Emeryville Railroad Quiet Zone Study

Draft Report

Submitted to the Redevelopment Agency of the City of Emeryville
Submitted by Wilbur Smith Associates
in association with Adavant Consulting
June 2, 2008

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EXECUTIVE SUMMARY

STUDY PURPOSE

The purpose of the *Emeryville Railroad Quiet Zone Study* was to explore the potential for implementation of a quiet zone on the Union Pacific Railroad (UP) corridor through the City of Emeryville. A railroad quiet zone is an area where locomotive engineers are not required to sound train warning horns as they approach an at-grade crossing.

There are three at-grade highway-rail crossings in Emeryville. These are at 65th, 66th, and 67th Streets, all of which cross the UP's Martinez Subdivision in northwestern Emeryville. The UP tracks are used daily by both passenger and freight trains, with passenger trains more numerous than freight trains. According to federal regulations, engineers of all these trains must sound their train horns when approaching the grade crossings. In the future, the number of trains operating on this corridor will increase, resulting in a greater frequency in train horning soundings. The implementation of a quiet zone in Emeryville would greatly reduce the existing and future noise impacts from train horn soundings.

QUIET ZONE PROCESS

The Federal Railroad Administration (FRA), the federal agency with oversight responsibility for safety on the national railroad system, has established a process for implementing a quiet zone. A quiet zone can be established if the Quiet Zone Risk Index (QZRI) or risk for a train-motor vehicle accident occurring in the quiet zone is less than or equal to National Significant Risk Threshold (NSRT). NSRT is the national average level of risk to the motoring public at public crossings equipped with flashing lights and gates and at which trains horns are regularly sounded. The FRA provides a program on its Web site for calculating the QZRI; the program is called the Quiet Zone Calculator.

If the QZRI is greater than the NSRT, a quiet zone may still be established by implementing one or more of four kinds of Supplementary Safety Measures (SSMs) at every public highway-rail crossing within a quiet zone:

- Temporary or permanent closure of a crossing
- Four-quadrant gate system
- Gates with medians or channelization devices
- One-way street with gates

Alternatively, a quiet zone could be established if SSMs are implemented only at some crossings so long as the resulting QZRI is less than or equal to the NSRT or Risk Index With Horns (RIWH), the level of risk to the motoring public when locomotive horns are sounded routinely at every crossing within a quiet zone. The FRA calculator also calculates the RIWH.

If the above conditions are met, a quiet zone can be implemented without the approval of the FRA; however, a quiet zone would require the concurrence of both the California Public Utilities Commission (CPUC), which shares safety oversight for these crossings with the FRA, and of the UP. Furthermore, the FRA crossing inventory forms will need to be periodically updated and submitted to the FRA.

EMERYVILLE QUIET ZONE SCENARIOS

Preliminary analysis of the existing Emeryville grade crossings showed that they could not qualify for a quiet zone designation. As a result, four scenarios were developed to evaluate alternative crossing treatments. These were:

1. Installation of four-quadrant gates at all three crossings.
2. Installation of a four-quadrant gate at 65th Street, with 66th and 67th Streets turned into a one-way couplet.
3. Installation of a four-quadrant gate at 65th Street, gating across all lanes on the west side of the 66th and 67th Street crossings, and medians on the east side of these two crossings.
4. Installation of four-quadrant gates at the 65th and 66th Street crossings, but no improvements at the 67th Street crossing.

In order to run the Quiet Zone Calculator, specifics of each crossing had to be developed. The study team visited each crossing and inventoried the warning and protective devices and signage currently in place. The team estimated train volumes and counted the motor vehicle traffic at each crossing. Projections of train and motor vehicle volumes at the crossings for future 2030 conditions were calculated. This data was used to run the calculator under both current and future 2030 conditions.

In addition, pedestrian and bicycle counts at the grade crossings were taken to assess the level of non-motorized activity at the crossings and in the rail corridor.

All four scenarios resulted in a QZRI that was below either the NSRT or the RIWH, given present and future traffic conditions. Thus, any one of the scenarios could be implemented without approval of the FRA but with concurrence of both the CPUC and the UP.

SCENARIO EVALUATION AND NEXT STEPS

The scenarios were evaluated on five different criteria. All had equal weighting. The criteria were overall safety, pedestrian safety, capital cost, impacts to local traffic flows, and requirements for review by the FRA. On balance, Scenario 1 appeared superior.

If the City of Emeryville seeks to move forward with any of the scenarios, the first requirement will be to provide a Notice of Intent to create a new quiet zone, which will trigger a 60-day comment period. The Notice of Intent will need to be provided to the freight and passenger railroads that would operate through the quiet zone and to the CPUC for their comment. The railroads and the CPUC have 60 days to submit comments.

