not an issue. The two UPRR crossings of Linden and Lincoln could be completed together in order to create a segment of track where locomotive horns are not sounded. The BNSF crossing at Linden is isolated and could be pursued individually as a Quiet Zone, with adjacent crossings pursued as funding would become available. The Willow Street crossing of the connector track is more than a quarter mile from the next nearest crossing at UPRR and Linden, and could therefore be pursued as a Quiet Zone individually as well. Each of these crossings can be treated with standard SSM improvements, as the roadway-railroad crossing is a typical single roadway crossing of one or more tracks that are within a railroad right-of-way.

The downtown BNSF crossings from College Avenue through Laurel are within ¼ mile of each other, and therefore need to be addressed as a corridor in order to utilize funding efficiently and achieve a Quiet Zone through all of downtown. The need for the downtown 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. A Quiet Zone may be implemented in segments; however each segment must be adjacent to a portion of an existing Quiet Zone. As a general recommendation, any roadway improvements to crossings within a potential Quiet Zone should be made compliant with Quiet Zone requirements.

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 UPRR crossings at Lincoln and Linden, and the BNSF crossing at Linden. Willow Street circuitry is unconfirmed and assumed to be motion detection. There is a public access on the southwest quadrant that is at 60 feet from the approach gate arm. This access would need to be evaluated using turning templates to confirm the 60 foot median would allow for adequate turning movements into and out of the access.

College Avenue and Cherry Streets have Constant Warning Time Circuitry (CWT) necessary for Quiet Zone establishment. College Avenue also has the required gates, lights, bells and raised medians. There is one commercial access on the southeast quadrant that is within 60' of the gate arm that would need to be relocated in order to render this crossing ready for Quiet Zone establishment. Cherry Street can be treated with longer medians or additional gates to establish the Quiet Zone at this crossing.

Mason Street has the unique condition of having the BNSF Railway tracks running down the center of the street, with parallel vehicle traffic lanes on each side. In order to silence the train horns, the track corridor must be isolated from the vehicle lanes, such that vehicles cannot utilize the paved area containing the railroad tracks as an additional lane to circumvent railroad gates or other crossing closure devices when a train is entering the corridor.

The downtown portion of Mason Street will be converted to 2-way operation in 2012. In advance of that operational change, the City and BNSF have agreed to isolate the tracks between the impending two directions of traffic by surrounding the tracks with a raised median between the cross streets. Much like a parkway with a wide, raised median dividing opposing directions of traffic, the curb and gutter on each side of the tracks would house the track corridor providing separation of vehicles from the track and trains, in a fashion that is familiar and consistent with driver expectancy.

The team reviewed the field conditions of each crossing, and determined the possible improvements that may work at each crossing. Following an initial review by the DDA and City, concept improvements were refined. Some options along the Mason Street corridor were eliminated due to geometric limitations within the existing street and intersections.

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 base plans for the proposed conversion of Mason Street from one-way to two-way traffic operations. These base plans also identified the locations of Bus Rapid Transit (BRT) stops planned for the Mason Street corridor. A field review was then conducted to identify the location of existing railroad crossing passive and active control, as well as pedestrian activity, parking conditions 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 Mason Street corridor:

Barrier Curbs- As part of the conversion of Mason Street to 2-way operation, minimum 6 inch high curbs will be installed on each side of the tracks, between the cross streets. The track areas between cross streets will be signed to prohibit pedestrian crossing except at designated crossing locations. Pedestrian crossing of the median areas containing the tracks would result in frequent sounding of locomotive horns. Locomotive operators have authority to sound the horn when they identify a risk afoul of the tracks, even within a designated Quiet Zone. The planned median treatment for track isolation is included in **Appendix C**.

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 on the through roadway.

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.

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 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. The close proximity of the travel lanes, particularly where travel lanes are already narrow, limits the available area for placement of the gates.

Bollards – Retractable bollards were considered for several crossings, used either alone or in conjunction with parallel gates. The state-of-the-art bollards are part of a federal railroad crossing safety test currently underway in Michigan. These bollards are not currently acceptable to the Colorado Public Utilities Commission as allowable traffic safety devices, and would require an application to the FRA to be considered for Quiet Zone compliance.

Roundabouts- Roundabouts are becoming more common across the country as a safer alternative to traffic signals under certain conditions. They significantly reduce travel speeds and separate conflicts within an intersection by converting the higher risk left turns and through movements to right turns. The roundabouts in effect create a one-way pair of roadways at a crossing. Pulling the left turning vehicles away from the tracks allows the driver to see in both directions on the crossing approach. The gate arms would block the entire crossing similar to a one-way approach or a crossing with raised medians. Concerns have been expressed by the railroad and jurisdictional agencies with regard to queuing backup around the roundabout and potentially having vehicles stopped on the tracks during approach of a train. For this reason, roundabouts are not currently supported by the railroad or agencies as an option. Some photos of existing railroad crossings with roundabouts (Salt Lake City Utah and are Jensen Beach, Florida) are shown in **Appendix D**.

B. Safety Considerations

Of primary concern are the areas between the cross streets along the Mason Street corridor. Typical Quiet Zone crossings are a single street crossing perpendicular or at a skew to a single railroad corridor with one or more tracks. The presence of the railroad tracks within the middle of the street allows access by vehicles to the rail corridor at locations other than the cross streets.

Currently the one-way travel on Mason Street allows for single direction weaving across the tracks for drivers wishing to make left or right turns of off Mason Street. The proposed conversion of Mason Street to 2-way traffic, with the track area between cross streets to be placed within raised medians, will eliminate this unidirectional weaving across the tracks. This conversion to 2-way is anticipated to be completed by 2012, and will serve to retrain Mason Street drivers to staying to the right of the railroad tracks in both directions. New signing and striping will also limit left turn movements at cross streets, and provide warning to left turning drivers of the event of an oncoming train.

For establishment of a Quiet Zone, the rail corridor isolation must be taken one step further. Pedestrian movements must be prohibited at locations along the corridor, except designated crosswalks at the cross streets. Pedestrians are not only subject to potential injury by trying to cross the raised median housing the tracks, but would also cause the train horn to be sounded as a regulatory warning in the event a train is approaching. This type of activity can undermine efforts toward silencing train horns, as locomotive engineers are required to sound the horn if any person or hazard is identified within the track envelope. This authority remains even in designated Quiet Zones.

C. Track Corridor Treatments

Currently the railroad tracks within Mason Street reside in a variety of pavement scenarios. A portion of the track south of Maple is in an open ballast section, bordered by curb and gutter. This was due to the presence of a switch between two track corridors at this location. The switch and a portion of the westbound track has been removed and is not anticipated to be reconnected. This scenario represents an "open ballast" section, which will be referenced throughout this discussion. Several cross streets on the north end of Mason currently have concrete crossing material at the location of the cross streets as the driving surface for vehicles over the tracks. The third scenario is present on crossings south of downtown, where the tracks are embedded in bituminous asphalt adjacent to the rails. These areas are experiencing pavement failure adjacent to the tracks.

Installation of the curb and gutter on each side of the tracks and removal of the pavement around the tracks between each cross street, will eliminate the maintenance and aesthetic issues in areas of pavement failure. Installation of concrete crossing material will be completed at each cross street as part of the track isolation work providing for smooth crossing surfaces at each crossing along the corridor. These improvements will provide for uniform treatment at each cross street and within each block along the track for consistent aesthetics, ease of maintenance, and safety.

D. Field Diagnostic Review

Following initial evaluation of the crossings and development of the crossing concepts, the DDA and City conducted Field Diagnostic Review meetings with each of the railroads and agencies of jurisdiction.

The UPRR Field Diagnostic was held on Tuesday, March 9, 2010 with the DDA, City and PUC in attendance. There were no alternatives eliminated at the two crossings of the UPRR. The results of this diagnostic allowed the 4-quadrant gate and wayside horn options at Linden and Lincoln to remain. The Diagnostic Review Summary is provided in **Appendix E** of this report.

The BNSF Office Review and Field Diagnostic was held on Thursday, April 15, 2010 with the DDA , City, PUC and FRA in attendance. The group met in office first to review the crossings concepts and discuss concerns. Following office review, the team visited each crossing to review geometry, roadway use, and sight distances and discuss concept options which may or may not remain viable. The Diagnostic Review Summary is provided in **Appendix E** of this report.

Key results of the BNSF Diagnostic Review regarding the downtown crossings are as follows:

- Concern regarding continued mid-block crossing by pedestrians over the tracks within curb and gutter and open ballast presents a slip, trip, fall liability to the City and will cause locomotive engineers to sound the horn even within a Quiet Zone

- BNSF will not support roundabouts at any location due to backup queuing concerns

- Potential closure of any cross streets must include closure or grade separation of the adjacent sidewalks, according to current PUC rule 4 CCR 723-7 Part 7211. Crossing Construction and Maintenance, Subpart (g), which states "Except at locations of existing highway-rail grade crossings, sidewalk and/or bike path crossings of mainline trackage shall be grade separated."

- The group discussed the lack of precedent for establishing Quiet Zones along corridors where tracks are within a street and the need to be open to other options

- The PUC and FRA recommended the 4-quadrant gate SSM installation at every crossing through the downtown and in close proximity to the tracks, as this option truly isolates the track crossing area during train presence while allowing thru movements along Mason and right-in-right-out movements to continue during train presence

- The PUC has authority in Colorado over all railroad crossings for safety. The FRA has nationwide jurisdiction with regard to treatments for Quiet Zone establishment. Given the unique nature of the Mason Street corridor downtown, it is unclear as to whether a proposed treatment for Quiet Zone establishment would be in compliance with the MUTCD, and therefore acceptable to the PUC. Alternatively, proposed treatments could be applied for through the PUC process and potentially approved, but not viable for Quiet Zone establishment with the FRA. There is no clear resolution to this process issue.

Table 16 identifies the original concept level options for each crossing that were considered within the Phase I Study Area and those that remain following the Field Diagnostic Review. Mason at Myrtle and Mason at Laurel are also shown due to proximity.

E. Downtown Pedestrian Crossings

The DDA's and City's interest in maintaining pedestrian crossings downtown, while considering closure of the vehicle crossings at Oak and Magnolia is an option that could be the subject of an application to the PUC, with a request for variance from the rule. Given the urban environment, existing pedestrian facilities, good visibility and slow train speeds, the Commission may consider allowing the sidewalks to remain (with adequate warning devices) with the road crossing closed.

Table 16. Quiet Zone Concept Improvement Options

					Original SSM/ASM Alternatives									
CROSSING	STREET	RR	M.P.	MIN. DIST BTWN XINGS (mi.)	ONE WAY STREET	RAISED MEDIANS	4-QUAD GATES	ROUND ABOUT	WAYSIDE HORNS	PARALLEL GATES	BOLLARDS	CLOSURE	GATES/ BOLLARDS	Diagnostic Review Results
906295A	Lincoln Ave	UPRR	31.72	0.21			x		x					Both options remain viable
906296G	Linden Street	UPRR	31.93	0.21			x		x					Both options remain viable
244857M (unconfirmed)	Willow Street	BNSF	74.75	0.34		x	x		x					Raised median option viable with check of turning templates
244644C	Linden Street	BNSF	75.09	0.46			x		x					Both options remain viable
244643V	College Avenue	BNSF	74.63	0.11		x								With relocation of the access on the SE quadrant; raised median option remains viable
244642N	Cherry Street	BNSF	74.52	0.10		x	x							Both options remain viable; raised median option requires closure of alley on SE quadrant
244641G	Maple Street	BNSF	74.42	0.10			x	x	x					4-quadrant gates is the only option that isolates the tracks during train presence
244640A	Laporte Avenue	BNSF	74.30	0.12			x	x			x			4-quadrant gates is the only option that isolates the tracks during train presence
244639F	Mountain Avenue	BNSF	74.16	0.10			x	x		x			x	4-quadrant gates is the only option that isolates the tracks during train presence
244638Y	Oak Street	BNSF	74.06	0.09	x		x			x		x		4-quadrant gates or a One-Way street configuration for EB Oak are viable options
244637S	Olive Street	BNSF	73.97	0.09		x	x		x				x	4-quadrant gates is the only option that isolates the tracks during train presence
244636K	Magnolia Street	BNSF	73.87	0.09			x		x	x		x		4-quadrant gates is the only option that isolates the tracks during train presence
244635D	Mulberry Street	BNSF	73.78	0.09			x		x				x	4-quadrant gates is the only option that isolates the tracks during train presence
244634W	Myrtle Street	BNSF	73.68	0.10					x	x		x		Although not evaluated in Diagnostic, a 4-quadrant gate option was generated
244633P	Laurel Street	BNSF	73.54	0.14					x				x	Although not evaluated in Diagnostic, a 4-quadrant gate option was generated

Legend:
- x — Option remains viable
- x — Option no longer viable (per Diagnostic)
- x — Option added (per Diagnostic)
- Laurel Street — Crossings not evaluated at the Diagnostic

Concept improvements for the cross streets along Mason Street include the curb and gutter isolating the track between each cross street. Therefore each concept ties into continuous curb and gutter north and south of the intersection. Some crossings have more than one concept option with 4-quadrant gates, to show various vehicle lane configurations.

