



MEMORANDUM

TO: Kathleen Bracke, City of Boulder Project Manager

FROM: Phil Weisbach, PE, Project Manager, SEH

CC: Alex May, Boulder Transportation Project Manager
Stephanie Sangaline, PE, Felsburg, Holt & Ullevig
John Seyer, HDR Project Manager

DATE: January 6, 2014

RE: Analysis of Costs to Eliminate Railroad Train Horn Noise in Boulder
SEH No. 119861

Executive Summary

The City of Boulder and Boulder County citizens have endured train horn noise at and around nine Burlington Northern Santa Fe Railway Company (BNSF) mainline railroad crossings in Boulder over many years. Six of the nine mainline crossings have City of Boulder roadway jurisdiction (or shared jurisdiction for the north 63rd Street crossing near SH 119). The City and County desire to understand the magnitude of costs they need in order to plan and budget for with the long term goal of eliminating train horn noise in Boulder. There are multiple options available to the City and County thru the Federal Railroad Administration (FRA) Quiet Zone (QZ) regulations and other non-quiet zone devices (e.g. wayside horns) that can be used to eliminate train horn noise in and around these crossings.

To that end, the City asked Short Elliott Hendrickson, Inc (SEH) to undertake a study of feasible potential train horn noise elimination options at the nine mainline crossings, and provide budgeting level conceptual costs for those options to arrive at an upper and lower budget range required to achieve the train horn noise elimination or reduction goals. The consulting firm Felsburg, Holt, and Ullevig (FHU) was also asked by the City to provide input into this project. And, in coordination with the Boulder Junction development project, the City undertook a more detailed Quiet Zone analysis of the Pearl Parkway Multiway Boulevard and Valmont crossings. The Pearl Parkway and Valmont crossing analysis was done by the consulting firm HDR. This report is the result of the cooperative efforts of SEH, FHU, HDR and City staff. City staff also coordinated this work with Boulder County staff.

Based on the analysis done with the information currently available, SEH estimates that the City and County should budget for between \$2,400,000 (assuming the lowest cost alternative is chosen at each location) to \$4,400,000 – (assuming the highest cost alternative is chosen at each location) to eliminate train horn noise. To determine the engineering details for the preferred option at each location, additional coordination with the BNSF, the Public Utilities Commission (PUC), FRA, and City and County staff, and stakeholders along the rail corridor will be needed. More accurate costs will need to be determined during this more detailed analysis of the preferred or optimal solution at each crossing. This is especially true at locations where roadway widening may be needed (primarily Independence and North 55th) for certain median or channelizing alternatives to determine the actual roadway improvement, crossing material, and right-of-way costs that may be involved. And, gate arm lengths at median locations should be measured to confirm whether additional median gates are needed or not.

Background

The City of Boulder asked SEH to estimate the cost to eliminate train horn noise by installing FRA compliant railroad QZ or wayside horns at nine Boulder and Boulder County mainline railroad crossing locations. The intent was to help establish a more accurate cost number for budgeting purposes required to eliminate train horn noise in Boulder. The information is based on local history, FRA crossing

database information and FRA quiet zone guidelines, plus the results of a diagnostic team field meeting held on July 25, 2013. The diagnostic team included representatives from the Public Utilities Commission (PUC), the BNSF, the City of Boulder, Boulder County, the FRA, HDR and FHU. SEH was not an attendee at that meeting however the City, HDR and FHU provided SEH with information based on the diagnostic required to complete this report.

The purpose of this study is to identify the range of feasible and probable options to eliminate train horn noise at the study area railroad crossings, and to establish the range of probable costs to implement the feasible options. The cost information would then be used by the City and County for budgeting purposes and to establish a prioritization for potential QZ crossings. The study's purpose is not to identify the exact type and details of train horn elimination at each crossing, or identify the process required to implement a QZ or construct a wayside horn, or to coordinate with all stakeholders in order to implement those quiet crossings. That additional work will be needed at the time the City and/or County has identified its top priority crossings and pursues in earnest the process to eliminate train horn noise at those crossings in Boulder.

Elimination of Train Horn Noise at Railroad/Roadway Crossings

The FRA has a set of criteria that - if met - eliminate the federal requirement that locomotive trains sound horns at all railroad/roadway crossings. Those criteria include Supplemental Safety Measures (SSMs) or Alternative Safety Measures (ASMs) that - when complied with - allow a community to establish a QZ or install wayside horns. These measures are further explained later in this report. The assumption is that all the crossings would have SSM compliant improvements – either median SSMs or quad gate SSMs - or potentially a treatment which would be a combination of the two (median on one side, entrance and exit gates on the other (an ASM). SSM compliant crossings are those that meet pre-determined FRA requirements that make implementing a QZ fairly simple once the required improvements are in place. QZ solutions with ASMs that are made up of a combination of SSMs can also sometimes - but not always- be easy to implement. However, the process to implement ASMs is more involved and takes longer. Wayside horns are not QZ elements, but can be used to substitute a lesser noise option (wayside horns) in lieu of a train sounding its horn at RR crossings.

Quiet Zones can be implemented individually or in phases with careful planning and evaluation of the risk assessments.

Study Limits

The study limits include the nine crossings of the BNSF mainline tracks from South 63rd St, just north of Arapahoe, on the south to North 63 St. at SH 119 (Diagonal Highway) on the north.

Cost Estimate Pricing Employed

FHU participated in the diagnostic on July 25, 2013. During the diagnostic, the team discussed possible options for necessary improvements at each crossing to create QZs. Subsequent to the diagnostic, FHU provided a summary of the crossings in question, the range of reasonable train horn elimination solutions applicable to each crossing, and an estimate of the railroad equipment costs required for each of the solutions at the crossings. The estimates are conceptual only, and do not include any of the civil work (sidewalk extensions, approach work, medians, etc). FHU recommends contacting the BNSF for actual costs for the required railroad equipment at the time of design. A clear understanding of what is “required” vs. what is “desired” by BNSF and others with respect to railroad equipment infrastructure should be clearly understood to allow for consistent identification of proposed improvements at the various crossings and consistent cost estimates once detailed negotiations at the crossings begin with the BNSF.

Since FHU attended the diagnostic and has the most recent available cost information from the BNSF, PUC, and FRA based on the diagnostic, the analysis by intersection that follows uses FHU's cost for the railroad elements (only) for each option - except for the Pearl Parkway and Valmont crossings where more detailed work was done by HDR. At those locations, HDR's cost estimates are used in this report. SEH supplemented the railroad elements cost with conceptual level estimates of the civil cost for each (generally, medians or channelizing devices), and the total costs by crossing and by option are reported herein. Railroad design costs were considered to be included in the railroad element costs. Construction management for each of the civil design options were considered to be negligible and were assumed to be covered by general engineering program costs within the City or County. New signage required to QZs or wayside horns are assumed to be supplied by City or County sign operation units and installed by City or County crews within existing operational budgets. And, gate arm lengths at median SSM locations should be measured to confirm that additional center median gates are not needed (such as at 55th St. near Roche) or that existing median gates are aligned properly for a QZ (such as the east median at Jay Road). More accurate costs will only be known upon a more detailed engineering analysis at each location.

To be conservative, SEH added a 10% contingency to the railroad costs estimated by FHU and the civil costs estimated by SEH for each option at each location. HDR included a 25% contingency for their estimated costs at the Pearl Parkway and Valmont crossings, so no additional contingency was added. However, since it is unlikely that the most expensive option will be selected at each of the crossing locations, an additional cost contingency is built in when a lower cost option than the high cost option is selected at any location.

Ongoing Costs Associated with Some Quiet Zone Solutions

In addition to construction costs, certain ongoing costs are sometimes required for quad gate SSMs (defined below). The BNSF policy on four quadrant gates is the road authority is responsible for the cost to maintain the exit gates and any traffic detection loops. The BNSF normally charges about \$5,000 per year to maintain the two exit gates. The loop detectors require annual testing which is estimated to be \$1,000 to \$3,000 per year per crossing. Often a municipality's traffic signal crews can do this annual testing and replacement. And if wayside horns are selected at any of the locations, the road authority (in this case, the City and/or County) is also responsible for monthly testing and maintenance. That annual cost is about \$5,000.

So beyond the construction cost ranges shown, the City and/or County need to be prepared to budget for these ongoing costs at locations where quad gate SSM solutions are implemented.

Coordination with the RTD Northwest Rail Project

The City did consider the effect of implementing QZs prior to RTD's Northwest Rail Corridor (NWR) being constructed and whether accommodations for the second track for the NWR corridor could be made with the initial QZ implementation. However, railroad gates cannot be set more than 12 feet back from the centerline of tracks. Thus, these gate location requirements for the initial QZ installations would not allow the gates to be set far enough back to accommodate the future NWR second track and still comply with gate installation placement requirements. The assumption is that RTD and the City/County would have to address the issue of maintaining any QZs previously established with RTD at the time RTD moved forward with actual NWR corridor implementation in Boulder.

Thus, per the City's direction, SEH is to consider the existing track configuration only at the potential QZ crossings with no consideration for what RTD may or may not do when (and if) the corridor is double-

tracked for the NWR corridor project. HDR's more detailed analysis of the Pearl Parkway and Valmont crossings did consider conceptual analysis based on the future implementation of RTD's NWR project.

Basic Crossing Protection Required to Eliminate Train Horn Noise at Railroad Crossings

To eliminate train horn noise at or approaching a railroad crossing, the FRA requires each such crossing to have flashing lights, bells, and gates at the entrance approach to each crossing. For QZs, the circuitry involved must be the type that provides the right method of communication in advance of the train. So flashing lights, bells, and gates are a "given" at all potential QZ crossings in Boulder. And the circuitry for the gates must be constant warning time (CWT) circuitry.

All of the crossings within the study limits have flashing lights, bells, and gates – but some crossings do not have the correct circuitry needed for a QZ. The cost estimates provided include costs for upgrading the circuitry where required. And, some of the existing gates are old and are not compatible with the gates required for QZ, so those would have to be replaced. Thus, this is the reason some of the cost estimates will show replacing existing gates with new gates.

Train Horn Elimination Possibilities

1. Supplemental Safety Measures (SSMs)

The FRA recognizes several configurations at railroad crossing approaches that allow train horn noise in advance of and at a railroad crossing that are particularly relevant to Boulder's crossings.

Crossings that have fully compliant SSM protection can be established as QZs with minimal process and time required. Below are three such configurations that are most relevant to Boulder's crossings.

a) Raised medians with flashing lights, gates, and bells



Raised medians at least 100' in length (60' in some specific instances) on both approaches to the crossing and which include non-traversable (vertical) curbs that are a minimum of 6" high.

< The photo to the left illustrates a typical raised curb installation at a railroad crossing approach.

b) Channelizing devices with flashing lights, gates, and bells

Similar to raised medians but more compact and easier to install in locations with tight geometric constraints, channelizing devices can be applied directly to the existing roadway or can be part of a more complex structure consisting of an island with reflectors mounted on the top. Such devices present drivers with a visual cue intended to impede crossing to the opposing traffic lane. The curbs are no more than six inches in height, usually less than twelve inches in width, and built with a rounded traversable (mountable) design to create minimal deflection upon impact. The reflectorized paddle delineators or tubes, typically 24-36 inches high, are built to be able to bounce back up after being hit or run over. These systems are designed to allow emergency vehicles to cross over into opposing lanes to go back in the opposite direction but not for the purpose of circumventing the traffic control devices at the crossing. Usually such a system can be placed on existing roads without the need to widen them.



< The photo at the left illustrates a typical channelization device installation at a railroad crossing approach.

- c) **Quad gates** – this means gates that block all entrances and exits to a crossing (generally, four). When lowered, the gate arms at any crossing must be within a foot of each other (if no median) or within a foot of the median face if there is a center median involved. This is to prevent vehicles from driving around the entrance gate, and to totally close off the crossing to vehicles.