After the 60-day comment period, Emeryville would be able to issue a Notice of Quiet Zone Establishment. The purpose of this notice is to provide a means for Emeryville to formally advise affected parties that a quiet zone is being established.

Prior to the establishment of the quiet zone, the SSMs must be designed and installed. As the design is initiated, it is necessary to contact the CPUC to request "Staff for Authorization to Alter a Highway-Rail Crossing Pursuant to General Order 88-B". GO-88B requires CPUC staff to authorize changes "in the type or addition of an automatic signaling device, crossing gate, crossing flagman or other forms of crossing protection or reduction of hours during which any such protection is maintained, or other minor alterations."

After the approval is granted by the CPUC, construction of the improvements can be initiated. After construction, an updated crossing inventory form with the description of the crossing devices and conditions needs to be provided to the FRA prior to the implementation of the quiet zone.

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CHAPTER 1: EXISTING CONDITIONS

This chapter presents the findings of the Existing Conditions analysis with an introduction on the benefits and requirements for establishment of a quiet zone. It describes existing freight and passenger rail operations in Emeryville and details the City's three at-grade railroad crossings. The understanding of rail operations and the circumstances applicable to each grade crossing are essential to the development of a plan to create a quiet zone. This chapter reviews rail operations and grade crossing conditions, including warning devices, vehicular traffic volumes, and accident experience. Land uses along the rail corridors and motor vehicle and rail traffic generators in the study area are also discussed. The study area is shown in Figure 1-1.

STUDY CONTEXT

According to federal regulations, trains are required to blow their horns at they approach at-grade crossings with roadways.[1] The horn sounding is a safety measure, to alert motorists and pedestrians intending to cross the tracks that a train is approaching.

Over the years, Emeryville land uses have changed from primarily industrial uses to more residential, office and commercial development. In addition, train traffic has increased resulting in more frequent sounding of train horns. Train horns caused little impact, in the past, on the industries adjacent to the railroad corridor; today the horns' impact is much more widely felt particularly by residents during evening and night hours and by office workers during daytime hours. While the environs of the 66th Street and 67th Street crossings have changed little over time, the parcels surrounding the 65th Street have undergone considerable transformation in use. New apartment complexes are located on either side of the tracks with office development to the east. Numerous commercial establishments and a hotel are located nearby.

A potential solution to reduce the impacts of train horn noise is to establish a quiet zone for the three at-grade crossings in Emeryville. Quiet zones are areas where locomotive engineers are not required to sound train warning horns as they approach an at-grade crossing. Quiet zone designations are authorized by the Federal Railroad Administration (FRA), the federal agency with oversight for the safety of the national rail system. The quiet zone process is detailed in Chapter 3.

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1 The regulation can be downloaded at http://www.fra.dot.gov/downloads/safety/trainhorn_2005/amended_final_rule_081706.pdf

Figure 1-1
STUDY AREA LOCATION

EXISTING POPULATION AND EMPLOYMENT

According to Association of Bay Area Government (ABAG) projections reported in the City's 2006 General Plan Update, Emeryville's population in 2005 was reported at 8,000. The General Plan Update cited Emeryville's employment in 2005 as 20,140.

RAIL OPERATIONS IN EMERYVILLE

Rail service in Emeryville is provided along the UP right-of-way. The rail corridor is located on the west edge of Emeryville between Shellmound Street and Hollis Street. The UP Martinez Subdivision tracks provide an important link in the region's freight and passenger rail network. Local and regional freight and passenger traffic traveling from the Bay Area to Sacramento, the Central Valley, and all along the West Coast from Seattle to San Diego all rely on use of this corridor to move goods and people.

The UP right-of-way contains two main tracks through Emeryville along with parallel support trackage on each side. One capacity improvement concept discussed in the past by UP and the Capital Corridor Joint Powers Authority (the administrative agency for the Caltrans-sponsored, Amtrak-operated *Capitol Corridor* service) was for a third main track between Sacramento and Oakland[2]. Specifically, this involved rebuilding of the westernmost freight service track to function as a third main track through Emeryville. An additional concept prepared by the Port of Oakland has called for a fourth main track through Emeryville[3].

In the past, a number of local spurs from the UP main tracks provided connections to the manufacturing and industrial areas in Emeryville. These connections are no longer in use, and the physical rail lines have been disconnected or removed from local streets.

FREIGHT OPERATIONS

The UP and Burlington Northern Santa Fe Railway (BNSF) operate local and regional freight traffic through Emeryville. While the tracks are owned by UP and UP operates the majority of freight service, BNSF operates freight trains on the corridor via trackage. In total, approximately 30 freight trains pass through Emeryville every day. Since there are no rail shippers served within the study area, all freight traffic is through traffic. Freight train operations are summarized in Table 1-1 below.