The following sheets identify concept improvements for each railroad crossing. They are shown on aerial base maps for consideration.

Lincoln Ave
US DOT #906295A
Main Line
SSM: Wayside Horns (Option 1)

Concept Crossing Improvements

July 6, 2011

NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. May need interconnect to traffic signal at Jefferson St.
3. Industrial/Commercial land use on all four quadrants.
4. Needs advance warning signs along Jefferson St.

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)	

N

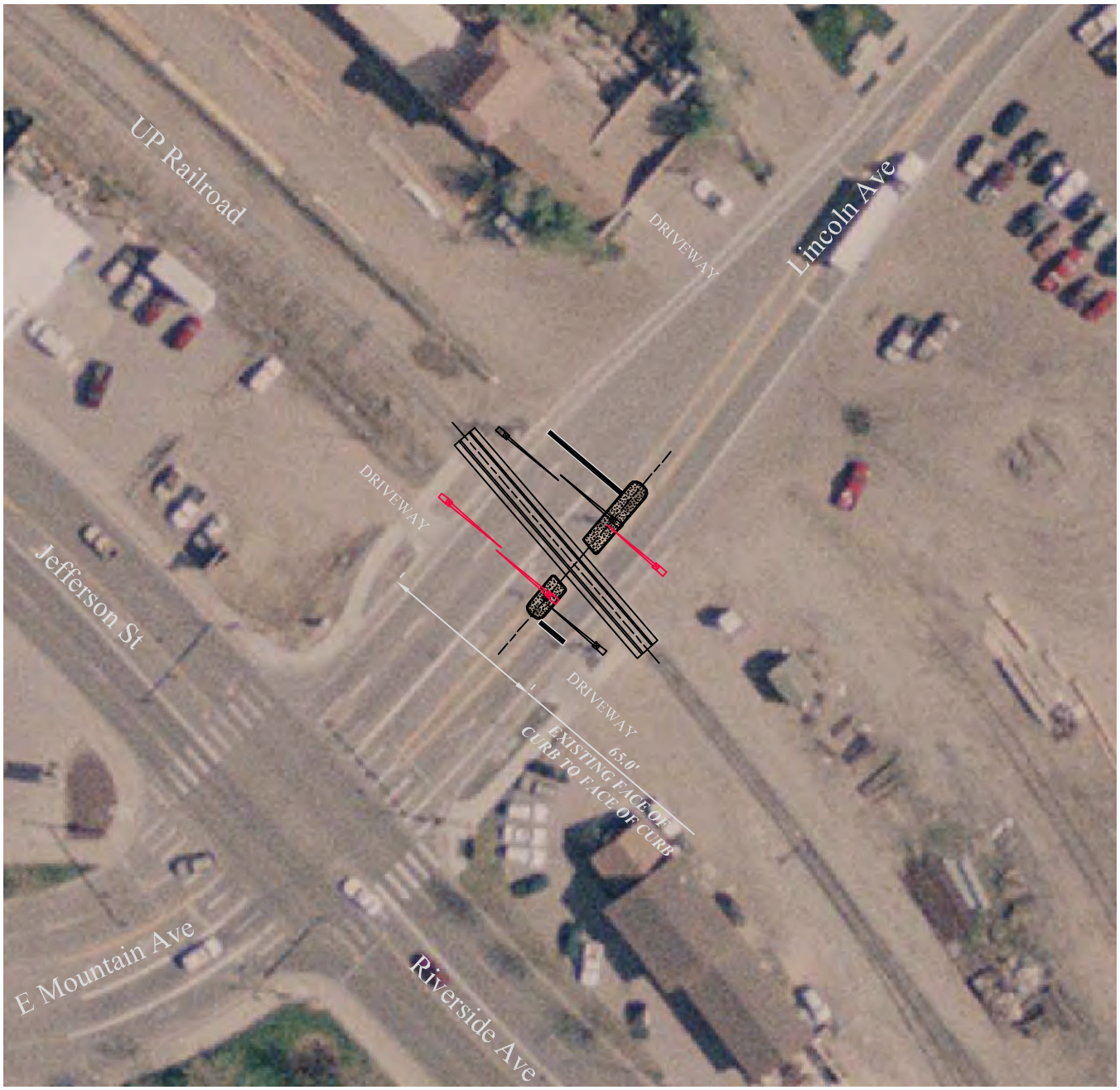
0 30 60

SCALE: 1"=60'

Lincoln Ave
US DOT #906295A
Main Line
SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. May need interconnect to traffic signal at Jefferson St.
3. Industrial/Commercial land use on all four quadrants.
4. Needs advance warning signs along Jefferson St.

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)	

N

0 30 60

SCALE: 1"=60'

Linden Ave
US DOT #906296G
Main Line
SSM: Wayside Horns (Option 1)

Concept Crossing Improvements

July 6, 2011

NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. May need interconnect to traffic signal at Jefferson St.
3. Industrial/Commercial land use on all four quadrants.
4. Needs advance warning signs along Jefferson St.

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)	

N

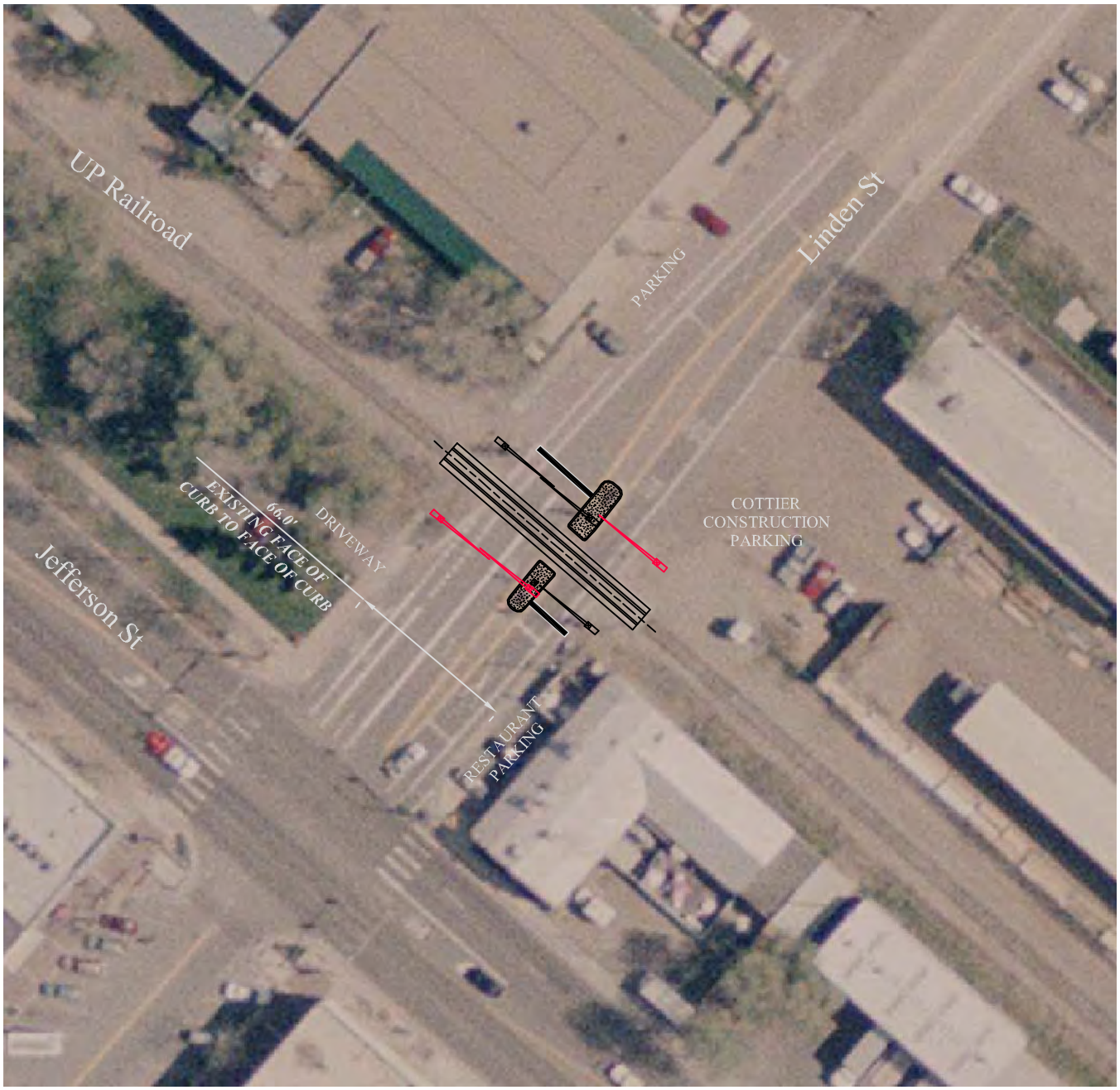
0 30 60

SCALE: 1"=60'

Linden Ave
US DOT #906296G
Main Line
SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. May need interconnect to traffic signal at Jefferson St.
3. Industrial/Commercial land use on all four quadrants.
4. Needs advance warning signs along Jefferson St.

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

N

0 30 60

SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Linden Ave
US DOT #244644C
Main Line
SSM: Wayside Horns (Option 1)

Concept Crossing Improvements

July 6, 2011

NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. If Linden St. is widened consider panel extensions or replacement at crossing.
3. Industrial/Commercial land use south of tracks. Residential land use north of Vine Drive.

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

N

0 30 60

SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Linden Ave
US DOT #244644C
Main Line
SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements

July 6, 2011

NOTES:
1. No train detection; needs CWT Circuitry and new bungalow.
2. Industrial/Commercial land use south of tracks. Residential land use north of Vine Drive.

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)	

N

0 30 60

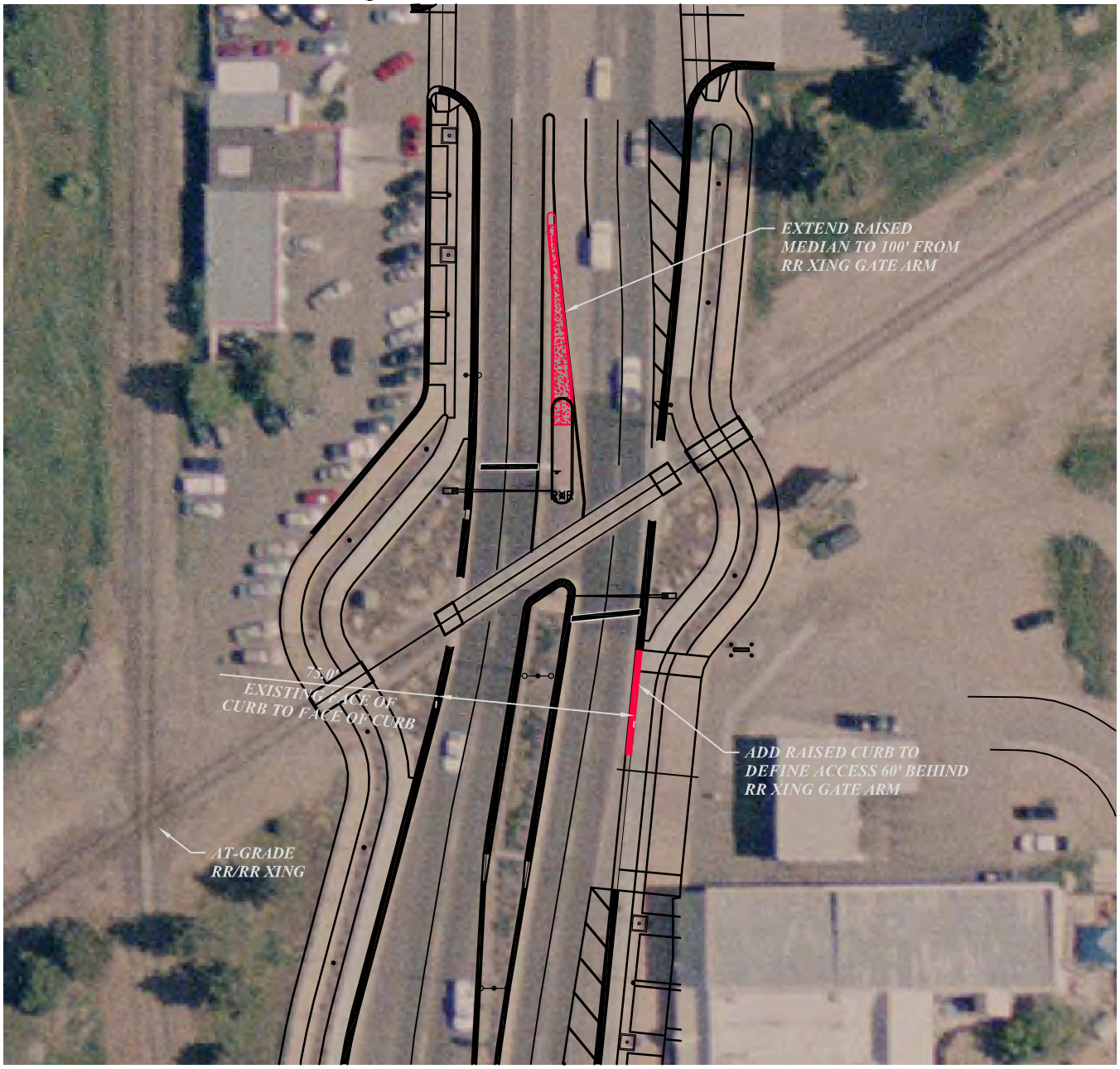
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

N College Ave
US DOT #244643V
Main Line
SSM: Existing Raised Median with Gates

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has CWT Circuitry, raised medians, and gates.
2. Need to define business access on SE quadrant at 60-feet from RR Gate Arm.