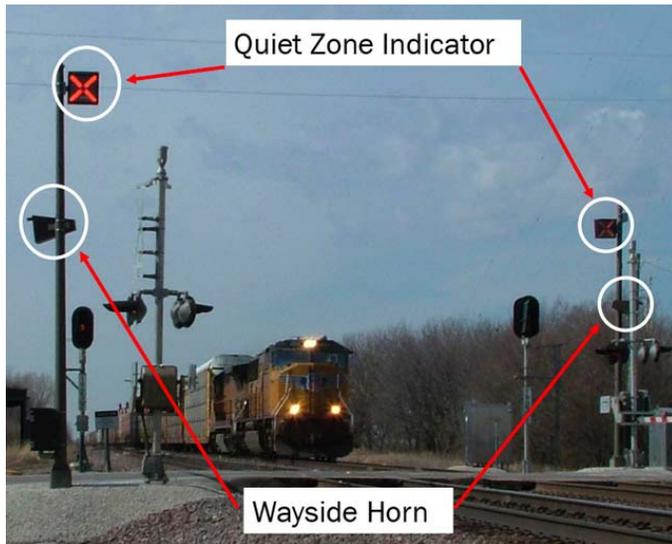
< The photo at the left illustrates a typical quad gate.

2. Other non-SSM Quiet Zone Options

ASMs - FRA QZ rules allow other types of QZ treatments to be considered, called Alternative Safety Measures (ASMs). ASMs, however, require more scrutiny, justification and process (and thus, more time) to implement. But because quad gate installations are so expensive, there may be some instances where an ASM solution is more cost effective if the time to implement is not critical. A potentially useful ASM hybrid may be a combination quad gate and median **SSM** which has entrance and exit gates on one approach and an entrance gates with the required length of raised medians or channelizing devices on the other approach.

3. Wayside Horns

Wayside horns are a system whereby horns are mounted at the crossing, and these horns sound when a train crosses - but train horns themselves are not sounded. The advantage is that the area of noise impact is much smaller. Trains are required to blow their horns beginning one-quarter mile in advance of a crossing, except for QZs or with the presence of wayside horns. Wayside horns are not a Quiet Zone SSM since horns will be sounded. But they can be used to replace train horns. Wayside horns essentially substitute a lesser and more directed (towards the roadway approaches) horn noise for a louder more dispersed locomotive train horn noise. Wayside horns can be installed and train horns silenced without going thru a QZ process.



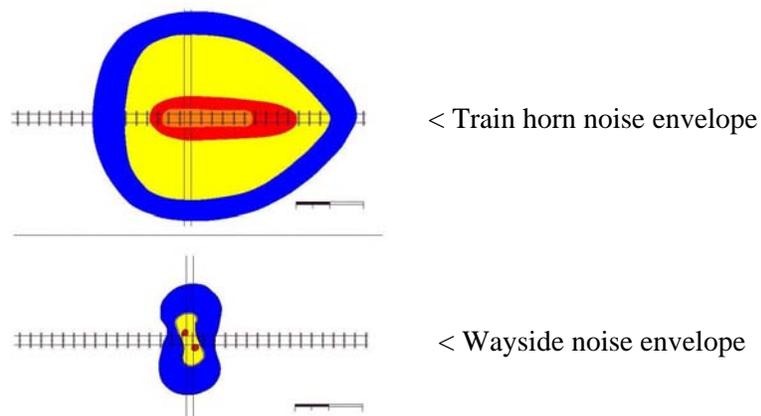
The disadvantage of wayside horns is that the area near the crossing will have a full and continuous horn impact for 30 seconds. But the noise is focused towards the street approaching the tracks, not a wide blast as is the case with train horns. Wayside horns work well at some locations where the land uses are non-residential in nature.

The cost of the wayside horns at the specific locations listed below were determined by FHU based on the July 25, 2013 diagnostic. The road authority (City and/or County) is also responsible for monthly testing and maintenance. That annual cost is about \$5,000. This

may vary depending on if the road authority needs to contract out this service or if it can be done with City forces. The manufacturer provides training. Wayside horns are technically not a true QZ option, but are often used in conjunction with a QZ corridor to reduce the envelope of horn noise at locations where SSMs or ASMs may be too difficult or too costly to implement.

Wayside horns may be a good option at some appropriate, non-residential locations to provide some noise relief if the cost or difficulty of installing FRA compliant QZ solutions are problematic.

The graphic below illustrates the relative noise impact envelope of a train horn (top figure) vs. that of a wayside horn (bottom figure). Orange indicates the most intense noise area, followed by red, yellow and blue to illustrate lessening sound intensity. The wayside horn focuses the noise primarily at the crossing and towards the crossing roadway. A train horn's noise results in a substantially larger area of impact with comparatively higher noise levels.



Non-Engineering ASMs

The SSMs and ASMs above are considered engineered measures as they require engineered structural solutions (medians, gates, horns) to control safety at the crossing to a level that allows train horns to be silenced. However, the FRA QZ rules also have provisions for Non-Engineering ASMs that rely on

enforcement and public education and awareness at a level adequate to provide for safety at crossings such that the FRA would allow train horns to be silenced. The three non-engineering ASMs called out in the QZ rules are:

1. **Programmed enforcement** whereby community and law enforcement officials commit to a systematic and measurable crossing monitoring and traffic law enforcement at the rail/roadway grade crossings, alone or in combination with the Public Education and Awareness ASM.
2. **Public Education and Awareness** whereby a community – alone or in combination with programmed law enforcement – conducts a program of public education and awareness directed at motor vehicle drivers, pedestrians, and residents near a crossing to emphasize the risks associated with the rail/roadway crossings and applicable requirements of state and local traffic laws at the crossings.
3. **Photo Enforcement** to gather valid photographic or video evidence of traffic law violations at a public rail/roadway crossing together with follow-through by law enforcement and the judiciary.

Each entails a significant level of effort by government agencies, and requires monitoring, documentation, and follow-up – which of course also means on-going costs to continue the monitoring and reporting required. While this approach is technically allowed by the FRA, SEH is not aware of any city, county or public road authority that has implemented a QZ using non-engineering ASM's to date. Without the physical barriers in place through engineering SSM or ASM to minimize the risk of non-compliance, there is a higher risk is high that a tragic accident could take place compared to engineered SSMs.

Crossings Evaluated

- 63rd St. just north of Arapahoe*
- 55th St. between Frontier and Central*
- Pearl Parkway, between Foothills Parkway and 30th St.*
- Valmont, between Foothills Parkway and 30th St.*
- 47th St, just east of Foothills Parkway, between Sterling Drive and the Diagonal Highway*
- Independence Road, just east of the Diagonal Highway**
- Jay Road, just east of SH 119**
- 55th St, just south of SH 119**
- 63rd St., just south of SH 119 (shared City/County jurisdiction)

* denotes City of Boulder roadway jurisdiction

**denotes Boulder County roadway jurisdiction

Crossings Not Evaluated

The private crossing near Pearl East Business Park, just west of Boulder Creek was not addressed, as it is a locked gate (actually, cable) emergency fire access only. As such, trains do not blow horns at this location.

The spur track at South 63rd Street/Butte Mill Road is a spur track leased by the BNSF to support delivery and storage of coal to Xcel's Valmont Power Plant. It is not a BNSF mainline track, but because train horns do blow at this crossing - as well as it being in close proximity to the mainline So. 63rd Street crossing - it was analyzed in this report. Xcel operates the train engines on this spur. Thus, should the City desire to address the train horn noise at this crossing, Xcel would be an additional stakeholder with which to coordinate.

The crossings evaluated within the study area, and distances between the crossings, are shown on the following page. Photos of the existing conditions at each location are provided at the end of this report.

Summary of Findings

The result of our analysis was that the seven QZ locations are estimated to cost between a range of \$2.4 million to \$4.4 million for installation of the SSMs necessary to create Quiet Zones at all of the railroad crossings within the study limits depending on the specific choices at each crossing location .

The range is due to many factors, primarily which options are best and most affordable at the various locations. The next steps include determining if the City and County want to proceed with pursuing QZs at any of the crossings - and if so, at which crossings - and then select the preferred QZ treatment for each crossing. In addition, the agencies will need to secure funding needed for implementation and also on-going maintenance costs associated with the railroad crossing improvements. At that point, once funding is secured, the City and/or County can move forward with conducting the detailed engineering and BNSF/FRA/PUC review, and undertake negotiations for each of the selected crossings per the QZ requirements – being again mindful of the difference between BNSF “requirements” vs. “desired” improvements.

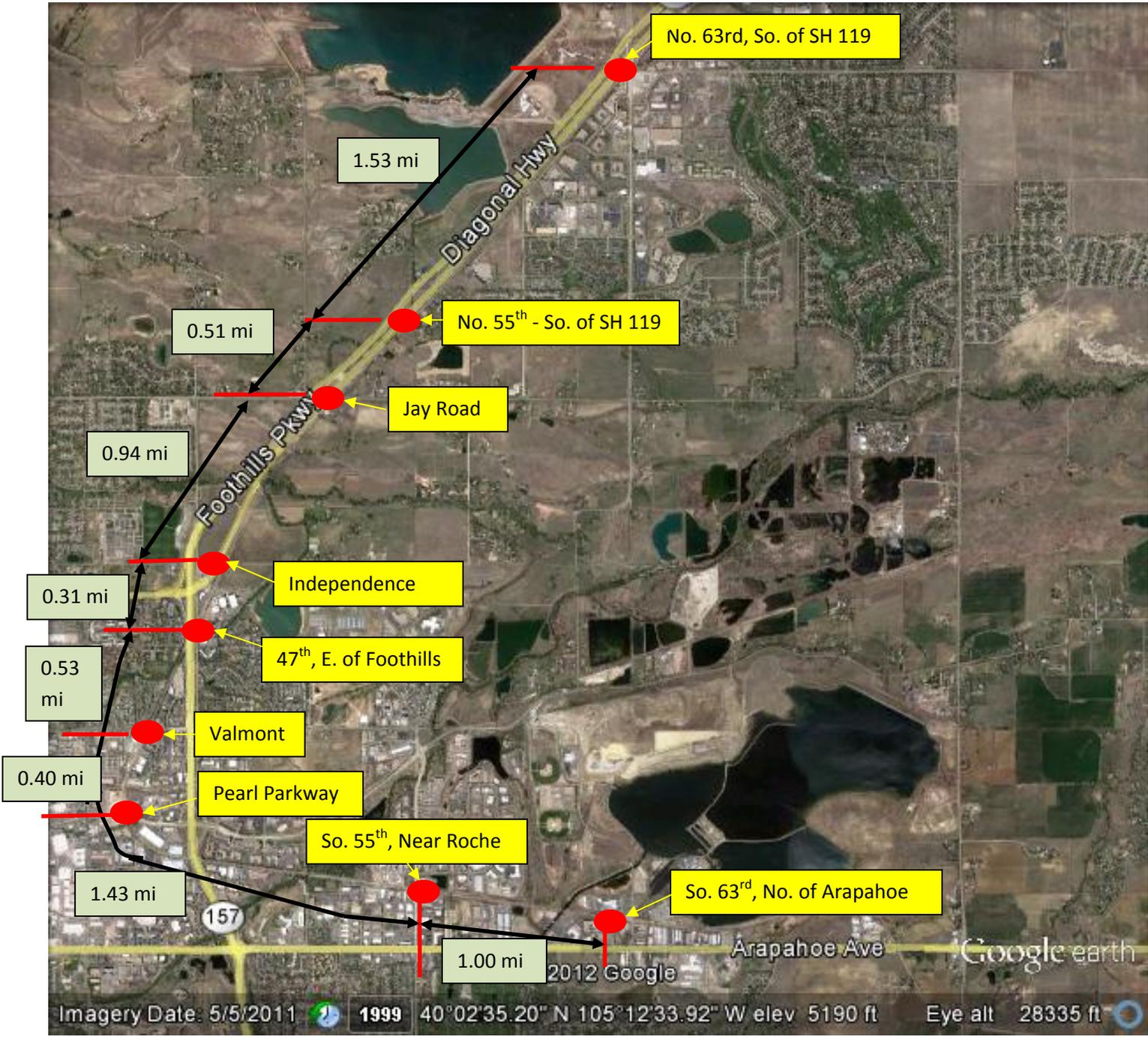
The Excel spreadsheet below summarizes our findings as to low and high costs for the feasible options at each of the nine crossings.