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2 Per Bay Area Regional Rail Plan Technical Memorandum 4g, Summary of Capacity Issues on the Bay Area Regional Rail System (March 28, 2007).

3 A 2007 Trade Corridors Improvement Fund (TCIF) nomination by the Port of Oakland called for four tracks. TCIF provides funding for infrastructure improvements on corridors handing a high volume of freight movement. The California Transportation Commission (CTC) approves nominations for specific funding proposals. Actual project funding is dependent on appropriation by the California Legislature.

Trains in the northbound direction are primarily headed for UP's major Northern California classification yard in Roseville or for transcontinental destinations such as Chicago, Kansas City or St. Louis. Southbound, most trains are headed to the Port of Oakland or UP's Oakland area classification yards. Trains are also bound for shippers along the East Bay rail routes to San Jose and also to Southern California. Freight trains include various sorts of traffic, from containers and trailers on flatcars or double-stack intermodal cars, to set-up automobiles and general carload traffic, such as boxcars, gondolas, tank cars and lumber carriers.

Future freight train growth is estimated to be a function of growth experienced at the port. Recent improvements requested by the Metropolitan Transportation Commission (MTC) would help the Port of Oakland increase its level of activity, thus increasing rail activity through Emeryville. Twelve projects were recently proposed to create these improvements including a $325 million truck-train terminal at the Port of Oakland and $315 million worth of track improvements between Richmond and Martinez.

The existing double-tracked mainline could support upwards of 80-100 trains per day. Estimates for freight volumes in Year 2030 are between 50-60 trains per day, leaving little room for passenger train expansion. The addition of a third maintrack through the corridor would further support both freight and passenger expansion plans.

Table 1-1: Freight Train Operations Summary	
Trains per day	30
Trains per time of day	Evenly spread through day
Typical train length (average)	5,000'
Maximum timetable speed	40 mph
Typical speeds	20-30 mph
Growth rate in trains	3% per year
Train horn rules	GCOR[4]

4 A General Code of Operating Rules (GCOR) has been adopted by all western railroads as a common set of rules. Requirements to sound train horns under various conditions are included. The GCOR can be found at http://gsee.sdf-us.org/signals/docs/pdf/gcor/gcor_4-2000.pdf

PASSENGER OPERATIONS - AMTRAK

Amtrak has rights under federal law to operate intercity and long distance passenger rail service on the UP tracks through Emeryville. Long distance operations occur once a day in each direction on both the California Zephyr (Emeryville – Chicago) and the Coast Starlight (Seattle – Los Angeles). Regional service is provided daily on the Capitol Corridor (Sacramento – San Jose) and San Joaquin (Bakersfield – Oakland) services. All these passenger services stop at the Emeryville Amtrak Station, located south of 65th Street and north of the Powell Street overcrossing, allowing passengers to board and alight. In addition, Thruway Bus service to San Francisco is available from the station. Passenger train operations are summarized below in Table 1-2.

The long distance services contribute four trains per day to the corridor and the regional services add a total of 40 daily trains (32-Capitol Corridor, 8-San Joaquin). In total, passenger operations consist of 44 daily trains running through Emeryville, and 4-5 trains per hour in both the AM and PM peak hours.

Currently, Capitol service has reached the peak in terms of allowable trains it can run based on its current contract with the UP. Allowing additional passenger trains through this agreement would result in a compromise of freight activity that the UP would have to agree to.

Table 1-2: Passenger Train Operations Summary	
Trains per day	44
Trains per time of day	Operating hours 6am – 10pm
Typical train length (average)	700'
Maximum timetable speed	50 mph
Typical speeds	35-45 mph
Growth rate in trains	Limited by UP Agreement
Train horn rules	GCOR

Emeryville Station

The Emeryville Amtrak Station, opened in 1993, is located at Horton Street and 59th Street along the UP right-of-way. The station is open daily from 5:30am – 11:00pm. The staffed ticket office is open from 5:30am to 10:30pm; Quick Trak machines are also available for self-service ticket purchase during station hours. The station has an enclosed waiting area with restrooms, pay phones, a snack bar and ATM. Baggage can be checked at this station between the hours of 6:15am – 9:30pm. A pedestrian bridge connects the station to the EmeryBay Public Marketplace to the west. Photographs of the station area are included in Figures 1-2 to 1-5.