LEGEND:

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

N

0 30 60

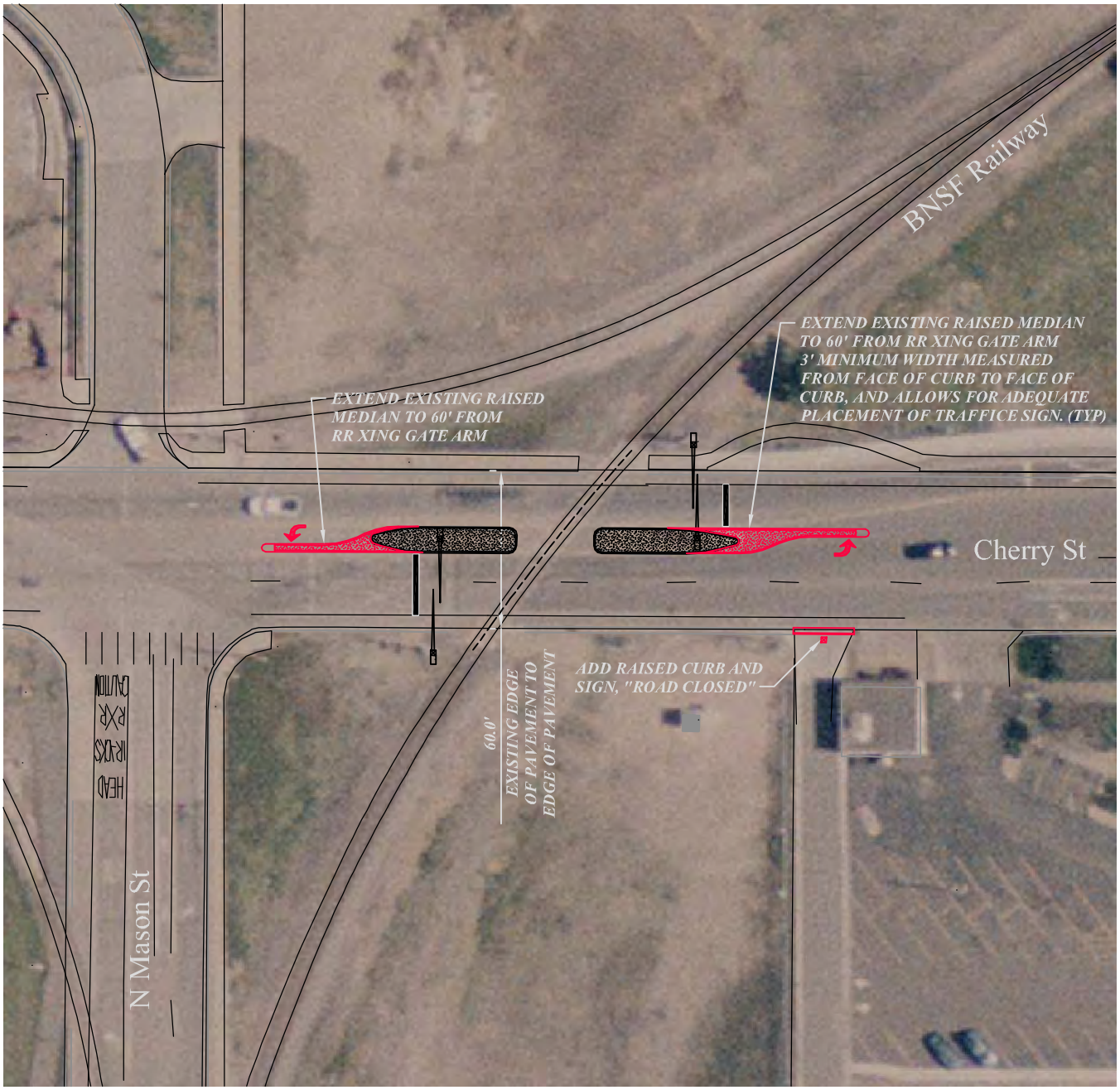
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Cherry Street
US DOT #244642N
Main Line
SSM: Raised Medians with Gates (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has CWT Circuitry, raised medians, and gates.
2. Determine if access on SE quadrant can be closed and instead utilize the next access to the 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
Approximate centerline of road or railway (where needed for reference)	

N

0 30 60

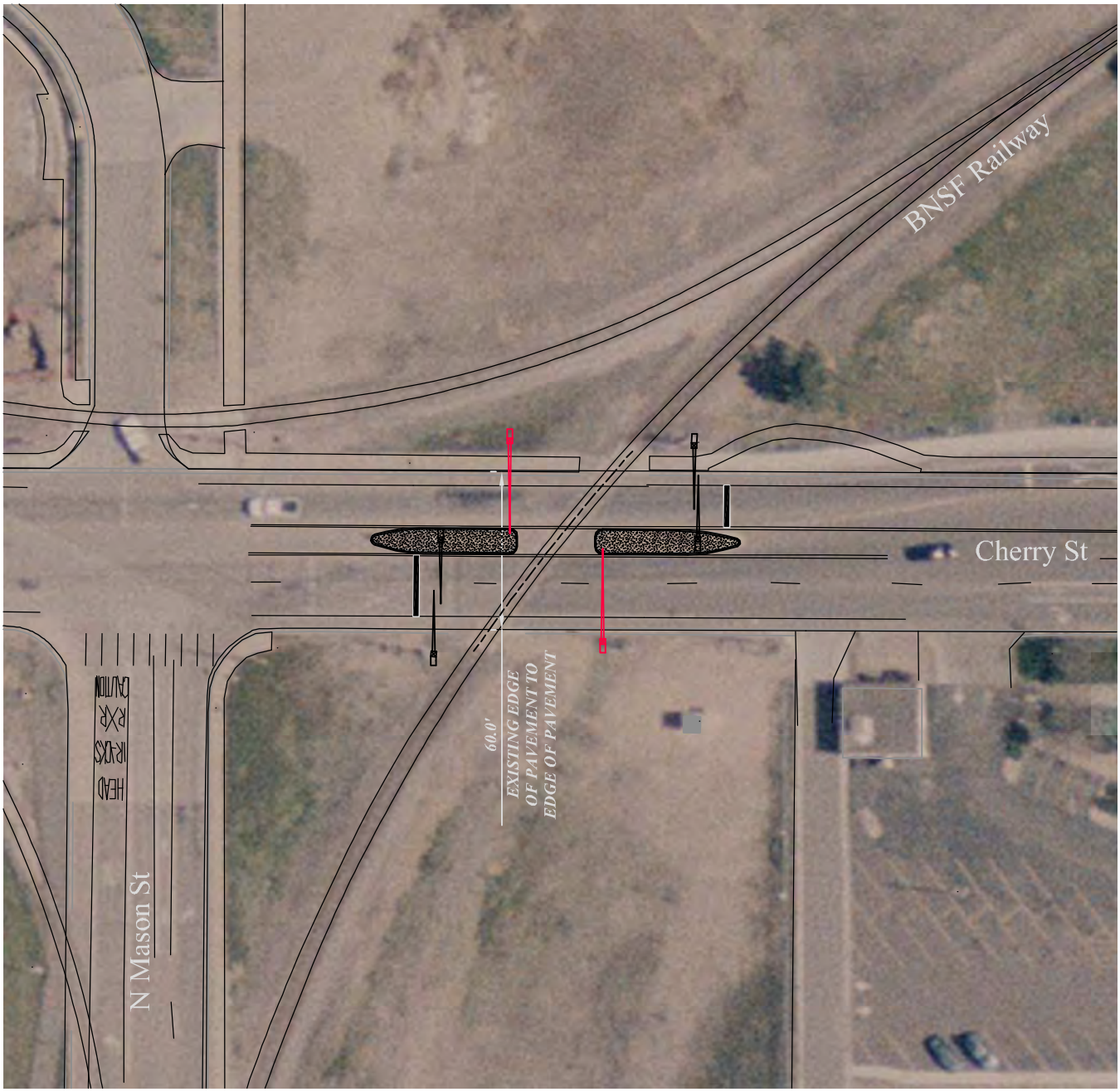
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Cherry Street
US DOT #244642N
Main Line
SSM: 4-Quadrant Gates (Option 2)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has CWT Circuitry, raised medians, and 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)	

N

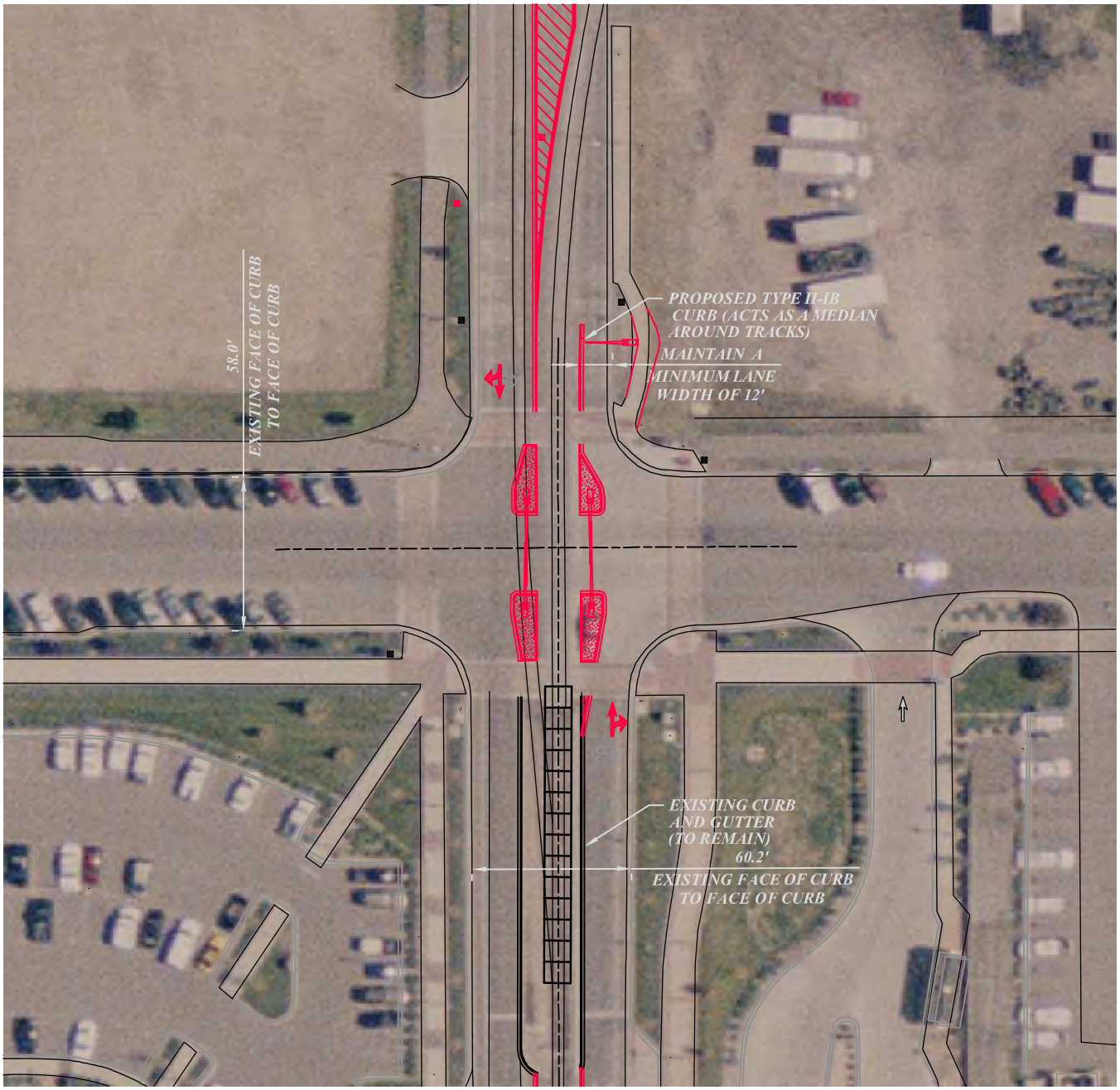
0 30 60

SCALE: 1"=60'

Maple Street
US DOT #244641G
Main Line
SSM: 4-Quadrant Gates

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. Assumes west leg of wye track is removed.
3. Curb and gutter north of Maple St and east of tracks allows for 12' lane. Curb stops when track curves into lane.
4. Left turns off of Mason St. are prohibited.