Boulder Train Horn Noise Elimination Cost Summary									
Low Cost Option									
High Cost Option									
Only a Single Cost Option									* - Crossing is in County. 63rd. No. and So. in City
Jurisdiction >	City	City	City	City	City	County	County	County	City/County*
Option V Location >	S. 63rd	S. 55th	Pearl Parkway	Valmont	47th	Independence	Jay Rd.	N. 55th	N. 63rd
Quad Gates SSM	\$ 880,000		\$ 379,400			\$ 440,000		\$ 385,000	
Median SSM		\$ 396,000		\$ 715,100	\$ 429,000	\$ 462,000	\$ 88,000	\$ 253,000	
Median SSM- median gate mods		\$ 616,000		\$ 917,600			\$ 198,000		
Channelizing Device SSM						\$ 297,000		\$ 88,000	
Hybrid	\$ 577,500								
Wayside Horn	\$ 275,000		\$ 110,000			\$ 330,000		\$ 176,000	\$ 110,000
Low End Total Cost =	\$ 2,398,100	\$ 2,400,000 < rounded							
High End Total Cost =	\$ 4,377,000	\$ 4,400,000 < rounded							

Analysis of the Railroad Crossing Locations

Our analysis for each crossing is documented on the following pages. Please also refer to the “Boulder Railroad Crossing Table” provided by FHU which is attached after the report text. Much of the feasible option and railroad cost information was developed by FHU and summarized in this table. And refer to the HDR information regarding the Pearl Parkway and Valmont crossings after the “Boulder Railroad Crossing Table.”

Boulder RR Crossing Locations and Distances Between



Details For Each Railroad Crossing Studied:

1. South 63rd just north of Arapahoe (244811Y) MP 25.38

Existing Conditions:

- Flashers and gates in place
- Signal system upgrade 2006 – ie, relatively new signals
- Constant Warning Time circuitry is in place.
- Existing crossing has short center medians.
- 63rd is a two lane roadway across this crossing.

Potential Options:

Median options were discussed at the July 25, 2013 diagnostic. Due to the site geometry, medians were not considered viable options. Feasible options at this location include quad gates or wayside horns since this is primarily an industrial area with few if any residences within close proximity to the crossing.

Quad Gate SSM:

Install gates at all four quadrants at the crossing. Per FHU’s report, the spur to the north is controlled by the same railroad bungalow. Therefore, a quad gate option would also require four quad gates at the spur track also for a total of eight gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$800,000
• Estimated City civil costs:	<u>\$ 0</u>
Total	\$800,000
Add 10% for contingencies	\$880,000

With any quad gate situations, loop detectors often have to be installed to make sure the exit gates do not go down if a car is still between the gates. Annual testing in the amount of \$3,000 should be budgeted for this, if required, as well as provisions for replacements cost of the loops. In addition, there is an annual exit gate testing cost of about \$5,000 per year per installation that needs to be budgeted for.

Wayside Horn Option:

Because of the industrial nature of the area around this crossing and the high cost of the quad gates, wayside horns are an attractive option at this location. But because of the spur track, wayside horns would have to be installed at all four crossing approaches.

<u>Construction Cost Estimate:</u>	\$250,000
Add 10% for contingencies	\$275,000

Wayside horns also require monthly testing and maintenance at an annual cost of about \$5,000 that would need to be budgeted for.

Hybrid Option:

SEH also evaluated the possibility of a hybrid option, whereby quad gates would be installed at the mainline BNSF crossing and wayside horns at the spur track. The rationale for this was that most of the train traffic at the crossing is due to the trains on the mainline track. The spur track is used to deliver coal to the Valmont Power Plant, and those deliveries happen much less frequently. Thus with this industrial area option some wayside horn noise would still be generated in the immediate vicinity of the crossing, but the most noise would be eliminated at the mainline track crossing and with significantly less cost.

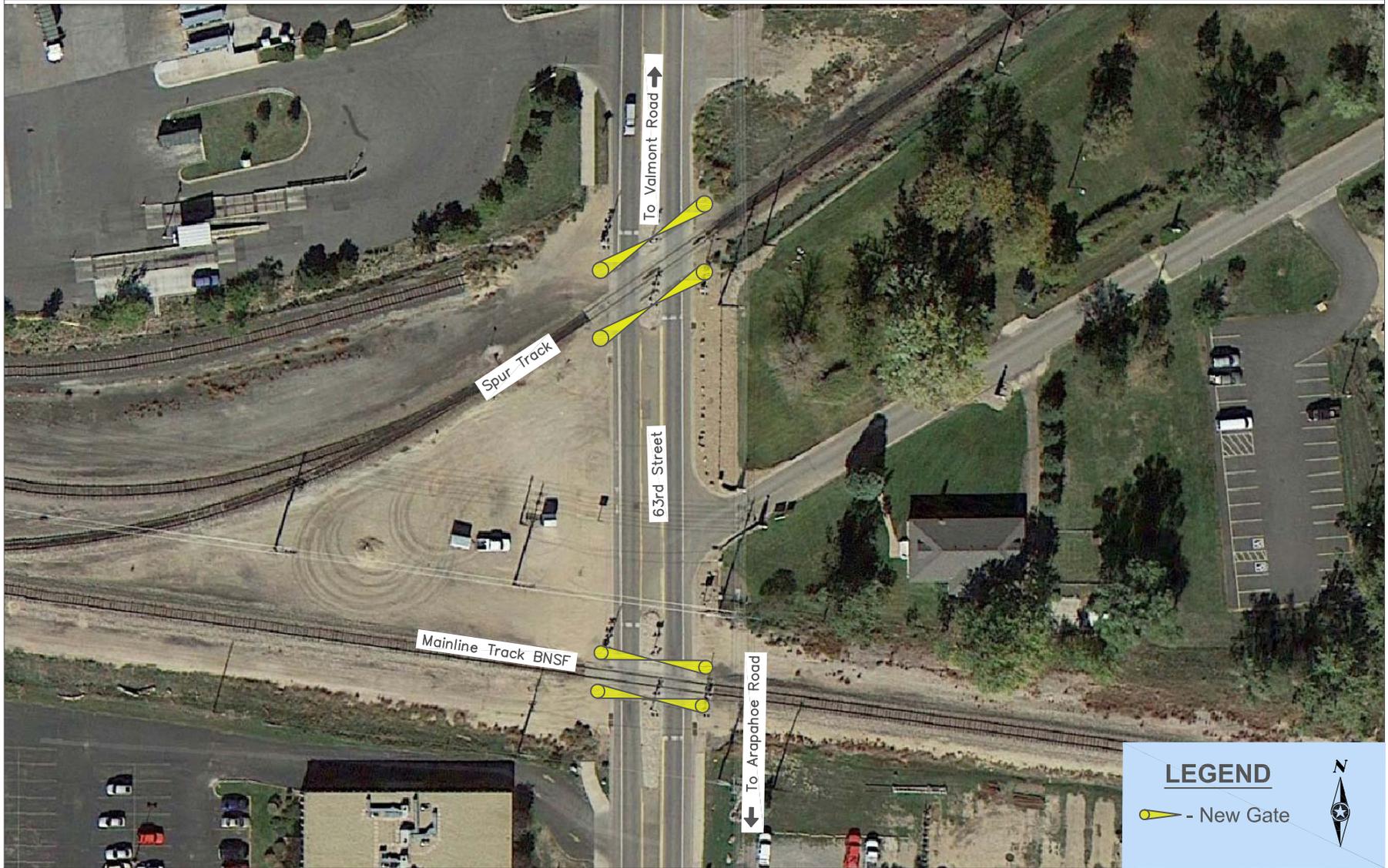
Since both crossings are controlled by the same bungalow, the railroad would have to determine if this were a feasible option or not.

<u>Construction Cost Estimate:</u>	\$525,000
Add 10% for contingencies	\$577,500

Range of Costs at this crossing to eliminate or reduce train horn noise:

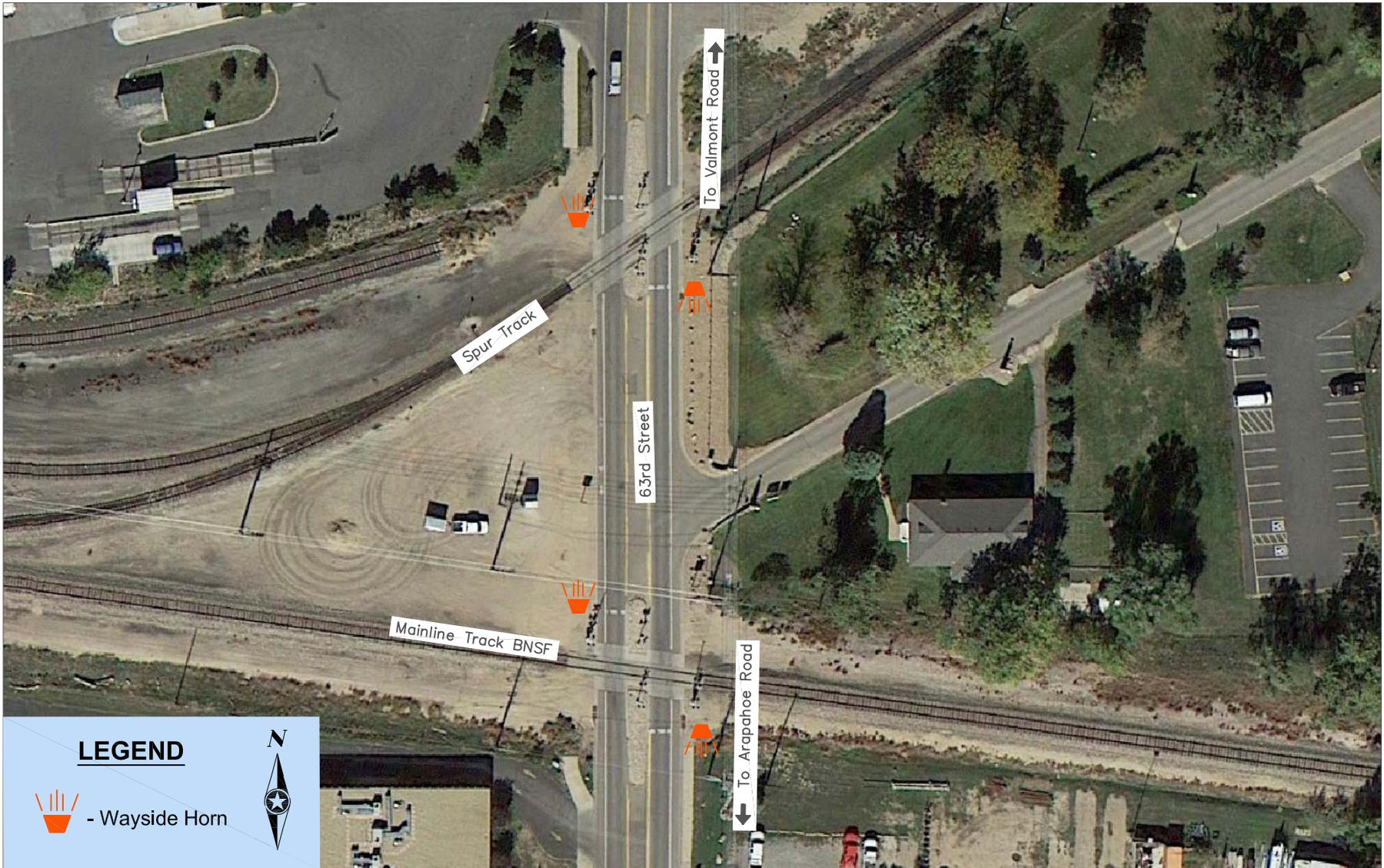
From **\$275,000** for wayside horns to **\$880,000** for quad gates.