Figure 1-2: Emeryville Station Platforms

Figure 1-3: Pedestrian Bridge

Figure 1-4: Ticket Office

Figure 1-5: Waiting Room

AT-GRADE CROSSINGS IN EMERYVILLE

There are three at-grade rail crossings in Emeryville (65th Street, 66th Street, and 67th Street) north of the Amtrak Station, as shown in on Figure 1-6. The crossings are close to each other with a distance of about 400 feet between adjacent crossings. These are all crossings of public roadways and run perpendicular to the rail lines. Shellmound Street runs parallel and adjacent to the rail corridor on the west. It is striped for bicycle lanes in both directions through this area. Warning devices, crossing layout, land use, and accident history of each crossing is described below. Photographs of each crossing and summary of findings can be found in the crossing inventory report in Appendix A.

65TH STREET

65th Street, the southernmost crossing, crosses three active tracks. These include the Martinez Subdivision Tracks 1 and 2, and on the west a third track used exclusively for freight trains. Furthermore, there are two tracks tying into the mainline tracks just south of the crossing. An Emeryville Station track is to the east of the mainline tracks and an additional freight lead is on the west side of the mainline tracks. Concrete crossing panels are in place for all tracks and are painted with KEEP CLEAR markings.

Motor vehicle flow is two-way on the crossing with one traffic lane in each direction. An additional lane, left-turn only, is marked on 65th Street for westbound traffic just west of the tracks. This crossing has the heaviest traffic of the three at-grade crossings with 5,400 Average Daily Traffic[5] (ADT). This complex intersection is signalized on both sides for Shellmound Street to the west and Overland Avenue to the east. Overland Avenue terminates at 65th Street. Signal timings are set to allow motor vehicles to clear the intersection and not be trapped on the tracks. Motorists on the northbound approach of Shellmound Street are further deterred with flashing NO RIGHT TURN signs from turning onto 65th Street when the signal cycle will not allow them to clear the intersection and the rail crossing.

65th Street is a designated bicycle route with bicycle lanes striped on the eastern leg of 65th Street. These lanes are dashed through the at-grade crossing. Pedestrians are directed with barriers and signs to cross on the south side of the tracks. Shellmound Street is also striped for bicycle lanes and Overland Avenue is a designated bicycle boulevard.

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5 Average Daily Traffic (ADT) - is defined as the total traffic volume during a given period (from 1 to 364 days) divided by the number of days in that period. Current ADT volumes can be determined by continuous traffic counts or periodic counts. Where only periodic traffic counts are taken, ADT volume can be established by applying correction factors such as for season or day of week. For roadways having traffic in two directions, the ADT includes traffic in both directions unless specified otherwise.

24-hour tube counts were taken at the grade crossing locations on January 22-26, 2008 to measure ADT.

Warning devices at the crossings include automatic two-quadrant gates, warning bells and flashing lights. Stop lines, railroad crossing symbols and advance warning signs are included on all approaches to the crossing except for the northbound approach from Shellmound Street which is fitted with the NO RIGHT TURN signs as discussed above. Observations at these locations show that the crossing gates tend to drop approximately 20-40 seconds prior to train arrival and remain down for 10-20 seconds following the clearing of the intersection. The total time that the gate is down depends upon the size and speed of the train. On average, passenger trains occupy the intersection for approximately 20 seconds with an average total gate drop time of approximately 40 seconds. Due to the longer length and overall slower speed of most freight trains, gate drop times on average were higher. In addition, southbound freight trains begin slowing in the vicinity of these grade crossings in preparation for entering the Port of Oakland.

Surrounding land uses are a mix of residential, office and industrial. Residential development includes The Courtyards Apartments on the southeast corner and the Archstone Emeryville Apartments on the southwest corner. The Pacific Storage complex is on the northwest corner with the EmeryTech office building on the northeast corner.

Records of accidents since 1975 occurring at grade crossings are maintained by the FRA as part of its grade crossing collision database[6].

One grade crossing accident was reported at the 65th Street crossing occurring on January 24, 2002. This incident involved an automobile and a freight train. The automobile driver drove around the gates and was moving over the crossing at approximately 20 miles per hour at the time of the incident. The freight train had two locomotive units and 7 cars; it was estimated to be traveling eastbound at 50 miles per hour. The accident occurred in the evening under clear weather conditions. The automobile driver was injured with $500 reported damage to the highway vehicle.

66TH STREET

66th Street crosses four tracks. These include the two mainline tracks, the third track on the west used for freight trains and the stub-end drill track to the east of the other tracks. This drill track terminates just south of the 66th Street crossing. Concrete crossing panels are in place for all tracks and are painted with KEEP CLEAR markings.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. 66th Street tees into Shellmound Street just west of the crossing; this intersection is not signalized, but 66th Street traffic is signed to yield to cross traffic on Shellmound. Stop lines and railroad crossing symbols are included on the 66th Street approach from the east, but no railroad advance warning signage is provided. Stop lines are

[6] http://safetydata.fra.dot.gov

also marked on the approach from Shellmound Street. No other warning signage or pavement markings are provided from this direction. Motor vehicle traffic flows at this crossing are generally low with 2,100 ADT.