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)	

N

0 30 60

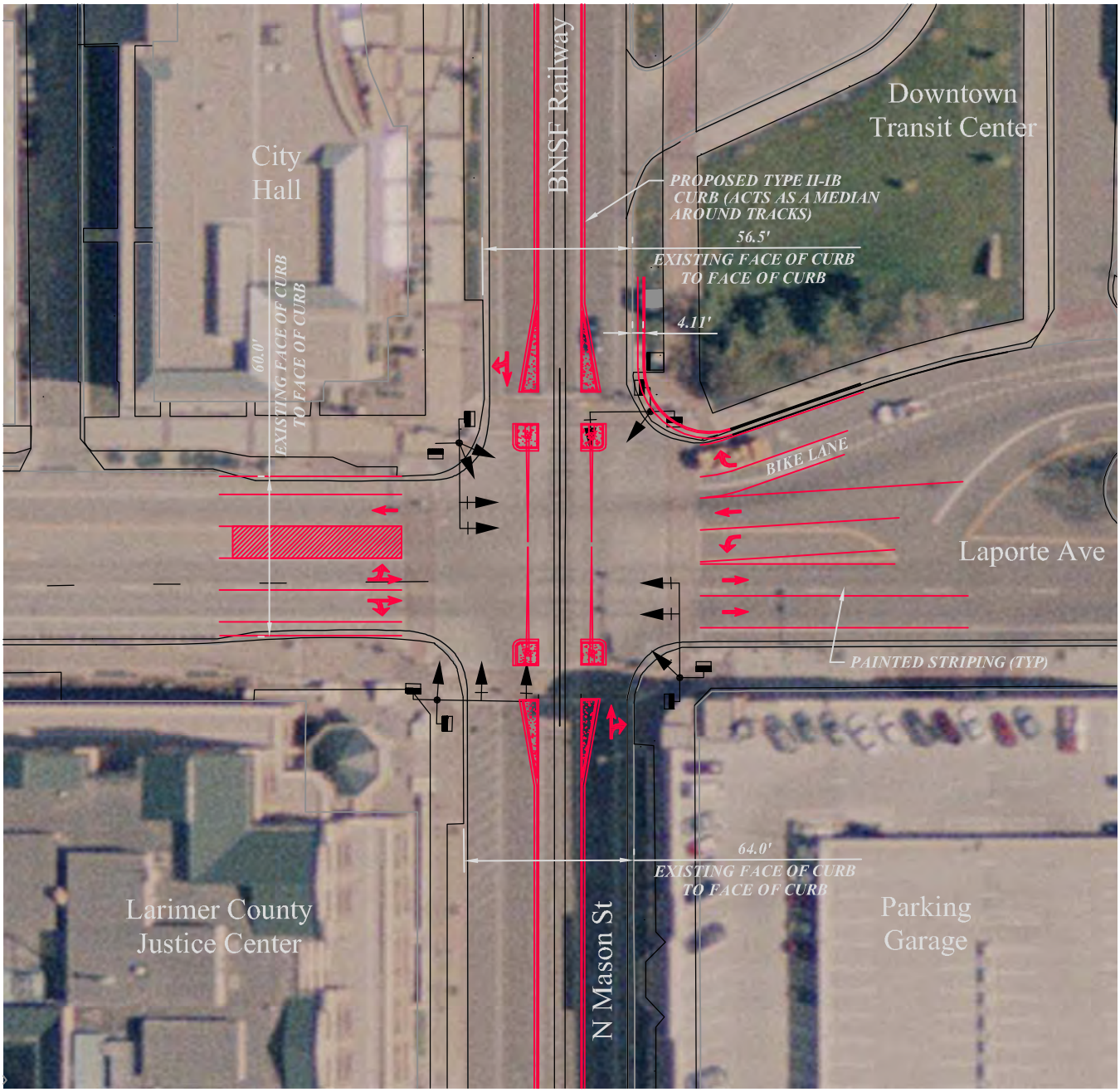
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Laporte Ave
US DOT #244640A
Main Line
SSM: 4-Quadrant Gate (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. Turning templates for a Standard City Bus vehicle were run for left turn movements on eastbound and westbound Laporte Ave. for placement of the RR gates.

LEGEND:

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

N

0 30 60

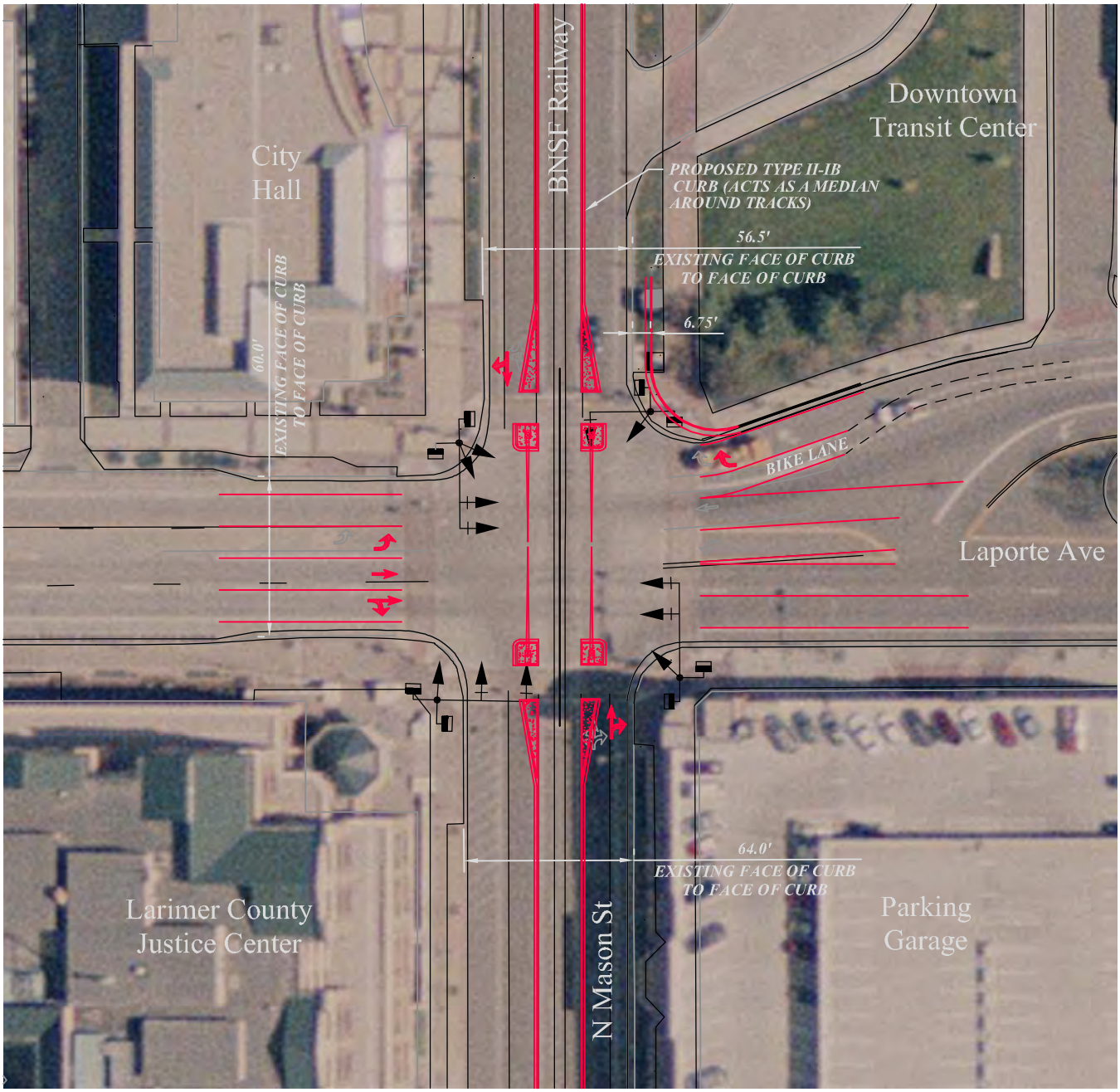
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Laporte Ave
US DOT #244640A
Main Line
SSM: 4-Quadrant Gate (Option 2)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. Turning templates for a Standard City Bus vehicle were run for left turn movements on eastbound and westbound Laporte Ave. for placement of the RR gates.

LEGEND:

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

N

0 30 60

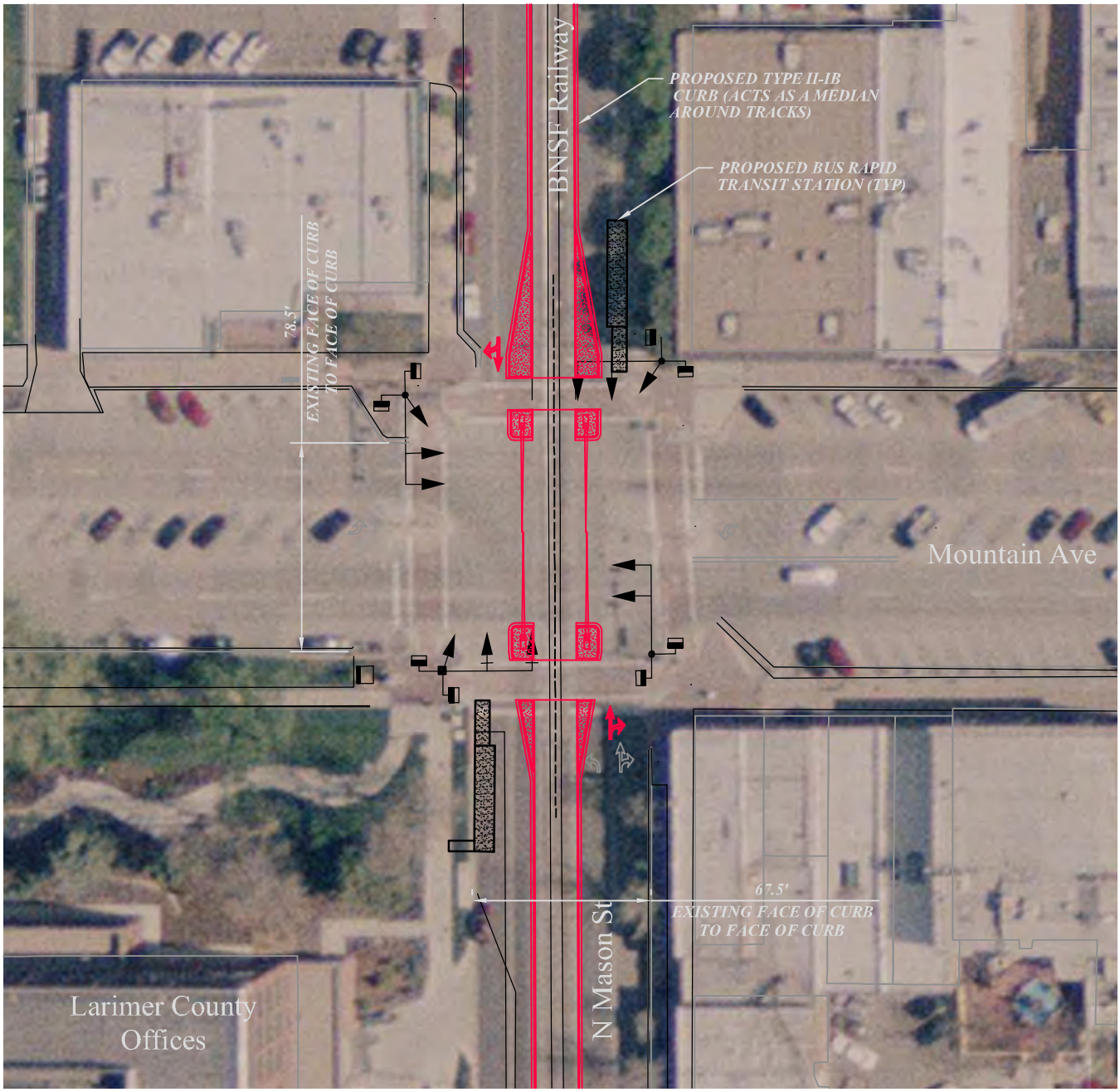
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Mountain Ave
US DOT #244639F
Main Line
SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. This option prohibits left turns off of Mason St. Mason St. lanes are limited to Thru/Right Turn only.