One additional consideration for this crossing: As part of a current City of Boulder capital project, the existing Legget Inlet bridge north of this crossing is planned to be replaced, and related roadway improvements are to be constructed on the approaches to this bridge. These improvements are soon to be underway and anticipated to be complete in early 2015. The City desires to have a continuous sidewalk along the west side of 63rd St. crossing the mainline BNSF track and the spur track in the future. But no timeline or funding has been identified to date for these improvements. Consideration of this future pedestrian facility should be factored into potential QZ options at this location.



CITY OF BOULDER - Railroad Quiet Zones
63rd Street (South End)
4 Quad Gates
DOT# 244811Y





LEGEND

 - Wayside Horn



CITY OF BOULDER - Railroad Quiet Zones
63rd Street (South End)
Wayside Horns
DOT# 244811Y





CITY OF BOULDER - Railroad Quiet Zones
 63rd Street (South End)
 Quad Gates and Wayside Horns
 DOT# 244811Y



2. South 55th Street between Frontier and Central Ave. (244813M) MP 26.38

Existing Conditions:

- Flashers and gates are in place.
- The existing medians conform to QZ length requirements. There is a curb cut for a fenced off drive access at the Xcel facility in the southeast quadrant of the intersection that the FRA/BNSF may require removal and a full curb installed.
- Flashing light signals are in the median.
- Signal system is old, installed in 1985.
- FRA inventory says DC circuits at site. QZ requires Constant Warning Time circuitry.

Potential Options:

A wayside horn could be an option at this location, but the infrastructure for a median SSM is pretty much in place except for upgraded circuitry and approach gates. Thus, the feasible option at this location is a median SSM. Gate arm lengths at median should be measured and coordinated with the BNSF to determine whether additional median gates are needed or not.

Median SSM – No Additional Median Gates:

The circuitry upgrade would include bungalow and new approach gates. Fencing would be required to eliminate vehicle trespass along RR right-of-way.

Construction Cost Estimate:

• Railroad equipment costs only:	\$350,000
• Estimated City civil costs (fencing, curbs):	<u>\$ 10,000</u>
Total	\$360,000
Add 10% for contingencies	\$396,000

Median SSM – Includes Two Additional Median Gates:

The circuitry upgrade would include bungalow and new approach gates. Fencing would be required to eliminate vehicle trespass along RR right-of-way.

Currently, only outside lane approach gates are in place. Currently, as a non-QZ crossing, these entrance gates are only required to go to the middle of the inside (median side) travel lane. With QZ median SSMs, the gate must come within a foot of the median curb. However, with two travel lanes, the gutter pans, and the on-street bike lane on 55th St., a gate that comes down within one foot of the median curb may be longer than the BNSF will allow. If that is the case, additional median gatea may be required in the median at an estimated additional cost of \$100,000 each.

Construction Cost Estimate:

• Railroad equipment costs only:	\$550,000
• Estimated City civil costs (fencing, curbs):	<u>\$ 10,000</u>
Total	\$560,000
Add 10% for contingencies	\$616,000

Range of Costs at this crossing to eliminate or reduce train horn noise:

The cost of a median SSM is (approximately) between **\$396,000** and **\$616,000**.



CITY OF BOULDER - Railroad Quiet Zones
55th Street (South End)
Approach Gates With Raised Medians
DOT# 244813M





LEGEND

 - New Gate



CITY OF BOULDER - Railroad Quiet Zones
55th Street (South End)
Approach Gates With Raised Medians & Median Gates
DOT# 244813M



3. Pearl Parkway between Foothills Parkway and 30th Street (244815B) MP 27.83

Existing Conditions:

- At the time of this report, Pearl Parkway and the Pearl Parkway RR crossing are under construction for improvements triggered by the Boulder Junction development.
- The crossing is currently narrowed to one lane in each direction across the tracks.
- Flashing lights, bells, and gates are in service at both approaches.
- Circuitry is being upgraded to CWT as part of this project.
- Note: Cost information for the QZ improvements provided by HDR.

Potential Options:

There are existing medians that satisfy QZ length requirements both east and west of the RR tracks on Pearl Parkway. However, accesses from the Boulder Junction development (both on the north and south side of Pearl Parkway) will be in too close proximity to the tracks to satisfy the QZ median SSM requirements. Thus, a median SSM is not a feasible option in this location. Although the current circuitry is not CWT, it will be once the proposed improvements are complete.

Thus, the two feasible options are a four quad gate SSM or wayside horns.

Quad Gate SSM:

The costs below are taken from HDRs QZ report, from Table 2. HDR's costs below assume only new exit gates and associated signal equipment due to other improvements being constructed with the current project.

Construction Cost Estimate:

- Quad gate installation Total **\$379,400** (includes a 25% contingency)

With any quad gate situations, loop detectors may have to be installed to make sure the exit gates do not go down if a car is still between the gates. Annual testing in the amount of \$3,000 should be budgeted for this, as well as provisions for replacements cost of the loops. In addition, there is an annual exit gate testing cost of about \$5,000 per year per installation that needs to be budgeted for.

An additional potential cost is possible traffic signal pre-emption at the railroad crossing for the signalized intersections of Pearl and new Junction Place and the existing intersection at Pearl and 30th. Necessary conduit and a railroad pre-emption package (in the new bungalow) have been integrated into the current Pearl Parkway project work. However, additional costs will be required if implemented in the future. This analysis assumes that additional cost can be covered within the 25% cost contingency assumed by HDR.

Wayside Horn Option:

Wayside horns are a more cost effective option at this location. However, although feasible, the residential uses at the Boulder Junction project make this option less desirable.

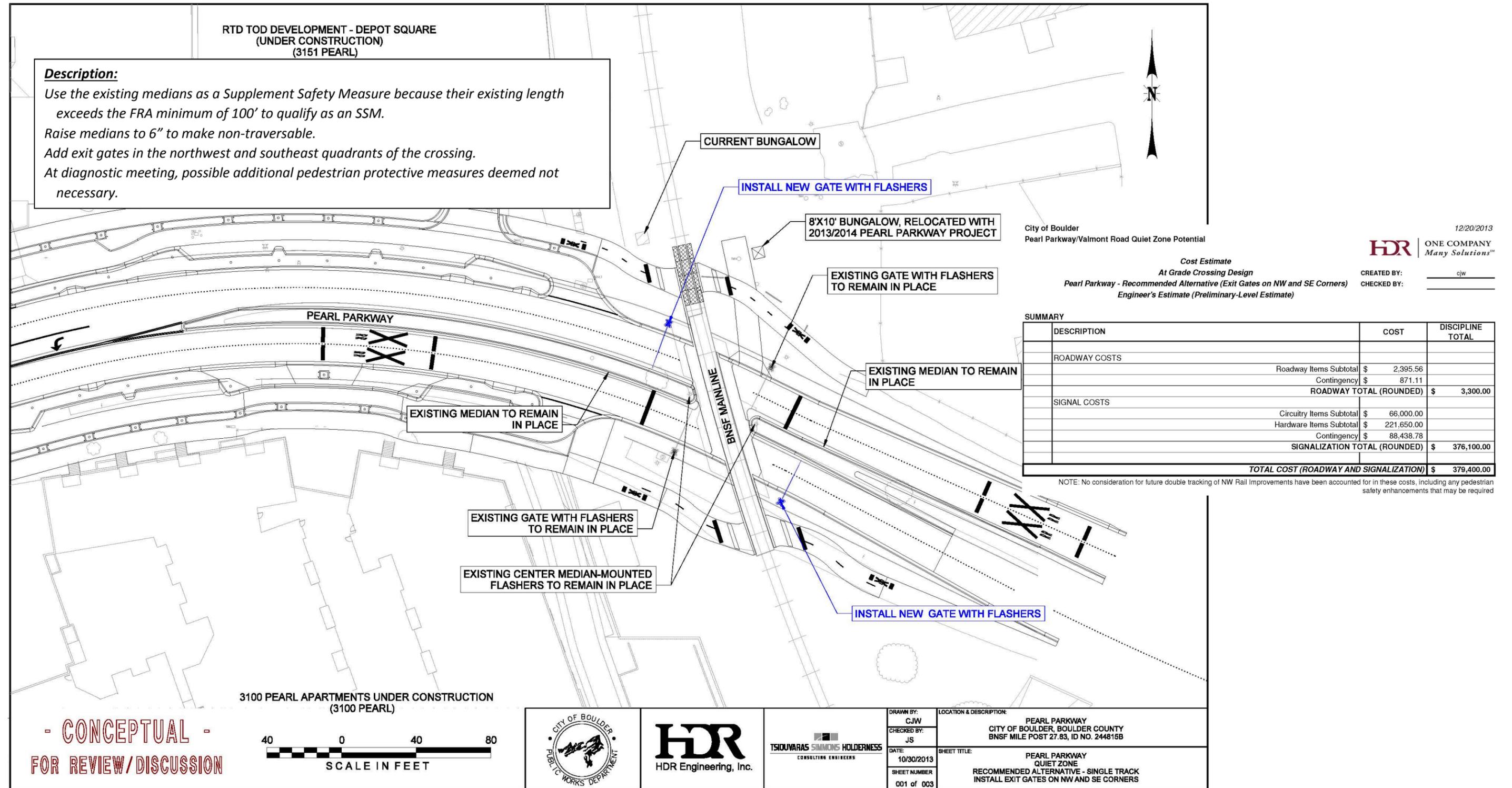
<u>Construction Cost Estimate:</u>	\$100,000
Add 10% for contingencies	\$110,000

Wayside horns also require monthly testing and maintenance at an annual cost of about \$5,000 that would need to be budgeted for.

Range of Costs at this crossing to eliminate or reduce train horn noise:

Between **\$110,000** for wayside horns to **\$379,400** for a quad gate SSM.

FIGURE 9. PEARL PARKWAY PREFERRED ALTERNATIVE



4. Valmont between Foothills Parkway and 30th Street (244818W) MP 31.50

Existing Conditions:

- Approach gates are in place.
- Flashing light signals are in the median.
- The existing medians both east and west are too short to conform to QZ length requirements.
- Signal system is old, installed in 1985.
- FRA inventory says DC circuits at site. QZ requires Constant Warning Time circuitry.
- Note: Cost information for the QZ improvements provided by HDR.

Potential Options: A wayside horn could be an option at this location, but the infrastructure for a median SSM is pretty much in place except for upgraded circuitry, new approach gates, and median extensions. Both east and west medians can be fairly easily extended to meet or exceed the minimum QZ median length requirements. The median to the west would include a westbound Valmont left turn pocket. Thus, the best option at this location is a median SSM. Gate arm lengths at median should be measured and coordinated with the BNSF to determine whether additional median gates are needed or not.

Median SSM:

The costs below are taken from HDRs QZ report, from Table 2.

Construction Cost Estimate:

- Railroad equipment and median costs: **Total \$715,100** (includes 40% contingency)

Median SSM – Includes Two Additional Median Gates: (No illustration provided)

The circuitry upgrade would include bungalow and new approach gates.

Currently, only outside lane approach gates are in place, but these entrance gates are only required to go to the middle of the inside (median side) travel lane. With QZ median SSMs, the gate must come within a foot of the median curb. However, with two travel lanes, the gutter pans, and the on-street bike lane on Valmont, a gate that comes down within one foot of the median curb may be longer than the BNSF will allow. If that is the case, additional gate arms may be required in the median at an estimated additional cost of \$100,000 each.