Warning devices at the crossings include automatic two-quadrant gates, warning bells and flashing lights. Average gate drop times are similar to those for 65th Street as discussed above.

Surrounding land uses are industrial and office and include EmeryTech office building on the southeast corner, R&L Warehouse Distribution Services on the northeast corner, and Pacific Storage and Expression College for the Digital Arts to the west.

One grade crossing accident was reported at 66th Street occurring on November 24, 1979. This incident involved a truck-trailer and freight train consisting of one locomotive only. The truck driver drove around the gates and was traveling at approximately 5 miles per hour over the crossing when the truck was hit by a train. The freight train was estimated to be traveling eastbound at 5 miles per hour. The accident occurred at midday during clear weather conditions. This incident did not result in injury or fatality; property damage to the highway vehicle was reported to be $500.

67TH STREET

67th Street, the northernmost crossing, crosses five tracks. These include the two mainline tracks, the freight lead to the west, and a siding on either side. The siding tracks are truncated south of the 67th Street crossing. Concrete panels are in place for all tracks and are painted with KEEP CLEAR markings.

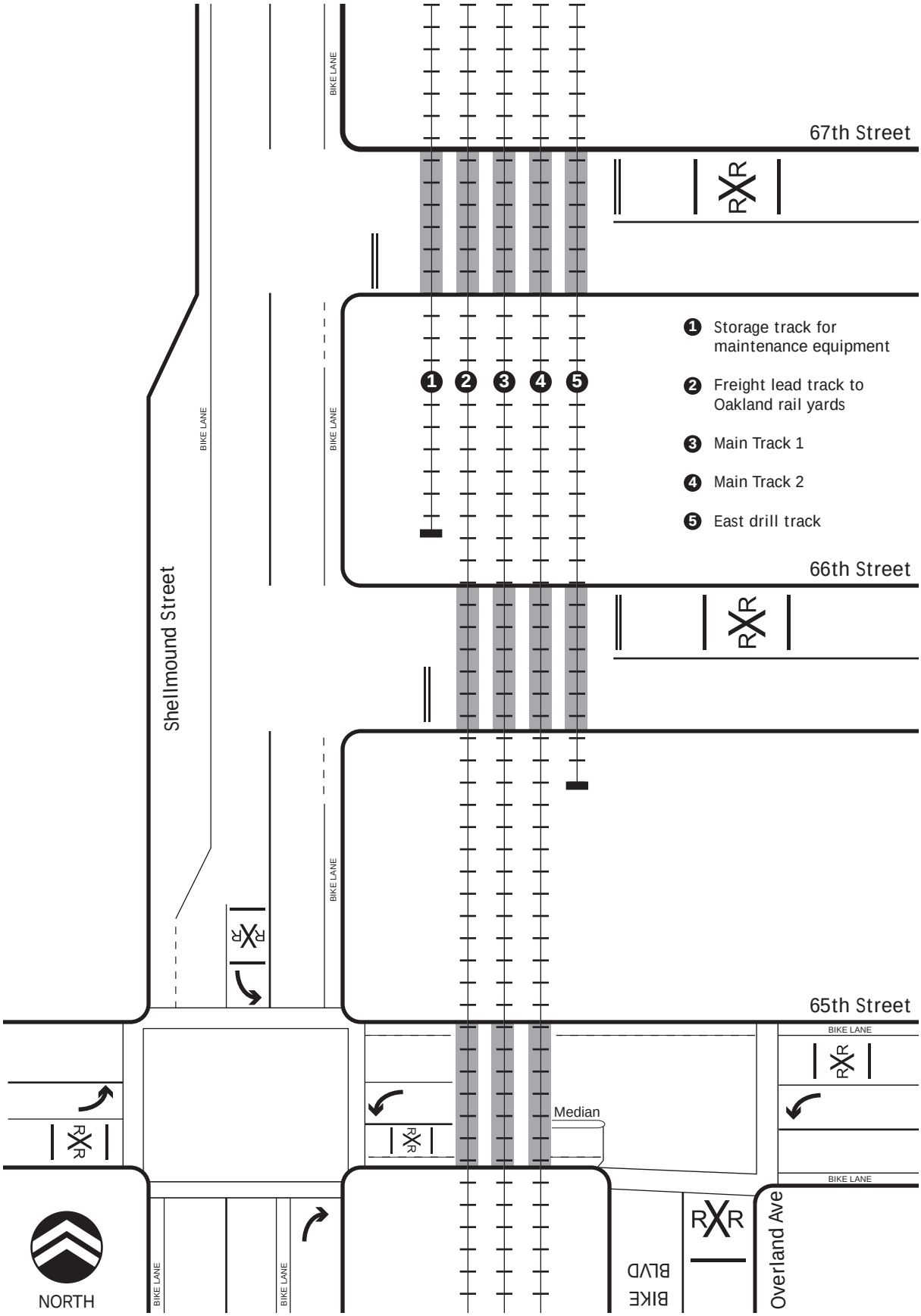
Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. 67th Street tees into Shellmound Street just west of the crossing; this intersection is not signalized. Stop lines and railroad crossing symbols are included on the 67th Street approach from the east but no railroad advance warning signage is provided. Stop lines are also marked on the approach from Shellmound Street. No other warning signage or pavement markings are provided from this direction. Motor vehicle traffic flows at this crossing are generally low with 2,200 ADT.