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)	

N

0 30 60

SCALE: 1"=60'

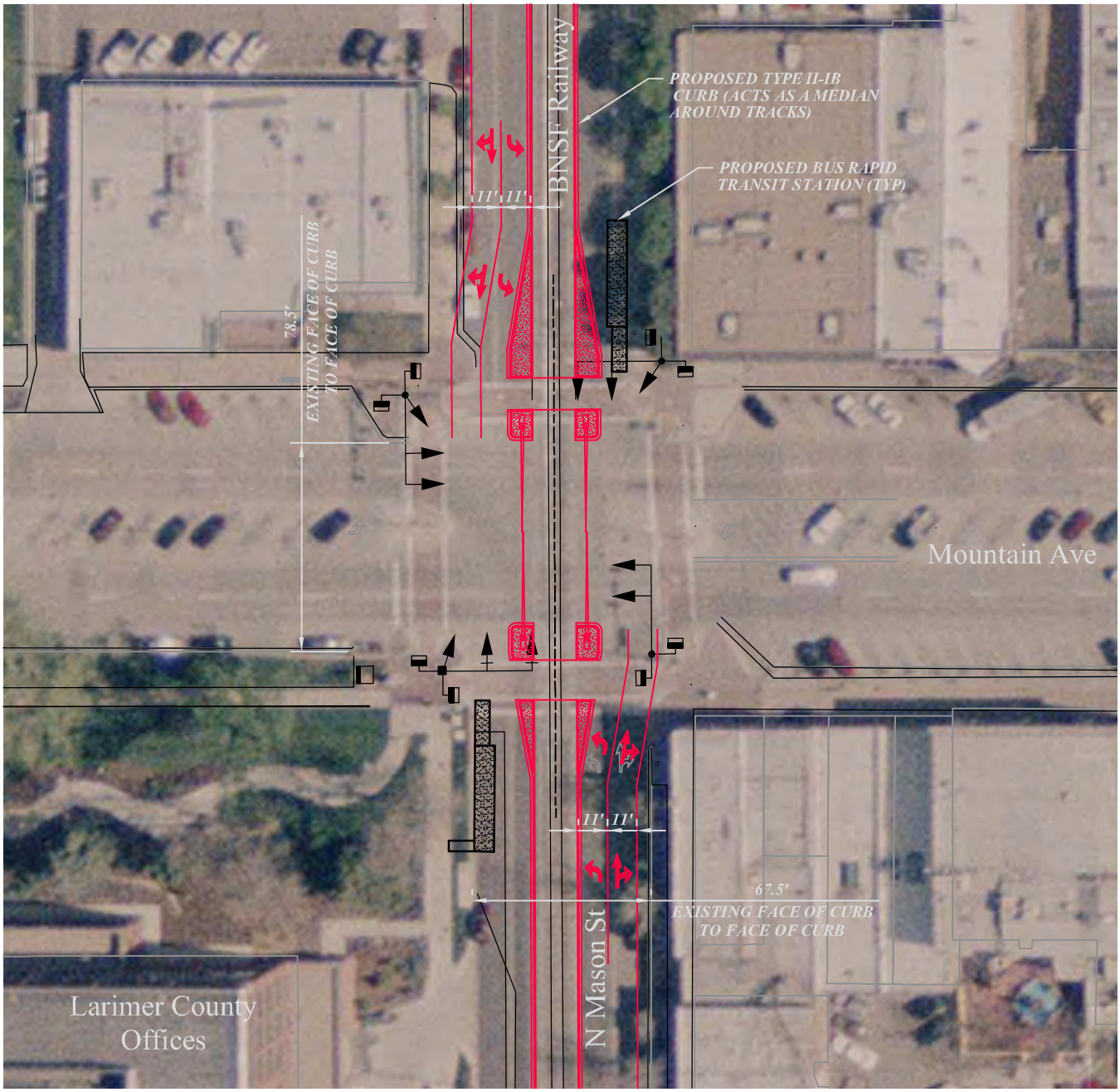
FELSBURG HOLT & ULLEVIG

Mountain Ave
US DOT #244639F
Main Line

Concept Crossing Improvements

July 6, 2011

SSM: 4-Quadrant Gates with Dedicated Left Turn Lane (Option 2)



NOTES:
1. Has train detection; DC/AFO.
2. This option allows left turns in a dedicated Left Turn lane.
3. Additional right-of-way would be needed along Mason St. for Thru/Right Turn lane.

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)	

N

0 30 60

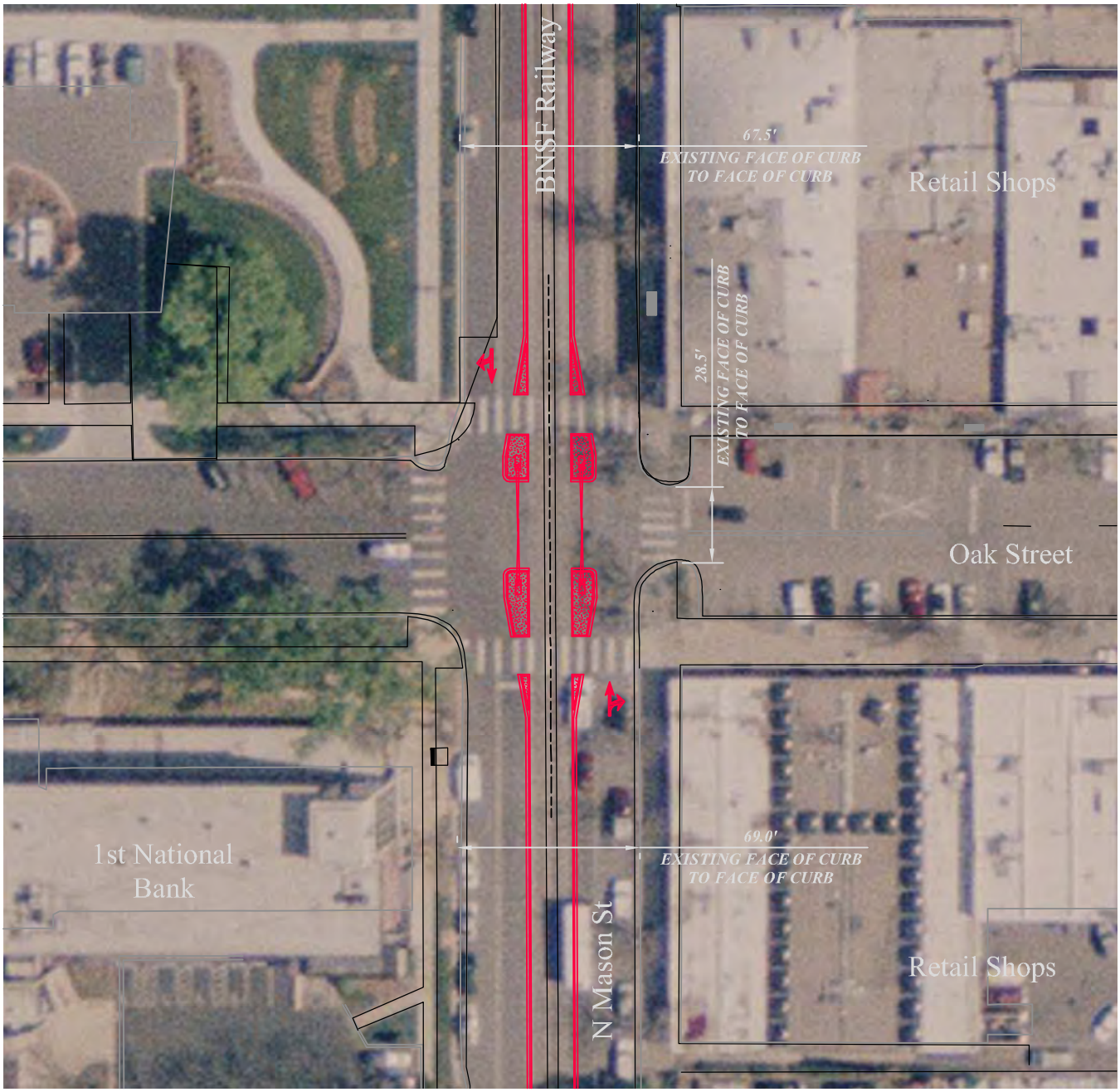
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Oak Street
US DOT #244638Y
Main Line
SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection.
2. This option prohibits left turns in all directions at all times.

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)	

N

0 30 60

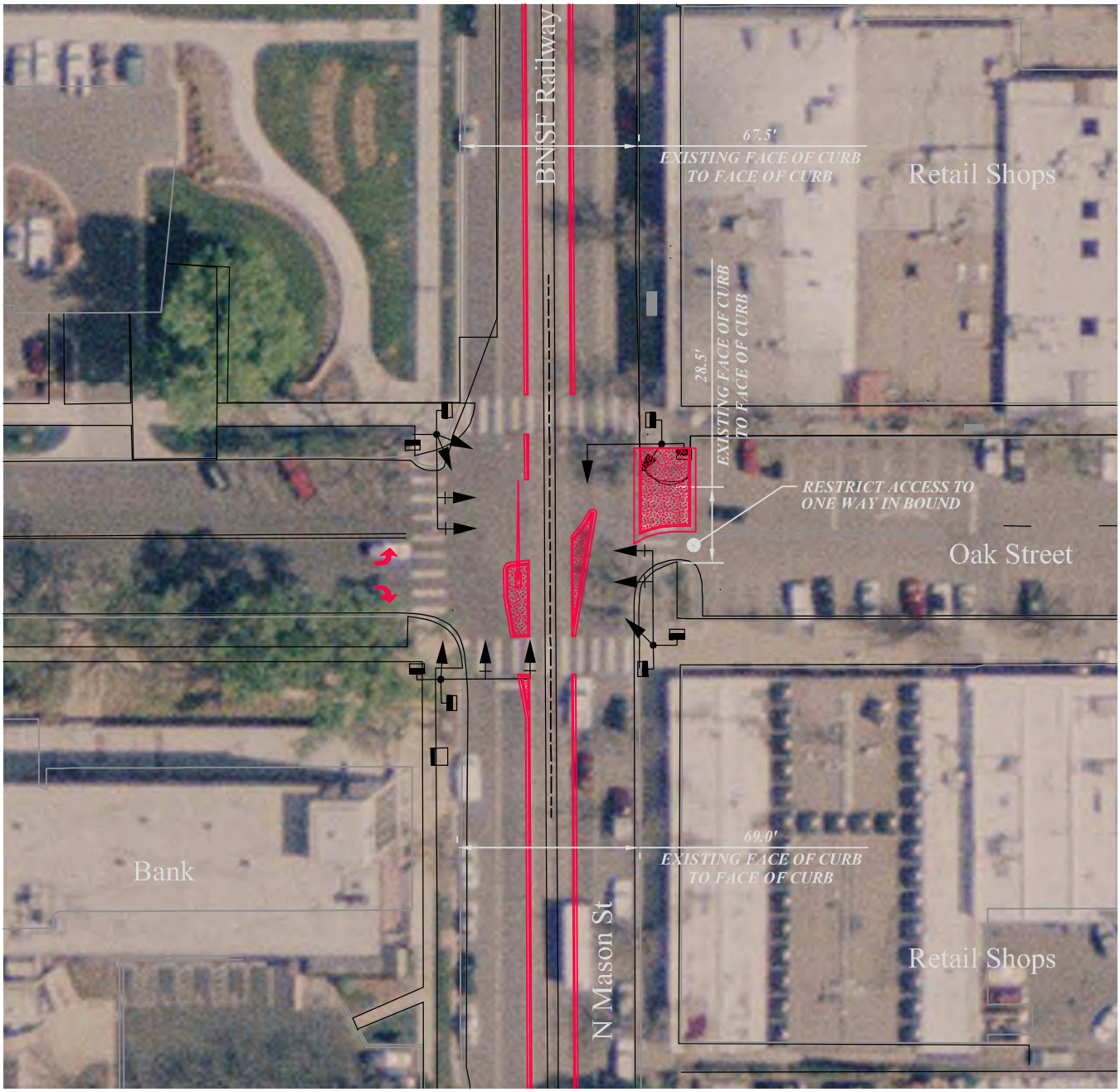
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Oak Street
US DOT #244638Y
Main Line
SSM: One Way Street with Approach Gates (Option 2)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection.
2. Closes intersection when trains are present.
3. This option prohibits left turns in all directions at all times.
4. Oak St. through movements are prohibited.
5. Oak St. east of Mason St. is converted to One Way east traffic flow.
6. Left turn movements on eastbound Oak to northbound Mason will accommodate passenger vehicles only. Truck turning movements will need to be prohibited.