Construction Cost Estimate:

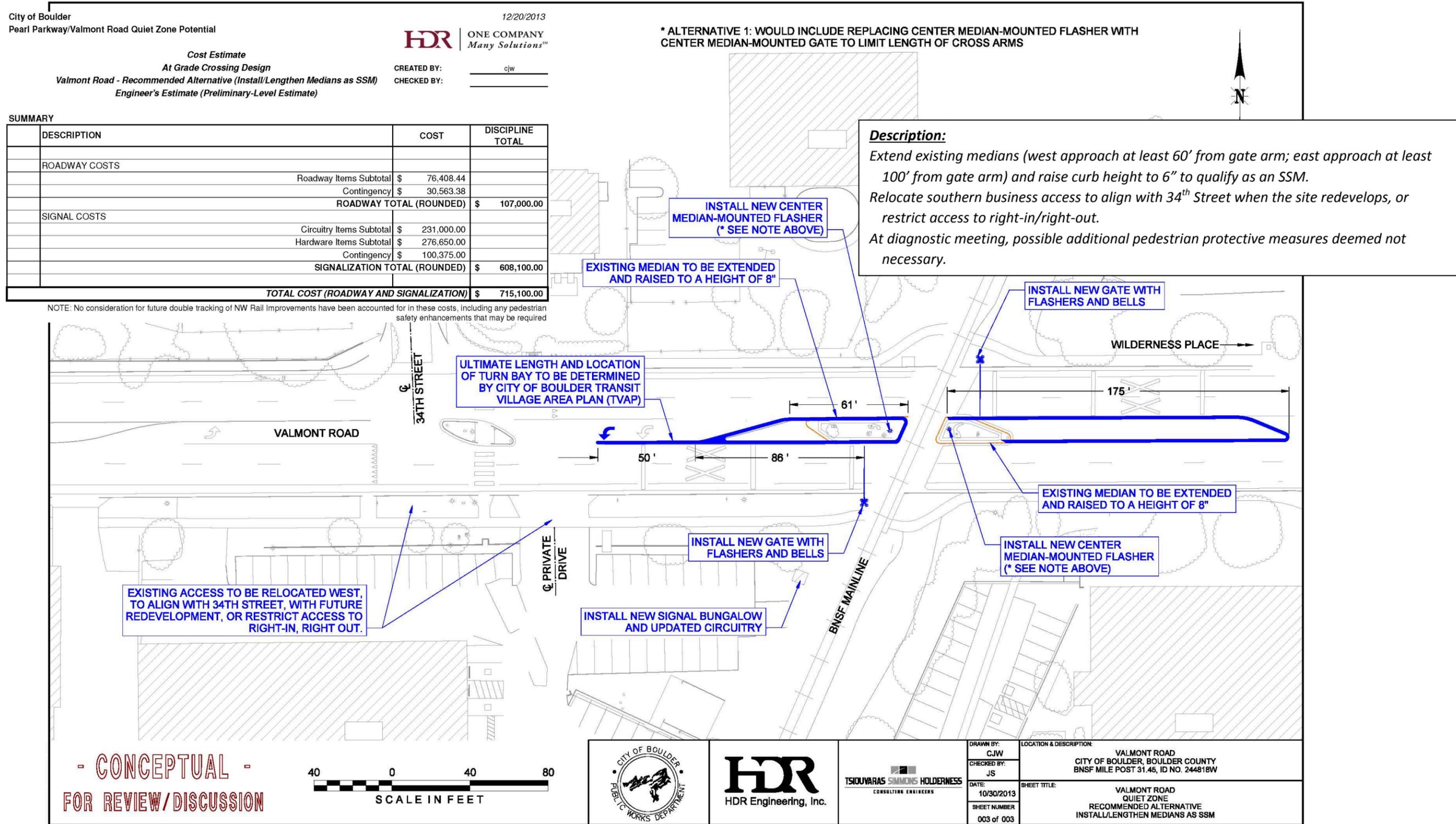
- Railroad equipment (4 gates) and median costs: **Total \$917,600** (includes 25% conting.)

An additional potential cost is possible traffic signal pre-emption at the railroad crossing for the signalized intersections of Valmont and Wilderness Place and the potential future signalized intersection of Valmont and 34th (west of the crossing). This analysis assumes that additional cost can be covered within the 25% cost contingency assumed by HDR.

Range of Costs at this crossing to eliminate or reduce train horn noise:

The range of costs for a median SSM is between **\$715,100** and **\$917,600**.

FIGURE 10. VALMONT ROAD PREFERRED ALTERNATIVE



5. 47th Street (244821E) MP 32.04

Existing Conditions:

- Flashing lights and gates are currently in place.
- Signal system upgrade in 2006. So gates are relatively new.
- There are existing medians on both approaches. The median to north satisfies the FRA length requirement and is OK “as is.” The median to south needs to be extended approximately 49 feet. This is easy to do, as this is within a painted median area. Simply sawcut and remove existing asphalt, install new curb and gutter, patch asphalt, and install new median cover material.
- 47th is a two lane roadway (one lane in each direction) with on-street bikelanes.
- Constant Warning Time circuitry is not in place at this crossing.

Potential Options:

The infrastructure for a median SSM is pretty much in place except for upgraded circuitry, new approach gates, and a median extension. The south median can be fairly easily extended to meet or exceed the minimum QZ median length requirements. A wayside horn could be an option at this location. However, because of the dense residential area to the southeast of the crossing, a median SSM would be by far the best option.

Median SSM:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$ 350,000
• Estimated City civil costs:	<u>\$ 40,000 (median extensions, median cover)</u>
	Total \$390,000
Add 40% for contingencies	\$429,000

Range of Costs at this crossing to eliminate or reduce train horn noise:

The cost of a median SSM is approximately **\$429,000**.



CITY OF BOULDER - Railroad Quiet Zones
47th Street
Approach Gates with Raised Medians
DOT# 244821E



6. Independence Road (244822L) MP 32.33

Existing Conditions:

- Signal system upgraded in 2006.
- Flashing lights and gates in place
- Constant Warning Time circuitry is in place
- The existing crossing material is a new concrete in good shape

Potential Options:

Feasible options at this location are a median or channelizing device SSM, a quad gate SSM, and wayside horns.

Median or Channelizing Device SSM: The paved roadway with is narrow, about 22' wide. There is not enough room to install a median currently unless the existing gates are moved back and significant road widening to accommodate even a minimal width (assumed 4') median. There is enough room to the west (barely, at 65') and east to develop the 100' median length needed. Any widening would likely require additional costs to widen the crossing material as well. To the east, even a minimum 60' long median would restrict left-in, left-out access from the driveway. It may be possible to relocate the driveway on the north side of Independence to the east to accomplish the 60' (minimum) or 100' (desirable) median or channelizing length if the property owner is amenable and the relocated driveway would remain on his/her property. The benefit to the property owner for accepting this driveway relocation would be to maintain left-in, left-out access to Independence from the driveway.

Even a bare minimum 1' wide channelizing device may require some pavement widening, or if that is not feasible, for the County to accept approximately 10' or so travel lanes across the crossing.

And even with the median SSM, new approach gates and a circuitry upgrade would be required at substantial cost.

Quad gates would avoid all the complications of the median SSM above.

Wayside horns are a feasible option at this location. However, although primarily rural in character near the crossing, there are residential areas across SH 119 to the west that would still be affected by the wayside horn noise. And, there are also residential areas to the east and north that would continue to be affected by the wayside horn noise as well.

Median SSM:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$250,000
• Estimated City civil costs:	<u>\$170,000 (add medians, widen roadway)</u>
	Total
	\$420,000
Add 10% for contingencies	\$462,000

Channelization Device SSM:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$250,000
• Estimated City civil costs:	<u>\$ 20,000 (assumes County accepts lane width)</u>
	Total \$270,000
Add 10% for contingencies	\$297,000

Quad Gate SSM:

The costs below assume only a new bungalow and exit gates due to other improvements needed being constructed with the current project.

Construction Cost Estimate:

• Railroad equipment costs only:	\$400,000
• Estimated City civil costs:	<u>\$ 0</u>
	Total \$400,000
Add 10% for contingencies	\$440,000

With any quad gate situations, loop detectors may have to be installed to make sure the exit gates do not go down if a car is still between the gates. Annual testing in the amount of \$3,000 should be budgeted for this if required, as well as provisions for replacements cost of the loops. In addition, there is an annual exit gate testing cost of about \$5,000 per year per installation that needs to be budgeted for.

Wayside Horn Option:

Wayside horns are an option at this location. However, although feasible, the residential nature of residential areas east and west of the crossing make this option less desirable. The wayside horn cost is high because it also requires the circuitry to be upgraded to CWT.

<u>Construction Cost Estimate:</u>	\$300,000
Add 10% for contingencies	\$330,000

Wayside horns also require monthly testing and maintenance at an annual cost of about \$5,000 that would need to be budgeted for.

Range of Costs at this crossing to eliminate or reduce train horn noise:

From **\$297,000** for a channelizing device SSM to **\$462,000** for a median SSM.



CITY OF BOULDER - Railroad Quiet Zones
 Independence Road
 Install Medians / Channelizing Devices
 DOT# 244822L





CITY OF BOULDER - Railroad Quiet Zones
Independence Road
4 Quad Gates
DOT# 244822L





CITY OF BOULDER - Railroad Quiet Zones
Independence Road
Wayside Horns
DOT# 244822L

LEGEND

 - Wayside Horn





7. Jay Road (244823T) MP 33.24

Existing Conditions:

- Flashing lights and gates in place.
- Signals upgraded in 2006.
- Center median in place.
- Constant Warning Time circuitry is in place.
- Jay road westbound is two lanes approaching the crossing. There is a single lane eastbound approaching the crossing.
- Signal phasing at intersection includes simultaneous preemption of traffic signals.

Potential Options:

The infrastructure for a median SSM is pretty much in place except for providing a recording unit in the bungalow and extending the east median. The west median meets the minimum 60' length requirement. The east median can be fairly easily extended to meet or exceed the minimum QZ median length requirements. This is easy to do as this extension would be within a painted median area. Simply sawcut and remove existing asphalt, install new curb and gutter, patch asphalt, and install new median cover.

Wayside horns could be an option at this location. However, residential areas in the vicinity and the ease and cost-effectiveness of installing a fully compliant median SSM at this location that eliminates all horn noise makes wayside horns an undesirable solution.

Median SSM – No Changes to Existing Signals:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$ 60,000
• Estimated County civil costs:	<u>\$ 20,000 (extend E. median, median cover)</u>
Total	\$80,000
Add 10% for contingencies	\$88,000

Median SSM – Includes Realigning Signal Gates on the East Side: (No illustration provided)

The circuitry upgrade would include bungalow and new approach gates.