The crossing itself is protected with automatic two-quadrant gates, warning bells and flashing lights. Average gate drop times are similar to those for 65th Street as discussed above.

Surrounding land uses are industrial, and include a Sierra Spring Water Company warehouse on the southeast corner, warehouses on the west, and Coulter Steel and Forge on the northeast corner.

No reports of accidents at this crossing are included in the FRA Accident Database.

Figure 1-6
AT-GRADE CROSSING DIAGRAM



ROADWAY CHARACTERISTICS

GRADE CROSSING LAYOUTS AND ADJACENT INTERSECTION CONFIGURATION

All of the crossing angles between the roadway and rail lines are in the 60 to 90-degree category used by the FRA (non-skewed crossing). In fact, all of the three at-grade crossing roadways are perpendicular to the rail lines. All of the crossings have an adjacent intersection within 400 feet of the crossing. A rule of thumb in traffic planning is that a distance of 400 feet or more between a crossing and an adjacent intersection should be sufficient to prevent queuing of traffic extending from the crossing into the intersection. Where the distance is less than 400 feet and the adjacent intersection is signalized, some additional traffic studies might be merited in order to enhance safety at the intersection which could be affected by queue overspill. Because of the close proximity of intersections to the rail crossing in Emeryville, there is also concern for the potential of traffic stopped on the tracks due to red lights. Table 1-3 summarizes these findings.

Table 1-3: Crossing Layout and Adjacent Intersection Configuration

Cross Street Name	Smallest Crossing Angle	Adjacent Intersection within 400'	Adjacent Intersection Signalized
65th Street	60-90	Yes	Yes
66th Street	60-90	Yes	No
67th Street	60-90	Yes	No

MOTOR VEHICLE TRAFFIC AND DELAY

Vehicle traffic at the crossings is relatively low for an urbanized area (especially at the 66th Street and 67th Street crossings), and the crossings operate at acceptable levels-of-service. Average Daily Traffic and Level-of-Service for each crossing is shown in Table 1-4. Primary traffic generators in the area include Interstate 80 on/off-ramps to Shellmound (eastbound direction only), EmeryBay Public Market and United Artists movie complex, and adjacent office and residential development. To a lesser extent, the retail establishments at the Powell Street Plaza and Bay Street centers will generate traffic in the area.

The analysis methodology used to evaluate vehicular traffic delays and queuing at the study area crossings has been taken from the National Cooperative Highway Research Program (NCHRP) Report 288, *Evaluating Grade-Separated Rail and Highway Crossing Alternatives*, published by the Transportation Research Board, National Research Council, Washington D.C., in 1987. See Appendix A, Section IV, pages 34 through 36. Additional methodology information was obtained from the Transportation Research Record (TRR) 1754, Paper No. 01-3051, *Methodology for Evaluating Highway-Railway Grade Separations*, Washington D.C., 2001, pp. 77-80. A summary of the methodology as it has been applied to this study can be found in Appendix B of this report.

The findings show that the average delay for each vehicle that was delayed due to train movements was between 3.0 and 3.6 minutes. Time of delay averaged over total traffic using the crossing ranged from 16.4 to 20.0 seconds. The average queue length of motor vehicles stopped at the crossing was calculated at 2 cars per lane at 65th Street due to a train movement and a queue of 1 car for 66th and 67th Streets.