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)	

N

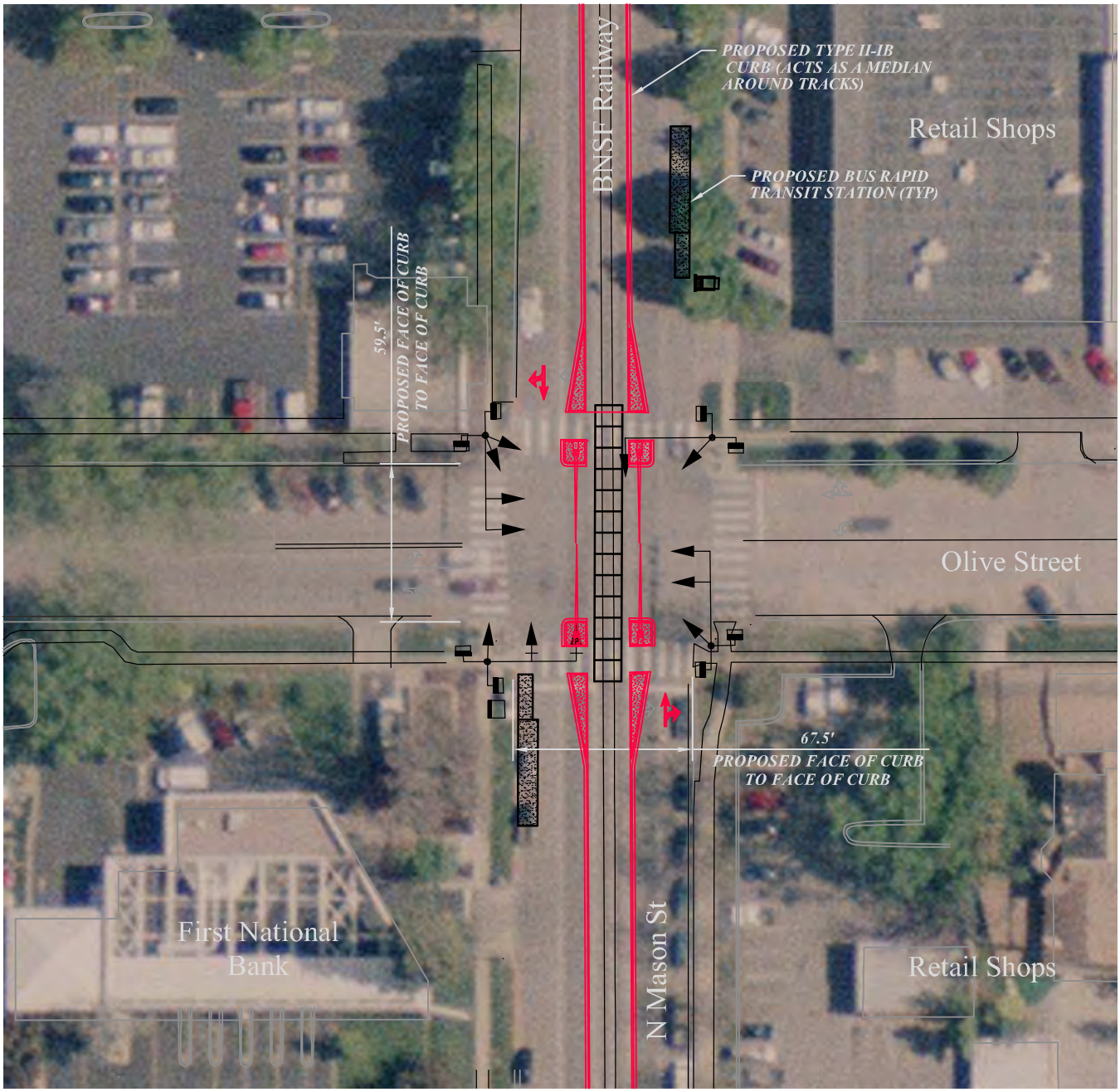
0 30 60

SCALE: 1"=60'

Olive Street
US DOT #244637S
Main Line
SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. This option prohibits left turns off of Mason St. Mason St. lanes are limited to Thru/Right Turn only.

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)	

N

0 30 60

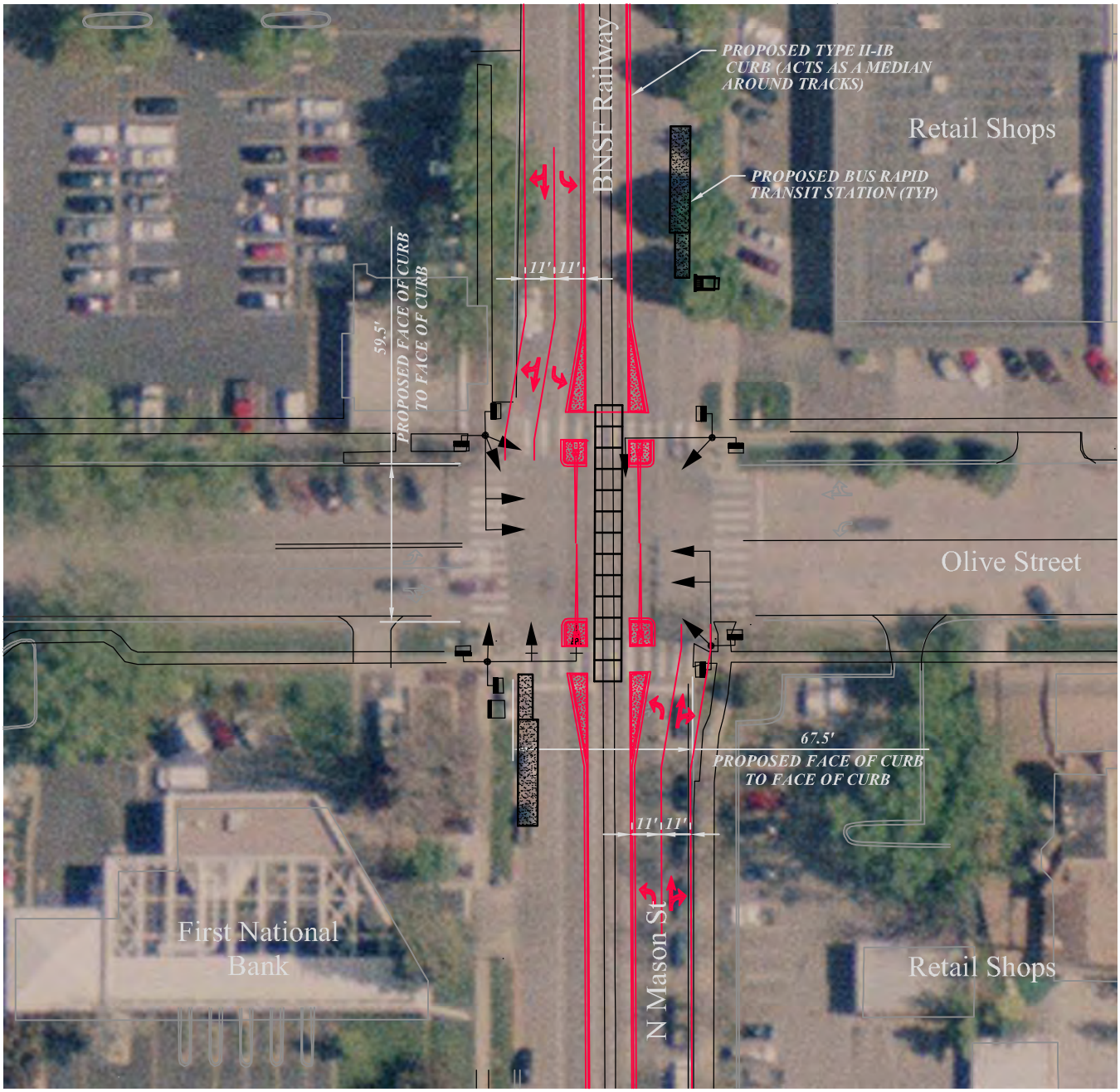
SCALE: 1"=60'

Olive Street
US DOT #244637S
Main Line

Concept Crossing Improvements

July 6, 2011

SSM: 4-Quadrant Gates with Dedicated Left Turn Lane (Option 2)



NOTES:
1. Has train detection; DC/AFO.
2. This option allows left turns in a dedicated Left Turn lane.
3. Additional right-of-way would be needed along Mason St. for Thru/Right Turn lane.

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)	

N

0 30 60

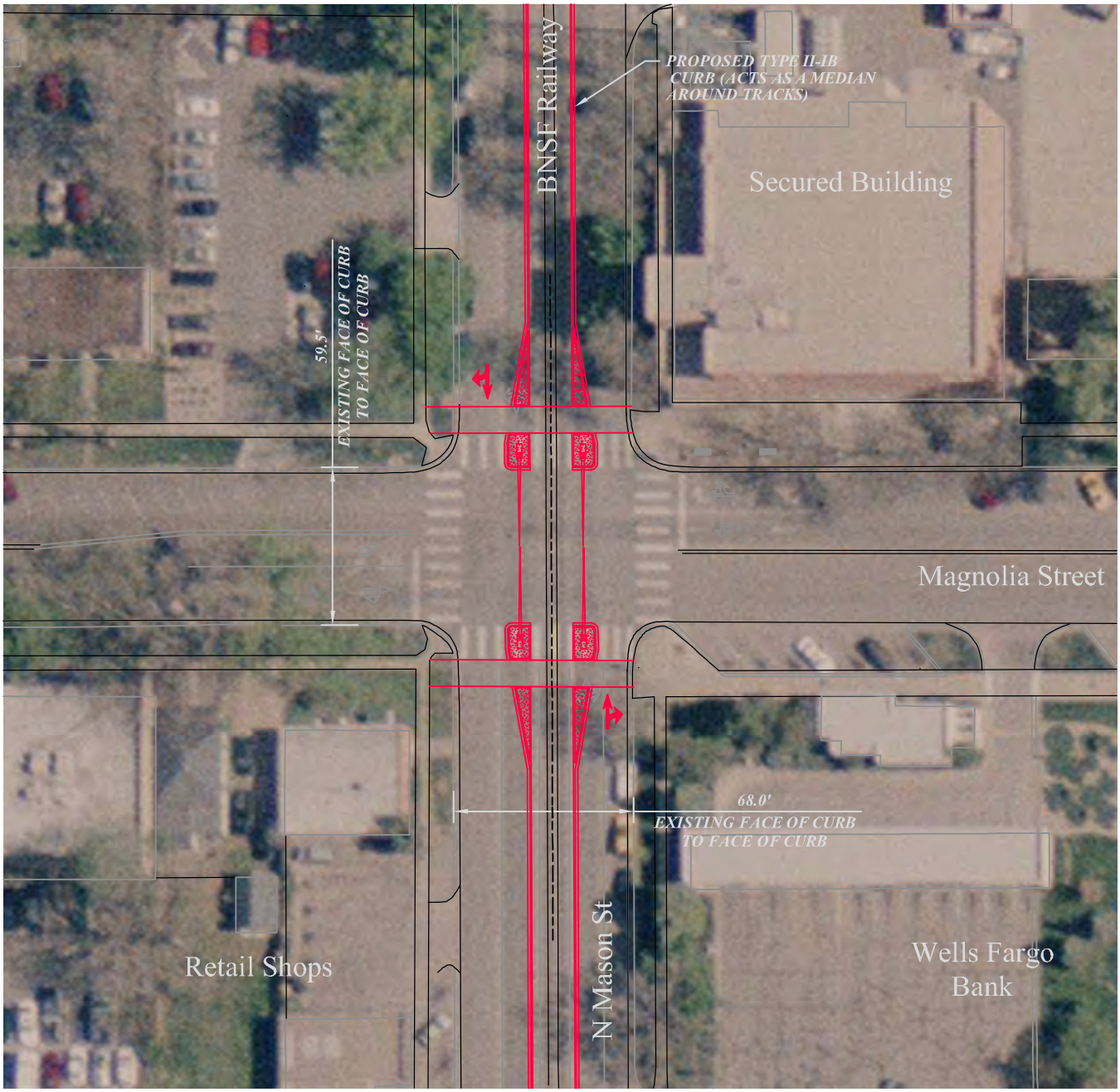
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Magnolia Street
US DOT #244636K
Main Line
SSM: 4-Quadrant Gates

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection.
2. This option prohibits left turns in all directions at all times.
3. Isolates tracks when trains are present; allows non-crossing traffic to continue.