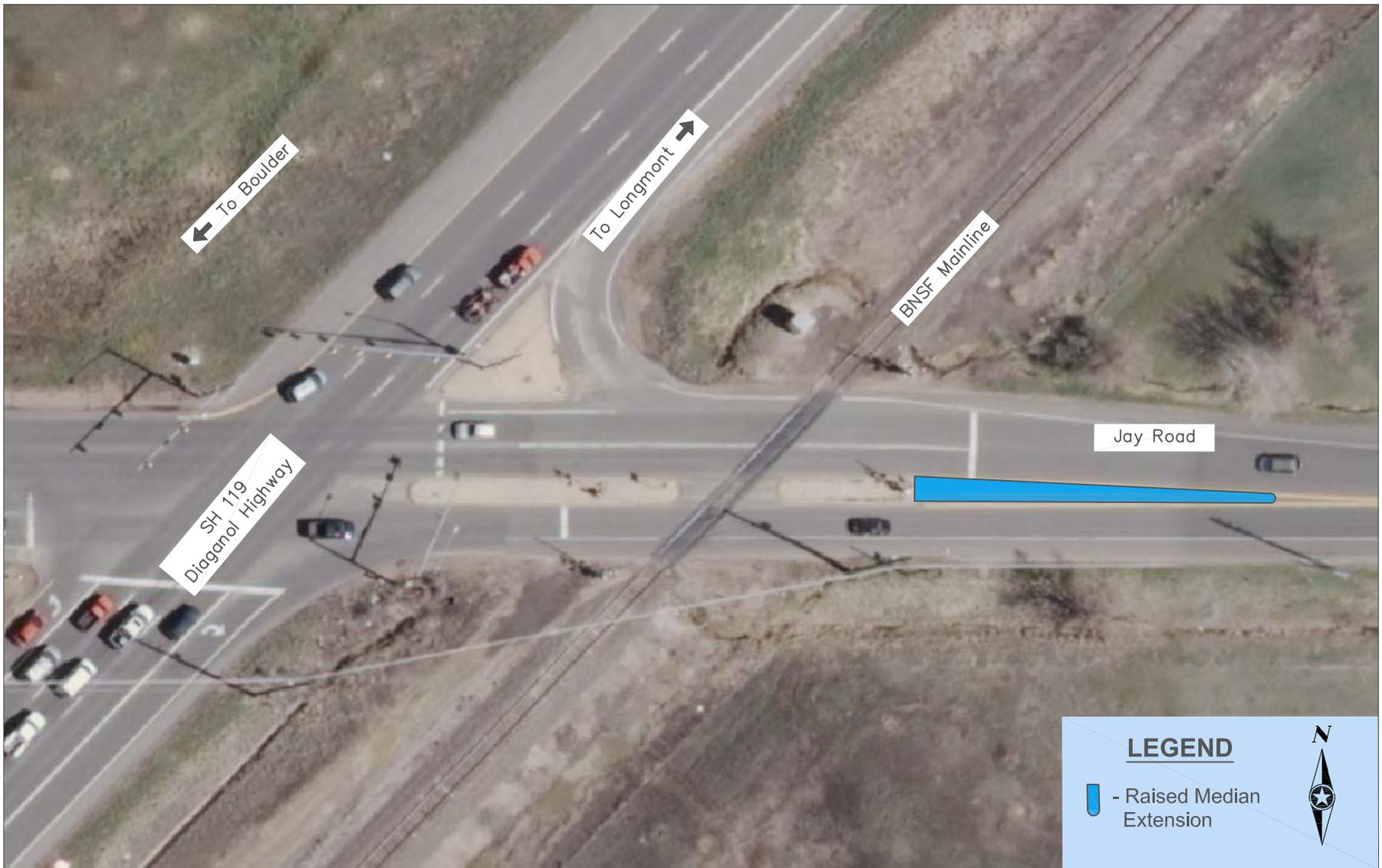
Currently, the two east side gates are set up as approach gates for a non-QZ installation. The outside gate and median gate do not appear to be directly opposite each other such that their gate tips are within a foot of each other. If that is the case, the gates may need to be realigned such that the east approach gates are fully QZ compliant. The estimated cost of realigning these gates could be up to \$100,000.

Construction Cost Estimate:

• Railroad equipment costs only:	\$160,000
• Estimated City civil costs (fencing, curbs):	<u>\$ 20,000</u>
Total	\$180,000
Add 10% for contingencies	\$198,000

Range of Costs at this crossing to eliminate or reduce train horn noise:

From **\$88,000** to **\$198,000** for a median SSM.



CITY OF BOULDER - Railroad Quiet Zones
Jay Road
Raised Medians
DOT# 244823T



8. North 55th Street (244824A) MP 33.77

Existing Conditions:

- Flashing lights and gates in place.
- New signals and gates in 2006.
- Narrow roadway (21' wide)
- Constant Warning Time circuitry is in place.
- The existing crossing material is new concrete in good shape

Potential Options:

Feasible options at this location are a median or channelizing device SSM, a quad gate SSM, and wayside horns.

Median or Channelizing Device SSM: The paved roadway with is narrow, about 21' wide. There is not enough room to install a median currently unless the existing gates are moved back and significant road widening to accommodate even a minimal width (assumed 4') median. There is enough room to the west (approximately 80') and also to the east to develop the median SSM length needed. Any widening would likely require additional costs to widen the crossing material as well. To the west, roadway widening is further complicated by an existing box culvert under SH 119, which may require walls and/or a box culvert extension.

Even a bare minimum 1' wide channelizing device would require some pavement widening, or if that is not feasible, the County must accept 10'(or less) travel lanes across the crossing.

With the median SSM, a recording unit in the bungalow would be required.

Quad gates would avoid all the complications of the median SSM above.

Wayside horns are a feasible option at this location. However, although primarily rural in character near the crossing, there are residential areas across SH 119 to the west that would still be affected by the wayside horn noise. And, there are also residential areas to the east (some very close) and west that would continue to be affected by wayside horn noise as well.

Median SSM:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$ 60,000
• Estimated City civil costs:	<u>\$170,000 (add medians, widen roadway)</u>
Total	\$230,000
Add 10% for contingencies	\$253,000

Channelization Device SSM:

The circuitry upgrade would include bungalow and new approach gates.

Construction Cost Estimate:

• Railroad equipment costs only:	\$ 60,000
• Estimated City civil costs:	<u>\$ 20,000 (assumes County accepts lane width)</u>
Total	\$ 80,000
Add 10% for contingencies	\$ 88,000

Quad Gate SSM:

The costs below assume only a new bungalow and exit gates due to other improvements needed being constructed with the current project.

Construction Cost Estimate:

• Railroad equipment costs only:	\$350,000
• Estimated City civil costs:	<u>\$ 0</u>
	Total \$350,000
Add 10% for contingencies	\$385,000

With any quad gate situations, loop detectors may have to be installed to make sure the exit gates do not go down if a car is still between the gates. Annual testing in the amount of \$3,000 should be budgeted for this if required, as well as provisions for replacements cost of the loops. In addition, there is an annual exit gate testing cost of about \$5,000 per year per installation that needs to be budgeted for.

Wayside Horn Option:

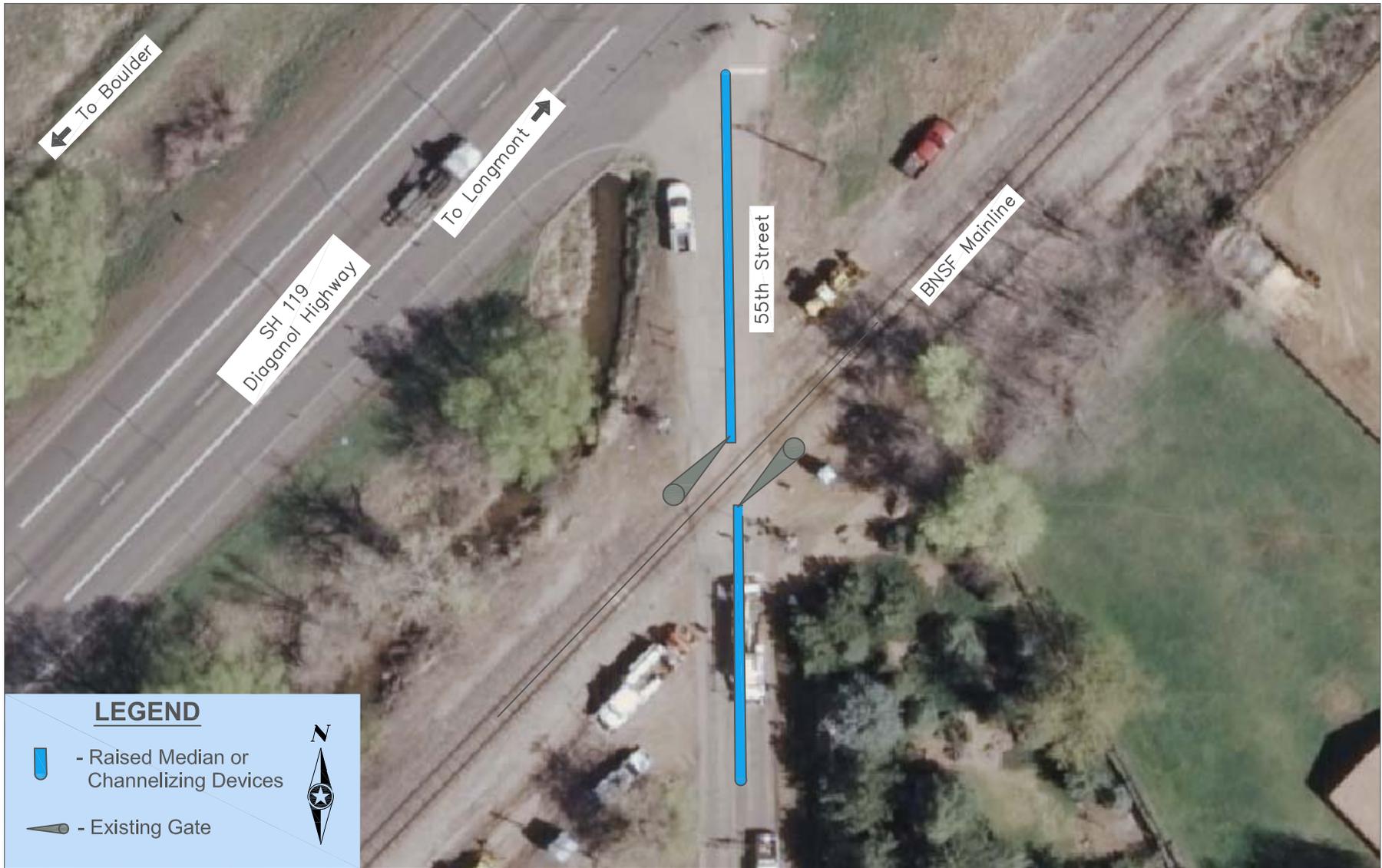
Wayside horns are an option at this location. However, although feasible, the residential nature of residential areas east and west of the crossing this option less desirable. The cost below includes \$60,000 to provide a recording unit installation in the bungalow.

<u>Construction Cost Estimate:</u>	\$160,000
Add 10% for contingencies	\$176,000

Wayside horns also require monthly testing and maintenance at an annual cost of about \$5,000 that would need to be budgeted for.

Range of Costs at this crossing to eliminate or reduce train horn noise:

From **\$88,000** for a channelizing device SSM to **\$385,000** for a median SSM.



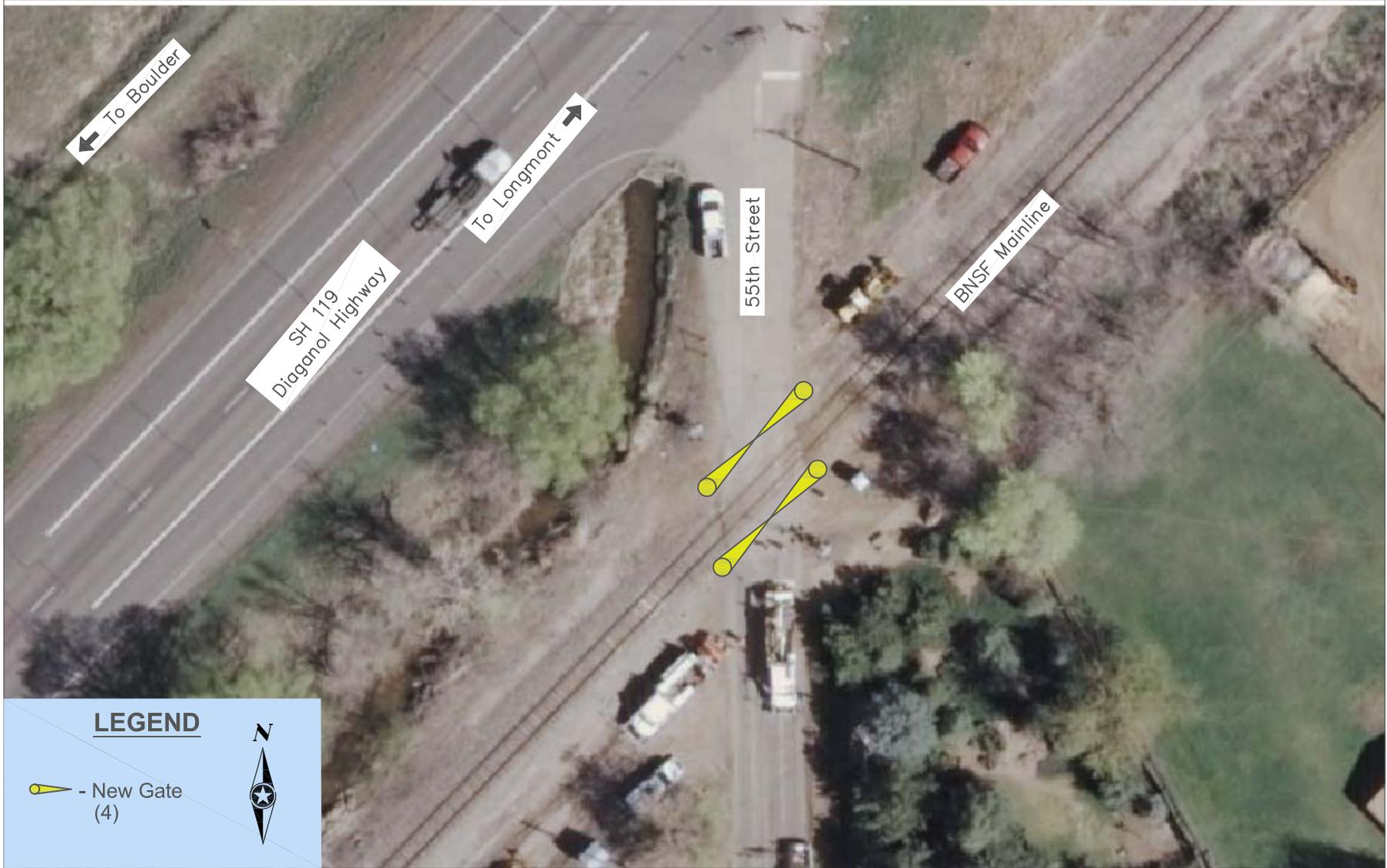
LEGEND

-  - Raised Median or Channelizing Devices
-  - Existing Gate



CITY OF BOULDER - Railroad Quiet Zones
55th Street (North End)
Medians / Channelizing Devices
DOT# 244824A