Table 1-4: Average Daily Traffic, Level-of-Service, Queuing and Delay

Cross Street Name	Average Daily Traffic	Level-of-Service	Average Delay for each Vehicle Delayed (minutes)	Average Delay per Vehicle (seconds)	Average Queue Length per Lane (feet)
65th Street	5,400	C	3.6	20.0	45
66th Street	2,100	C	3.2	17.1	10
67th Street	2,200	C	3.0	16.4	15

Source: Adavant Consulting, 2008

PEDESTRIAN/BICYCLE TRAFFIC

As previously mentioned, there are numerous bicycle facilities in the vicinity of the grade crossings. Shellmound Street and 65th Street are striped with bicycle lanes, and Overland Avenue is designated as a bicycle boulevard. To the north, Shellmound Street provides a connection through Aquatic Park to the Bay Trail and Berkeley Marina via the Berkeley pedestrian/bicycle overpass of Interstate 80. To the south, Shellmound Street provides a connection to Oakland via 40th Street, and Overland Avenue connects to Mandela Parkway. Because there are few east/west roadways that are bicycle-friendly, these three roadways (and particularly 65th Street) will carry significant bicycle traffic. The proximity of residential development to the attractions of Aquatic Park and EmeryBay Public Market will also attract pedestrian traffic through the at-grade crossings.

Observations during a recent Monday holiday (February 18, 2008-President's Day) substantiate the expectation that these crossings may carry significant bicycle and pedestrian traffic. Counts taken for a 45-minute period on this day between 2:30 – 3:15 p.m. found that 25 pedestrians and 17 bicyclists crossed at 65th Street. To determine the level of pedestrian and bicycle activity, a more formal study of bicycle and pedestrian traffic was conducted at the three crossings to provide the CPUC with a complete picture of activity at these crossings in assessing the potential for implementation of a quiet zone in Emeryville.

Pedestrian and bicycle counts were taken at the three crossings during the weekday PM peak period (3:30 p.m. – 6:30 p.m.) and during the weekend midday (Saturday from 11:15 a.m. – 1:15 p.m.). The findings are summarized below in Table 1-5 and show, as expected, that 65th Street carries the bulk of the pedestrian and bicycle traffic across the rail corridor. At the 65th Street crossing during the PM peak period, pedestrian volumes ranged from 30 to 50 pedestrians per hour; bicyclists were counted at the rate of 10 to 25 bicyclists per hour. Volumes at 66th and 67th Streets were similar with as many as 10 bicyclists and 10 pedestrians per hour.

Table 1-5: Pedestrian and Bicycle Traffic at the Grade Crossings

Cross Street	Weekday PM Peak Period (3:30 p.m. – 6:30 p.m.)				Weekend (Saturday) Midday Period (11:15 a.m. – 1:15 p.m.)			
	Total Volume		Peak Hour Volume		Total Volume		Peak Hour Volume	
	Peds	Bikes	Peds	Bikes	Peds	Bikes	Peds	Bikes
65th Street	111	54	49	26	39	33	22	19
66th Street	18	18	9	10	12	10	8	9
67th Street	17	12	9	9	11	10	7	8

Source: Wilbur Smith Associates, 2008. Weekday counts taken on Tuesday, March 4, 2008. Weekend counts taken on Saturday, March 8, 2008.

RAILROAD TRAFFIC

There are no rail traffic generators in the immediate vicinity of the three at-grade crossings. Industrial plants that once had on-site rail service have relocated or closed. The Port of Oakland is a significant origin and destination for rail traffic. It is located several miles southwest of the Emeryville crossings.

CHAPTER 2: FUTURE CONDITIONS

FUTURE POPULATION AND EMPLOYMENT

According to Association of Bay Area Government (ABAG) projections reported in the City's General Plan Update Opportunities and Challenges Report (January 2006, Revised), Emeryville's population in 2005 was reported at 8,000. By 2030, this population is projected grow 44 percent to reach 11,500. The Update listed the City's central Bay Area location, easy access to Interstate freeways, and the conversion of former industrial properties into high-density residential development as driving factors to the City's projected residential growth.

The ABAG projections also point to employment growth in the City, albeit at a slower rate. The General Plan Update cited Emeryville's employment in 2005 as 20,140. By 2030, this employment is projected to grow 10 percent to reach 22,220.

With more residents and more employment in the City, motor vehicle traffic crossing the UP tracks in Emeryville can be expected to increase. In addition, a larger population of residents and employees in the City can be expected to be impacted by train horn noise.

LAND USE CHANGES

Existing land uses in the vicinity of the three crossings consist of high-density residential (60-70 dwelling units per acre), office, public/institutional, light industrial and industrial uses.

The industrial and light industrial uses along both sides of 67th Street and along the north side of 66th Street, and the office and public institutional uses on west side of Shellmound Street north of 65th Street are identified in the General Plan Update as areas of potential future land use change. The area, comprising the northwestern most section of the City, has been suggested for an industrial enclave or eco-park, according to the Update.