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)	

N

0 30 60

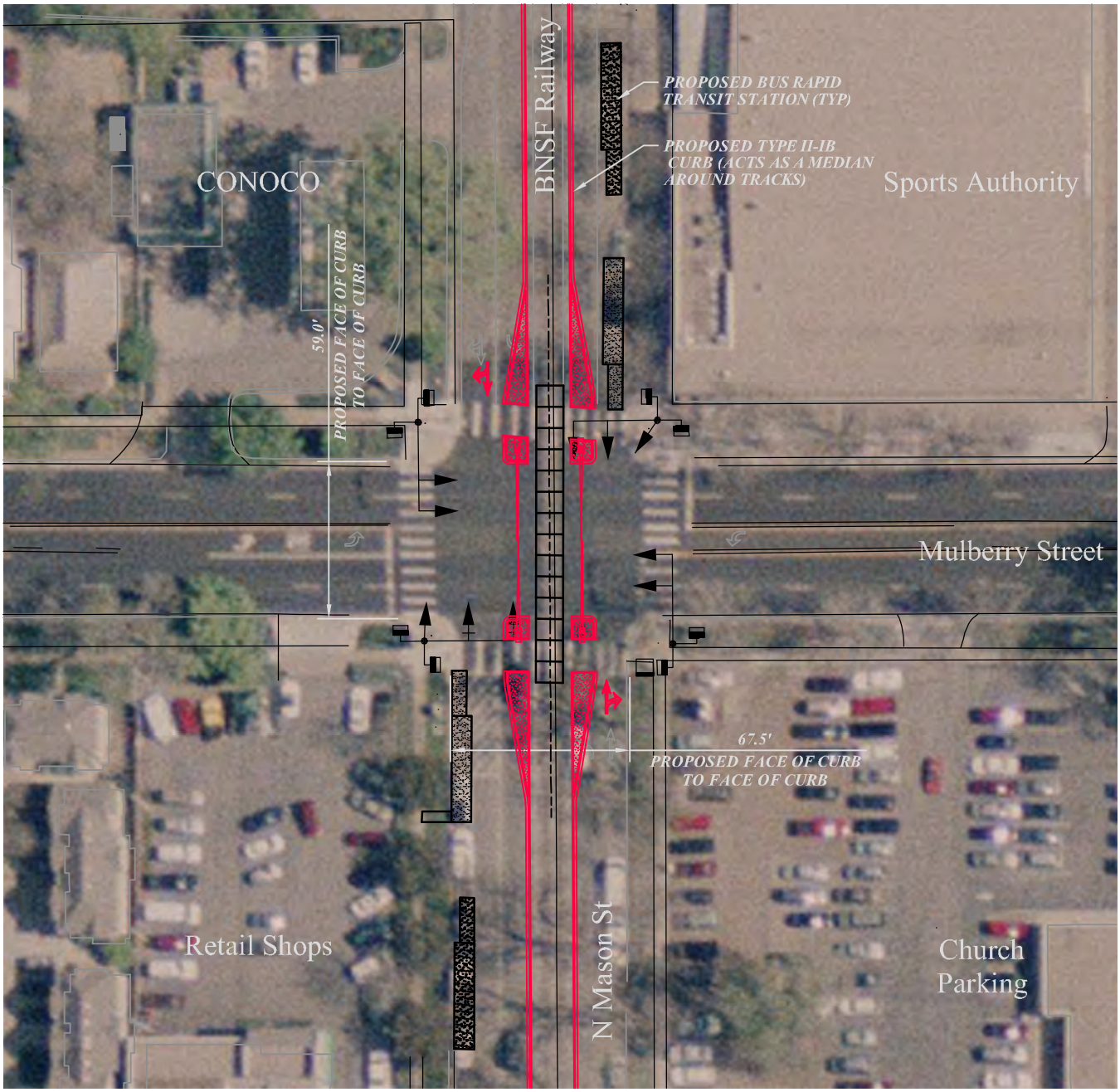
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Mulberry Street
US DOT #244635D
Main Line
SSM: 4-Quadrant Gates (Option 1)

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. BRT stops would need to be shifted away from intersection.
3. This option prohibits left turns off of Mason St. Mason St. lanes are limited to Thru/Right Turn only.

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)	

N

0 30 60

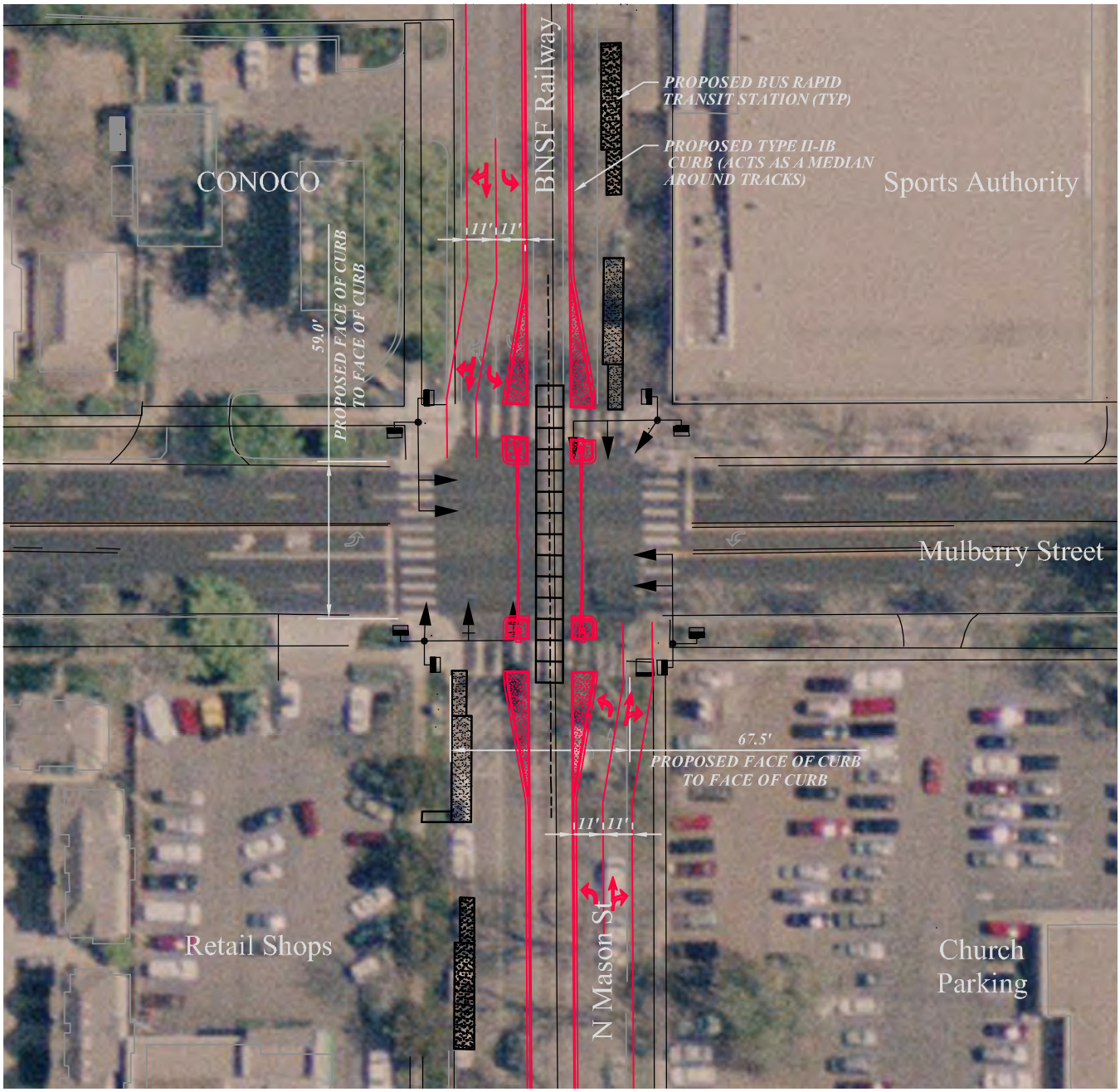
SCALE: 1"=60'

Mulberry Street
US DOT #244635D
Main Line

Concept Crossing Improvements

July 6, 2011

SSM: 4-Quadrant Gates with Dedicated Left Turn Lane (Option 2)



NOTES:
1. Has train detection; DC/AFO.
2. BRT stops would need to be shifted away from intersection.
3. This option allows left turns in a dedicated Left Turn lane.
4. Additional right-of-way would be needed along Mason St. for Thru/Right Turn lane.

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)	

N

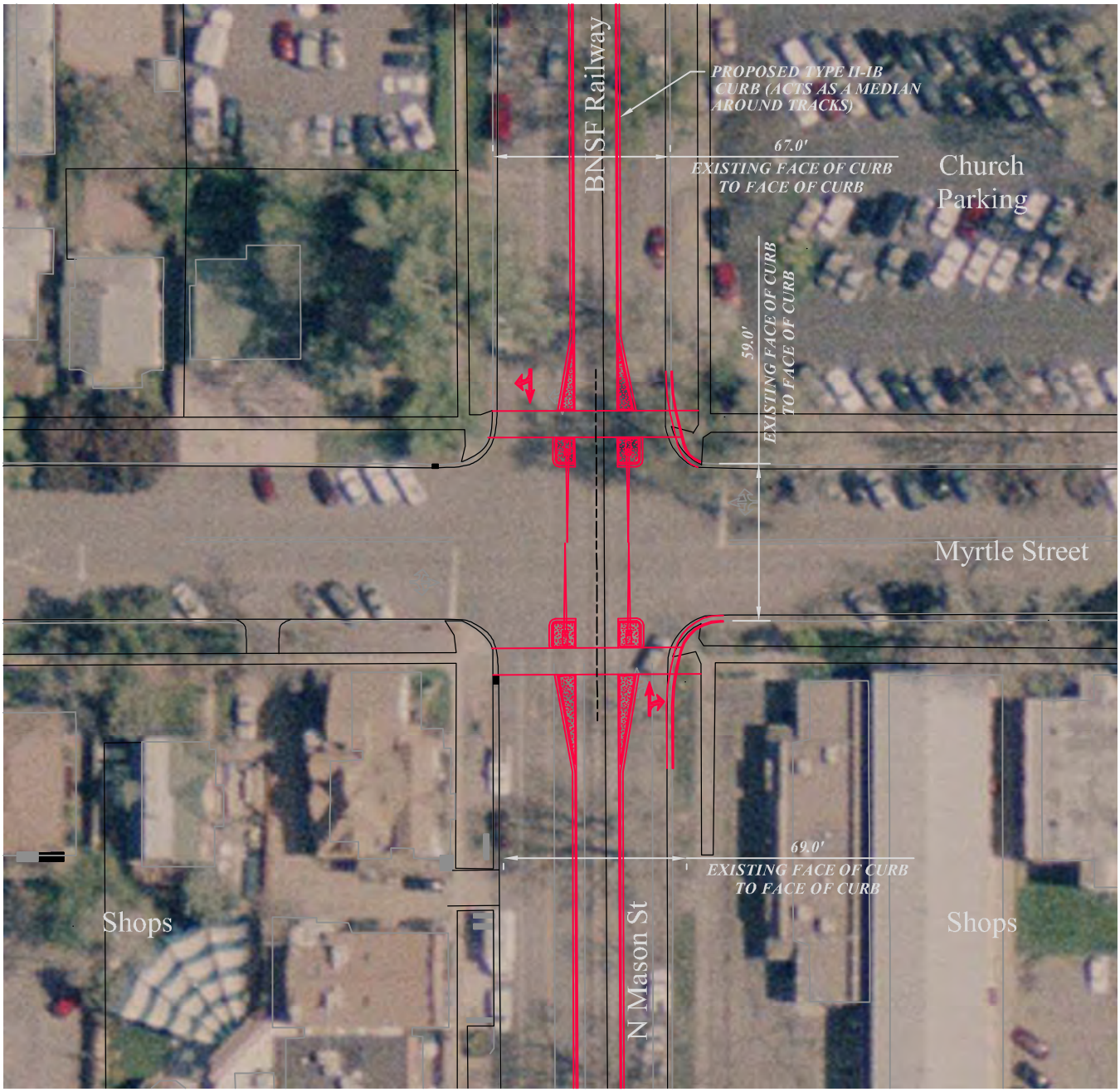
0 30 60

SCALE: 1"=60'

Myrtle Street
US DOT #244634W
Main Line
SSM: 4-Quadrant Gates

Concept Crossing Improvements

July 6, 2011



NOTES:
1. No train detection.
2. This option prohibits left turns in all directions at all times.
3. Isolates tracks when trains are present; allows non-crossing traffic to continue.