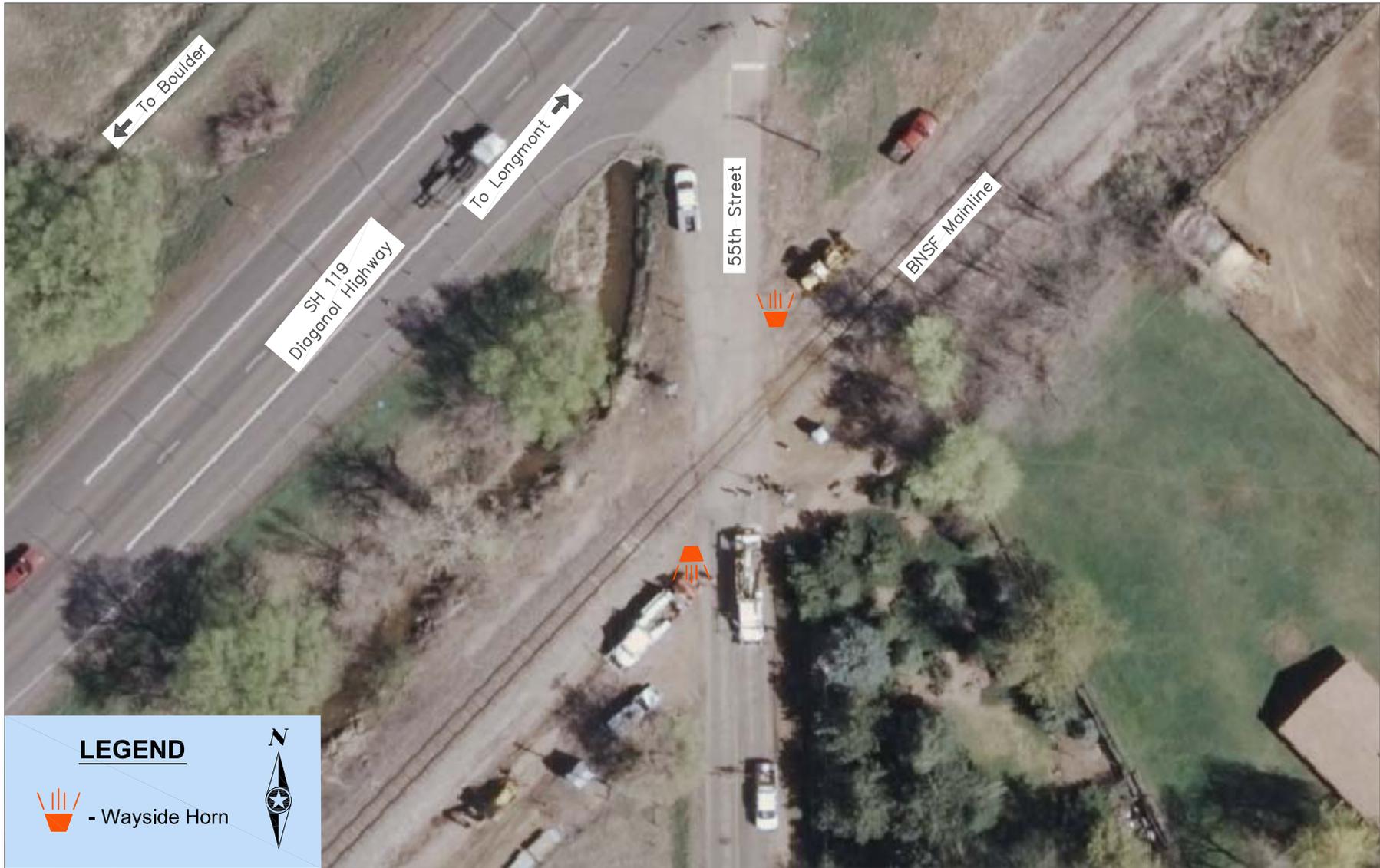
LEGEND

 - New Gate
(4)



CITY OF BOULDER - Railroad Quiet Zones
55th Street (North End)
4 Quad Gates
DOT# 244824A





LEGEND

 - Wayside Horn



CITY OF BOULDER - Railroad Quiet Zones
55th Street (North End)
Wayside Horns
DOT# 244824A



9. North 63rd Street (244827V) MP 35.26

This crossing was designed to comply with QZ requirements when the SH 119/63rd Street intersection was improved several years ago.

Flashing lights and gates are in place.

CWT circuitry is in place.

Medians north and south both meet FRA minimum required lengths.

Signal phasing at intersection includes simultaneous preemption of traffic signals.

Potential Options:

Based on the diagnostic held on August 21, 2013, the crossing seems to nominally meet the requirements of a median SSM. But because the west “pork chop” island does not provide 60’ from the gate arm to the SH 119, the City may have to apply to the FRA for the existing condition treatment to be considered as a modified SSM.

Wayside horns are a feasible option at this location. However, due to the proximity of a new hotel and residential areas relatively close to the crossing, a wayside horn is a less attractive option than the median SSM.

Median SSM:

The existing infrastructure is in place.

Construction Cost Estimate:

- | | |
|----------------------------------|-------------|
| • Railroad equipment costs only: | \$ 0 |
| • Estimated City civil costs: | <u>\$ 0</u> |
| Total | \$0 |

Wayside Horn Option:

Wayside horns are an option at this location. However, although feasible, the proximity of the new hotel and residential areas in the vicinity make this option less desirable.

Construction Cost Estimate: \$100,000

Add 10% for contingencies **\$110,000**

Wayside horns also require monthly testing and maintenance at an annual cost of about \$5,000 that would need to be budgeted for.

Range of Costs at this crossing to eliminate or reduce train horn noise:

From **\$0** for a median SSM to **\$110,000** for a wayside horn SSM.



LEGEND



- Wayside Horn



CITY OF BOULDER - Railroad Quiet Zones
63rd Street
Wayside Horns
DOT# 244827V



Quiet Zone Implementation Sequencing

Per the FRA QZ rules, a QZ must be a minimum of 0.5 (one-half) mile long. That is because trains are required to start sounding their horns approximately 0.25 (one-quarter) mile in advance of a crossing. Thus, in order to eliminate train horn noise as a train approaches within 0.25 mile of a crossing in either direction a QZ must be a minimum of 0.5 mile long (0.25 mile on either side of the crossing).

Since all Boulder crossings are greater than 0.25 mile apart, a QZ can be established individually at each crossing location if desired. Or multiple adjacent crossings can be bundled into a single QZ if desired assuming QZ crossing improvement requirements are met at all crossings that would be included in that QZ. This gives the City and County great flexibility in establishing QZs as priorities and as funding allows.

While QZs can be established independently if crossings are closer than 0.5 mile apart, some of the benefit at a QZ crossing is lost if one crossing is made a QZ and the other is not. A train passing a QZ crossing and then approaches a non-QZ crossing closer than 0.5 miles away must begin sounding its horn 0.25 miles from the crossing - but this is still within the 0.25 mile of the QZ crossing. Thus, the QZ crossing noise 0.25 mile abatement area is negatively affected by the train horn noise intended for the non-QZ crossing beginning before the train is beyond the 0.25 mile threshold of the QZ crossing. For example, the Pearl Parkway and Valmont Road crossings are approximately 0.40 miles apart and are adjacent to the Boulder Junction development, which includes residential development. Since the crossings are less than 0.50 miles apart - it would make sense to consider bundling these two crossings into the same QZ assuming the QZ improvements required at both are in place. If only one of those two crossings were implemented as a QZ, the QZ crossing would not get the full noise relief it could otherwise expect due to train horns needing to sound as trains approach within 0.25 mile of the other non-QZ crossing.

Boulder Railroad Crossing Table

STREET	ROAD AUTHORITY	DOT #	RR CIRCUITRY	EXISTING RAISED MEDIANS	ADJ. TRAFFIC SIGNALS	SSM OPTIONS	CONCEPT COST OF RAILROAD IMPROVEMENTS (SEE NOTE 1)	NOTES
63rd Street (south end)	City of Boulder	244811Y	CWT	YES; <60 FT; ADJ. ACCESSES	NO	4-QUAD or WAYSIDE HORNS	\$800,000 \$250,000	SPUR TO THE NORTH IS CONTROLLED BY THE SAME RAILROAD BUNGALOW; THEREFORE 4-QUADRANT GATES WOULD INCLUDE AN INSTALLATION AT THE SPUR TRACK ALSO
55th Street (south end)	City of Boulder	244813M	DC/AFO	YES; >100 FT; NO ADJ ACCESSES	NO	APPROACH GATES WITH RAISED MEDIANS	\$350,000	CIRCUITRY UPGRADE WOULD INCLUDE BUNGALOW AND NEW APPROACH GATES. FENCING WOULD NEED TO BE PROVIDED TO ELIMINATE VEHICLE TRESPASS ALONG THE RAILROAD RIGHT-OF-WAY
Pearl Parkway	City of Boulder	244815B	CWT (will be)	YES; >100 FT; ADJ ACCESSES PLANNED	NO	4-QUAD or WAYSIDE HORNS	\$300,000 \$100,000	PROPOSED ACCESSES WILL BE WITHIN 60 FT; (4-QUAD COST ASSUMES NEW BUNGALOW AND EXIT GATES ONLY DUE TO THE UPGRADES BEING INSTALLED AS PART OF THE CURRENT CONSTRUCTION PROJECT)
Valmont Road	City of Boulder	244818W	DC/AFO	YES; <60 FT; NO ADJ. ACCESSES	YES-175' EAST	APPROACH GATES WITH RAISED MEDIANS	\$350,000	CIRCUITRY UPGRADE WOULD INCLUDE BUNGALOW AND NEW APPROACH GATES. WEST MEDIAN TO BE EXTENDED TO 100 FT; TO INCLUDE WB LEFT TURN POCKET
47th Street	City of Boulder	244821E	DC/AFO	YES; NORTH= 100 FT; SOUTH= 45 FT; NO ADJ. ACCESSES	NO	APPROACH GATES WITH RAISED MEDIANS	\$350,000	CIRCUITRY UPGRADE WOULD INCLUDE BUNGALOW AND NEW APPROACH GATES. BIKE LANE WORK MAY HAVE BEEN DONE WITHOUT PUC APPROVAL; CITY MAY NEED FOLLOW UP
Independence Road	Boulder County	244822L	DC/AFO	NO	YES- 75' WEST @ HWY 119	INSTALL MEDIANS/ CHANNELIZING DEVICES or 4-QUAD or WAYSIDE HORNS	\$250,000 \$400,000 \$300,000	CIRCUITRY UPGRADE WOULD INCLUDE BUNGALOW AND NEW APPROACH GATES. CHANNELIZING DEVICES (BITUMINOUS CURB WITH HAZARD PANELS) CAN BE PLACED IF ROAD WIDENING FOR MEDIAN CONSTRUCTION IS NOT FEASIBLE
Jay Road	Boulder County	244823T	CWT simul pre	YES; WEST= 70 FT; EAST= 45 FT; NO ADJ. ACCESSES	YES- 90' WEST @ HWY 119	APPROACH GATES WITH RAISED MEDIANS	\$60,000	RAILROAD EQUIPMENT INCLUDES ONLY RECORDING UNIT INSTALLATION IN THE EXISTING BUNGALOW. EXTEND EAST MEDIAN TO 100 FT FOR APPROACH GATES WITH RAISED MEDIANS
55th Street (north end)	Boulder County	244824A	CWT	NO	NO	INSTALL MEDIANS/ CHANNELIZING DEVICES or 4-QUAD or WAYSIDE HORNS	\$60,000 \$350,000 \$160,000	RAILROAD EQUIPMENT INCLUDES ONLY RECORDING UNIT INSTALLATION IN THE EXISTING BUNGALOW. CHANNELIZING DEVICES (BITUMINOUS CURB WITH HAZARD PANELS) CAN BE PLACED IF ROAD WIDENING FOR MEDIAN CONSTRUCTION IS NOT FEASIBLE
63rd Street (north end)	City of Boulder Boulder County CDOT	244827V	CWT	YES; NORTH= 60 FT; SOUTH> 100 FT; NO ADJ. ACCESSES	YES- 75' NORTH @ HWY 119	APPROACH GATES WITH RAISED MEDIANS (WOULD BE MODIFIED SSM) OR WAYSIDE HORNS	0 \$100,000	WOULD NEED TO APPLY TO THE FRA FOR THE EXISTING CONDITIONS TREATMENT TO BE CONSIDERED AS A MODIFIED SSM . RAISED MEDIAN IS THE REQUIRED MINIMUM 60 FEET, BUT THE WEST PORKCHOP ISLAND DOES NOT PROVIDE 60 FEET FROM THE GATE ARM TO HWY 119.

RANGE OF CONCEPT RAILROAD INFRASTRUCTURE COSTS:	\$1,770,000	\$3,060,000
	LOW	HIGH

NOTES;

1. Concept level costs for railroad equipment options are based on recent railroad project work, and are provided for information only. Cost estimates should be requested from the railroad at the time of project design. Costs for civil work (i.e., sidewalk extensions, approach work, medians, etc.) are not included in this concept cost.
2. All crossings currently are equipped with approach railroad gates and flashing lights.
3. All crossings currently have concrete crossing material.

Cost Estimate
At Grade Crossing Design
Pearl Parkway - Recommended Alternative (Install Exit gates on NW and SE corner)
Engineer's Estimate (Preliminary-Level Estimate)

CREATED BY: _____
 CHECKED BY: _____

ROADWAY COST

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST	ROADWAY TOTAL
202-00195	Removal of Median Cover	SY	22	\$ 12.50	\$ 278	
202-00203	Removal of Curb and Gutter	LF	0	\$ 5.50	\$ -	
202-00220	Removal of Asphalt Mat	SY	0	\$ 10.00	\$ -	
202-00250	Removal of Pavement Marking	SF	0	\$ 3.50	\$ -	
202-05026	Sawing Asphalt Material (6 Inch)	LF	0	\$ 2.50	\$ -	
304-06000	Aggregate Base Course (Class 6)	TON	0	\$ 36.00	\$ -	
403-00720	Hot Bituminous Pavement (Patching) (Asphalt)	TON	0	\$ 100.00	\$ -	
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	0	\$ 22.00	\$ -	
610-00026	Median Cover Material (6 Inch Patterned Concrete)	SF	200	\$ 9.50	\$ 1,900	
627-30329	Preformed Plastic Pavement Marking (Xwalk-Stop Line)	SF	0	\$ 15.00	\$ -	
627-30405	Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	0	\$ 20.00	\$ -	
	Non-Quantified Items			10%	\$ 218	
	Contingency			25%	\$ 871	
SUBTOTAL					\$ 3,267	\$ 3,300

SIGNAL COST

DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	CIRCUITRY COST	HARDWARE COST	SIGNALIZATION TOTAL
Install 8x10 Instrument House Only	EA	\$ 150,000	0	\$ -		\$ -
Install Exit Gates with Exit Gate Management System	EA	\$ 100,000	2		\$ 200,000	\$ 200,000
Conduit	LF	\$ 15	100		\$ 1,500	\$ 1,500
Replace Existing Gate	EA	\$ 100,000	0		\$ -	\$ -
Install Center Median-Mounted Flasher	EA	\$ 25,000	0		\$ -	\$ -
Relocate Signals for 2nd Track	EA	\$ 20,000	0		\$ -	\$ -
Additional 2nd Track Circuitry	EA	\$ 20,000	0	\$ -		\$ -
System Integrated Preemption	EA	\$ 30,000	1	\$ 30,000		\$ 30,000
Exit Gate Detection System (loops,	EA	\$ 15,000	2	\$ 30,000		\$ 30,000
Miscellaneous Items			10%	\$ 6,000	\$ 20,150	\$ 26,150
Contingency			25%	\$ 16,526	\$ 71,913	\$ 88,439
SUBTOTAL				\$ 82,526	\$ 293,563	\$ 376,100

TOTAL COST (ROADWAY AND SIGNALIZATION) \$ 379,400

NOTE: No consideration for future double tracking of NW Rail Improvements have been accounted for in these costs, including any pedestrian safety enhancements that may be required

Cost Estimate
At Grade Crossing Design
Valmont Road - Recommended Alternative (Install/Lengthen medians as SSM)
Engineer's Estimate (Preliminary-Level Estimate)

CREATED BY: _____
 CHECKED BY: _____
 cjlw

ROADWAY COST

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST	ROADWAY TOTAL
202-00195	Removal of Median Cover	SY	40.0	\$ 12.50	\$ 500	
202-00203	Removal of Curb and Gutter	LF	200	\$ 5.50	\$ 1,100	
202-00220	Removal of Asphalt Mat	SY	422	\$ 10.00	\$ 4,222	
202-00250	Removal of Pavement Marking	SF	20	\$ 3.50	\$ 70	
202-05026	Sawing Asphalt Material (6 Inch)	LF	0	\$ 2.50	\$ -	
304-06000	Aggregate Base Course (Class 6)	TON	30	\$ 36.00	\$ 1,080	
403-00720	Hot Bituminous Pavement (Patching) (Asphalt)	TON	80	\$ 100.00	\$ 8,000	
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	650	\$ 22.00	\$ 14,300	
610-00026	Median Cover Material (6 Inch Patterned Concrete)	SF	2500	\$ 9.50	\$ 23,750	
627-30329	Preformed Plastic Pavement Marking (Xwalk-Stop Line)	SF	360	\$ 15.00	\$ 5,400	
627-30405	Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	552	\$ 20.00	\$ 11,040	
	Non-Quantified Items			10%	\$ 6,946	
	Contingency			25%	\$ 30,563	
TOTAL					\$ 106,972	\$ 107,000

SIGNAL COST

DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	CIRCUITRY COST	HARDWARE COST	SIGNALIZATION TOTAL
Install 8x10 Instrument House Only	EA	\$ 150,000	1	\$ 150,000		\$ 150,000
Install Exit Gates with Exit Gate Management System	EA	\$ 100,000	0		\$ -	\$ -
Conduit	LF	\$ 15	100		\$ 1,500	\$ 1,500
Replace Existing Gate	EA	\$ 100,000	2		\$ 200,000	\$ 200,000
Install Center Median-Mounted Flasher	EA	\$ 25,000	2		\$ 50,000	\$ 50,000
Relocate Signals for 2nd Track	EA	\$ 20,000	0		\$ -	\$ -
Additional 2nd Track Circuitry	EA	\$ 20,000	0	\$ -		\$ -
System Integrated Preemption	EA	\$ 60,000	1	\$ 60,000		\$ 60,000
Exit Gate Detection System	EA	\$ 15,000	0	\$ -		\$ -
Incidental Items			10%	\$ 21,000	\$ 25,150	\$ 46,150
Contingency			25%	\$ 37,500	\$ 62,875	\$ 100,375
SUBTOTAL				\$ 268,500	\$ 339,525	\$ 608,100
TOTAL COST (ROADWAY, CIRCUITRY, HARDWARE)					\$ 714,997	\$ 715,100

NOTE: No consideration for future double tracking of NW Rail Improvements have been accounted for in these costs, including any pedestrian safety enhancements that may be required

Cost Estimate
At Grade Crossing Design
Valmont Road - Recommended Alternative (Install/Lengthen Medians as SSM & Install Median Gates)
Engineer's Estimate (Preliminary-Level Estimate)

CREATED BY: _____
 CHECKED BY: _____
 cjw

ROADWAY COST

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST	ROADWAY TOTAL
202-00195	Removal of Median Cover	SY	40.0	\$ 12.50	\$ 500	
202-00203	Removal of Curb and Gutter	LF	200	\$ 5.50	\$ 1,100	
202-00220	Removal of Asphalt Mat	SY	422	\$ 10.00	\$ 4,222	
202-00250	Removal of Pavement Marking	SF	20	\$ 3.50	\$ 70	
202-05026	Sawing Asphalt Material (6 Inch)	LF	0	\$ 2.50	\$ -	
304-06000	Aggregate Base Course (Class 6)	TON	30	\$ 36.00	\$ 1,080	
403-00720	Hot Bituminous Pavement (Patching) (Asphalt)	TON	80	\$ 100.00	\$ 8,000	
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	650	\$ 22.00	\$ 14,300	
610-00026	Median Cover Material (6 Inch Patterned Concrete)	SF	2500	\$ 9.50	\$ 23,750	
627-30329	Preformed Plastic Pavement Marking (Xwalk-Stop Line)	SF	360	\$ 15.00	\$ 5,400	
627-30405	Preformed Thermoplastic Pavement Marking (Word-Symbol)	SF	552	\$ 20.00	\$ 11,040	
	Non-Quantified Items			10%	\$ 6,946	
	Contingency			25%	\$ 30,563	
TOTAL					\$ 106,972	\$ 107,000

SIGNAL COST

DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	CIRCUITRY COST	HARDWARE COST	SIGNALIZATION TOTAL
Install 8x10 Instrument House Only	EA	\$ 150,000	1	\$ 150,000		\$ 150,000
Install Median Gates	EA	\$ 100,000	2		\$ 200,000	\$ 200,000
Conduit	LF	\$ 15	100		\$ 1,500	\$ 1,500
Replace Existing Gate	EA	\$ 100,000	2		\$ 200,000	\$ 200,000
Install Center Median-Mounted Flasher	EA	\$ 25,000	0		\$ -	\$ -
Relocate Signals for 2nd Track	EA	\$ 20,000	0		\$ -	\$ -
Additional 2nd Track Circuitry	EA	\$ 20,000	0	\$ -		\$ -
System Integrated Preemption	EA	\$ 60,000	1	\$ 60,000		\$ 60,000
Exit Gate Detection System	EA	\$ 15,000	0	\$ -		\$ -
Incidental Items			10%	\$ 21,000	\$ 40,150	\$ 61,150
Contingency			25%	\$ 37,500	\$ 100,375	\$ 137,875
SUBTOTAL				\$ 268,500	\$ 542,025	\$ 810,600
TOTAL COST (ROADWAY, CIRCUITRY, HARDWARE)					\$ 917,497	\$ 917,600

NOTE: No consideration for future double tracking of NW Rail Improvements have been accounted for in these costs, including any pedestrian safety enhancements that may be required

63rd – North of Arapahoe- Looking North



55th at Roche – Looking North



Pearl Parkway – Looking East



Valmont – Looking East



47th St – Looking North



Independence – Looking West



Jay Rd – Looking West



N. 55th at SH 119 – Looking West



N. 63rd at SH 119 – N. of BNSF Tracks

North Side of Tracks



South Side of Tracks