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)	

N

0 30 60

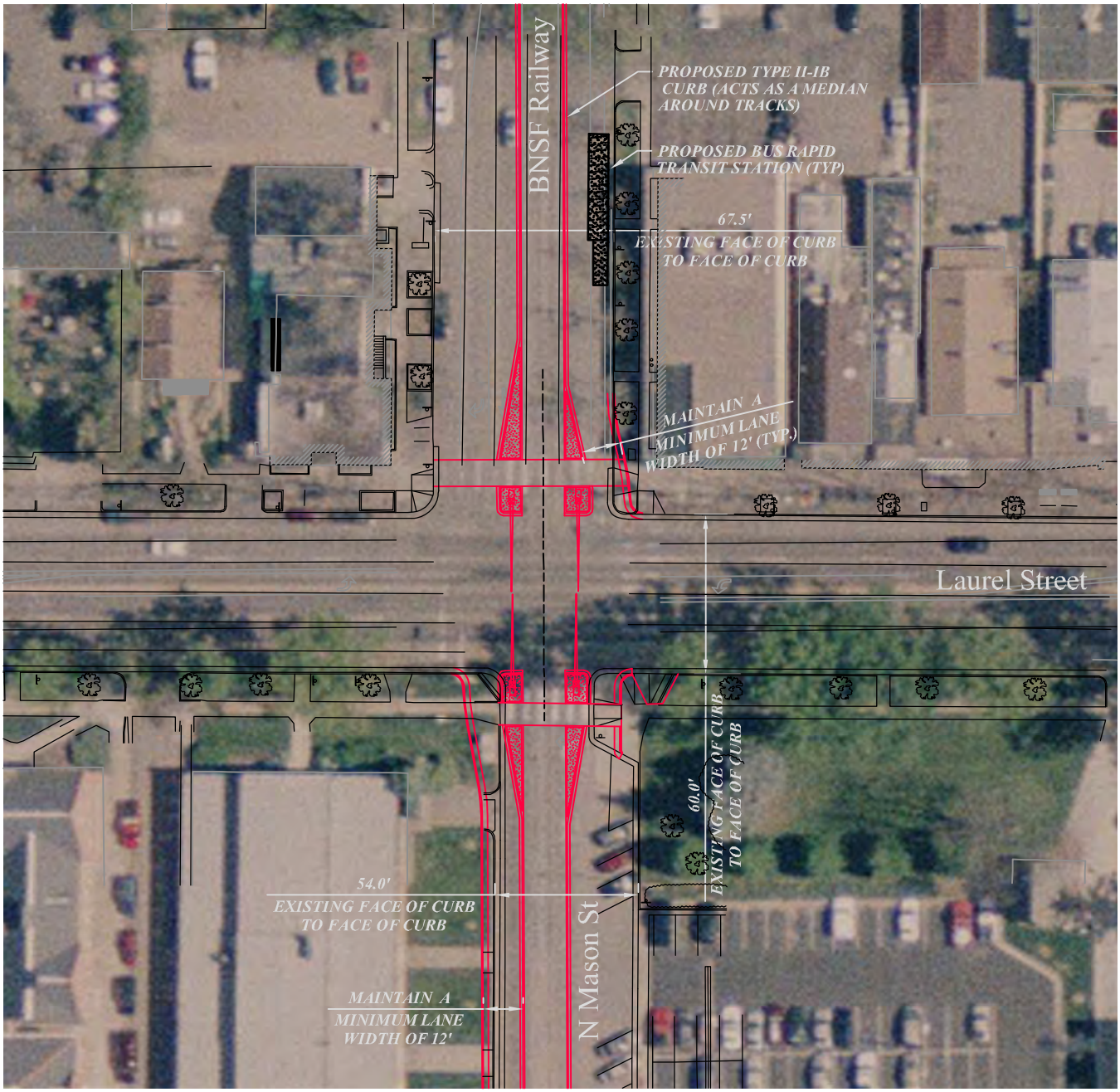
SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

Laurel Street
US DOT #244633P
Main Line
SSM: 4-Quadrant Gates

Concept Crossing Improvements

July 6, 2011



NOTES:
1. Has train detection; DC/AFO.
2. Isolates tracks when trains are present; allows non-crossing traffic to continue.
3. BRT stops would need to be shifted away from intersection.
4. Installation of curb and gutter along Mason St would be needed to allow for 12' lanes NB and SB.

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)	

N

0 30 60

SCALE: 1"=60'

FELSBURG HOLT & ULLEVIG

V. IMPLEMENTATION PLAN

A. Funding and Oversight

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. Concept Costs

Conceptual costs for each alternative that remained following the Field Diagnostic Review 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. Percentages of roadway bid item totals were used to estimate costs for stormwater management, construction traffic control, mobilization, signing & striping, and contingencies, as is typical practice at the concept cost level.

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 17 provides the Opinion of Conceptual Costs for each concept improvement.

C. Phasing

Northeast Quadrant 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 northeast of downtown have adequate spacing on each side to be pursued individually, with adjacent crossings added to the Quiet Zone as budget allows.

The crossings at UPRR and Lincoln, and UPRR and Linden are similar in nature, and evaluation indicated the most cost effective installation would be wayside horns. However, consideration must be given to the street project designed for Linden Street. Wayside horns may not blend with the pedestrian use anticipated, and therefore the 4-quadrant gate option may better serve the crossing and surrounding area at Linden and the UP. With either treatment at Linden, one crossing could be pursued initially, followed by the second crossing as funding becomes available.

The BNSF and Linden crossing evaluation also resulted in the most cost effective solution of wayside horns installation. This crossing has the limitation of a close proximity roadway (East Vine Drive) parallel to the railroad corridor which limits the improvements that can be accomplished between the tracks and the roadway.

The Willow Street crossing of the connector track can be treated with raised medians and approach gates. Turning templates would need to be run to confirm vehicle maneuverability around an approach median on the west side of the crossing for westbound to southbound vehicle movements into the complex on the southwest quadrant. Consideration might also be given to the minimal number of trains using this track and whether it is cost effective to treat this crossing, or allow it to remain as is, and not include this crossing in a Quiet Zone.

The BNSF crossing of North College requires only modification to the driveway on the southeast quadrant to comply with the minimum 60’ distance from the gate arm. This crossing currently

has all other necessary railroad and roadway elements to be compliant with the standard SSM of raised medians with gates.

BNSF at Cherry Street needs only adequate length medians and closure or relocation of the alley on the southeast quadrant of the crossing, to be compliant with the SSM of raised medians with gates. Currently this crossing houses the necessary circuitry and railroad crossing warning devices needed for Quiet Zone establishment. The only necessary improvement would be to lengthen each raised median to a minimum of 60' from the approach gate arm and close or relocate the alley.

Mason Corridor Crossings

The *Final Rule* indicates a necessary length for a Quiet Zone of ½ mile. Therefore ¼ mile is needed on each side of a crossing to meet this criterion. According to the *Final Rule* "the locomotive horn shall begin to be sounded at least 15 seconds, but no more than 20 seconds before the locomotive enters the crossing. Trains traveling at speeds in excess of 60 mph shall not begin sounding the horn more than ¼ mile in advance of the nearest crossing even if the advance warning is less than 15 seconds. Since the operating speeds of the BNSF along the Mason Street corridor are not likely to exceed 20 mph even with track improvements, the maximum distance in advance of a crossing that the locomotive horn can be sounded is approximately 600 feet (.11 miles) without violating the 20 seconds. Where several crossings are in closer proximity than .11 miles, these crossings need to be addressed as a corridor, in order to render the series of crossings quiet. Quiet Zones should also be continuous without breaks for individual crossings. One such corridor is the BNSF line along Mason Street from College Avenue to Laurel Street through downtown Fort Collins.

Following the Field Diagnostic Review, the crossing concepts along Mason Street from Maple to Laurel were each developed with a 4-quadrant gate installation. As a result of the area needed for 4-quadrant gates in close proximity to the tracks, many crossings could fit only one multi-use lane along Mason Street on each side of the tracks. This could prove disruptive to traffic progression along Mason Street in the event of a train, and in combination with a lead vehicle waiting to turn left. Much of this will be resolved with the 2-way conversion work along Mason.

As part of the conversion of Mason Street to 2-way operation, left turn movements from Mason Street onto cross streets will be prohibited at Maple and Oak. Left turn movements will be prohibited in all directions at the intersections of Mason-Magnolia and Mason-Myrtle. Left turns will continue to be allowed at LaPorte, Mountain, Olive, Mulberry and Laurel, and will be controlled by traffic signals at each intersection. Approved exhibits showing installations to be completed as part of the 2-way conversion along Mason Street are included in **Appendix F**.

As a result, consideration was given to the option of retaining another lane in each direction along Mason Street where left turns will be allowed to continue, which provides for a dedicated left turn lane at these locations. These concept options would require additional right-of-way to be acquired by the City, removal of on street parking, or both.

Table 17. Opinion of Conceptual Costs

					SSM Alternatives				Concept Level Costs by Option					
STREET	RR	RR CIRCUITRY	GATES/ LIGHTS	CROSSING SURFACE	RAISED MEDIANS	ONE-WAY STREET	4-QUAD GATES	WAYSIDE HORNS	CWT Circuitry /New Bungalow	Raised Medians	One-way Street	4-Quad Gates	Wayside Horns	Opinion of Construc-tion Cost
Lincoln	UPRR	DC/AFO	YES	conc			X		$80,000			$300,000		$380,000
								X	$80,000				$100,000	$180,000
Linden	UPRR	DC/AFO	YES	conc			X		$80,000			$300,000		$380,000
								X	$80,000				$100,000	$180,000
Willow	BNSF	DC/AFO	YES	conc	X				$80,000	$50,000				$130,000
		(assumed)					X		$80,000			$300,000		$380,000
								X	$80,000				$100,000	$180,000
Linden	BNSF	DC/AFO	YES	rubber			X		$80,000			$300,000		$380,000
								X	$80,000				$130,000	$210,000
College	BNSF	CWT	YES	conc	X				$ -	$20,000				$ 20,000
Cherry	BNSF	CWT	YES	conc	X				$ -	$35,000				$ 35,000
							X		$ -			$300,000		$300,000
Maple	BNSF	DC/AFO	Lights	conc			X		$80,000			$300,000		$380,000
Laporte	BNSF	DC/AFO	Lights	conc			X		$80,000			$300,000		$380,000
Mountain	BNSF	DC/AFO	Lights	conc			X		$80,000			$300,000		$380,000
Oak	BNSF	None		HMA			X		$80,000			$250,000		$330,000
						X			$80,000		$180,000			$260,000
Olive	BNSF	DC/AFO	Lights	HMA			X		$80,000			$250,000		$330,000
Magnolia	BNSF	None		HMA			X		$80,000			$300,000		$380,000
Mulberry	BNSF	DC/AFO	Lights	HMA			X		$80,000				$200,000	$280,000
Myrtle	BNSF	None		HMA			X		$80,000			$250,000		$330,000
Laurel	BNSF	DC/AFO	Lights	HMA			X		$80,000			$300,000		$380,000

Cost Range: (all crossings)	$3,855,000 (low)	to	$5,010,000 (high)

Note: The cost of acquisition of additional right-of-way and/or the removal of on-street parking to allow for a dedicated left turn lane at some cross streets in conjunction with the 4-quadrant gate installation is not included in these costs.