POTENTIAL FUTURE DEVELOPMENT

It is worth noting that a redevelopment plan for the EmeryBay Pubic Market Area has been proposed. This project, labeled the Marketplace Redevelopment, is bordered generally by 64th Street to the north, Shellmound Street and UP's tracks to the east, the Woodfin Suites Hotel to the south, and Christie Avenue to the west. The redevelopment would include new residential, office, retail, and mixed land uses. If realized, it will become a more significant traffic generator than what exists today, potentially producing higher motor vehicle, bicycle and pedestrian traffic over the 65th, 66th, and 67th Street at-grade rail crossings. In particular, the Final Environmental Impact Report, adopted January 2008, identified

that without the Marketplace Redevelopment project, the Shellmound Street/65th Street and the Overland/65th Street intersections (operating as a single intersection with the rail crossing in between) is projected in 2030 to operate at level-of-service F with an overall average delay of 96 seconds during the PM peak hour. It was noted that the intersection "would experience deficient operations when a train crosses over 65th Street".[1] With the addition of project trips, the overall average delay at the intersection would increase by 6 seconds. The FEIR has recommended signal modifications to improve overall intersection operations to level-of-service E in the PM peak hour in 2030 reducing the impact to a less-than-significant level.

FUTURE RAILROAD OPERATIONS

It is estimated that the total number of trains per day through Emeryville in Year 2030 will increase to 106 from the existing train traffic of 74 trains per day. This volume would consist almost equally of freight and passenger trains. The primary driver of freight rail traffic is likely to continue to be Trans Pacific container volumes traveling on UP and BNSF trains between the Port of Oakland and Midwestern and Southern cities. Amtrak California trains, the *Capitols* and the *San Joaquins*, are also likely to grow, in light of chronic congestion on I-80 and growing travel demand between the Bay Area and the Central Valley cities served by these trains.

Chapter 1 notes that future plans for the corridor include rebuilding of the westernmost freight service track to function as a third main track. This improvement would facilitate train operations given the overall 43 percent increase in rail traffic in 2030.

FREIGHT OPERATIONS

This analysis assumes that freight rail traffic on the UP Martinez Subdivision through Emeryville will grow on the order of 2 to 3 percent annually until 2030[2]. This rate of growth is consistent with the historic growth in the national economy. Future train volume in 2030 is therefore assumed to be in the neighborhood of 50 trains per day, versus about 30 today. Characteristics of this train traffic – train length and typical speeds – are not expected to change from what is experienced today.

1 *Marketplace Redevelopment Project EIR*, Executive Summary, June 2007, LSA Assoiates.
2 Annual growth is assumed to be 3 percent in the near term, tapering off in the longer term.

PASSENGER OPERATIONS – AMTRAK

Any major growth in Amtrak California trains, the *Capitols* and the *San Joaquins*, operating through Emeryville is subject to negotiation with UP. Caltrans, the sponsor for these trains, must come to an agreement with UP regarding future trains beyond the a single additional *San Joaquin* round trip (two trains) allowed under the current agreement, and UP can be counted on requiring expensive capacity enhancements to its lines before allowing more trains. Still, these trains are popular, and their ridership is high. As the Central Valley cities served by these trains are likely to experience strong job and population growth, travel demand from the Bay Area to these cities is likely to grow as well. Therefore, it is probable that Caltrans will seek to expand its train volumes. This study assumes passenger train volume in 2030 would be in the neighborhood of 56 trains per day, versus the 44 operating today. Characteristics of this train traffic – train length and typical speeds – would be the same as today. No increase is expected in Amtrak long distance train services – the *Coast Starlight* or *California Zephyr* trains.

FUTURE VEHICULAR TRAFFIC CONDITIONS AT CROSSINGS

To determine likely future traffic conditions in the study area, future vehicle traffic for Year 2030 was calculated for the at-grade crossings using output from the Alameda County Congestion Management Agency (ACCMA) model. The highway network in the AC CMA model includes major streets and arterials in Emeryville, such as Powell, Hollis, Shellmound and 65th Streets, but those not include minor streets such as 66th and 67th Streets, thus, it was necessary to develop a growth factor to estimate future motor vehicle traffic at the crossings. To accomplish this, a comparison of daily, AM peak hour and PM peak hour link volumes from the AC CMA model for Year 2005 and Year 2030 was made for the roadways surrounding the study area. An average annual growth rate of 2.0 percent resulted from this analysis. This growth factor was applied to the existing AADT obtained in the field from traffic counts to arrive at future 2030 AADT as shown below in Table 2-1. These future AADT estimates cannot account for potential reassignment of local traffic among the three streets that may be caused by differences in vehicle delay at the crossings. Detailed calculation sheets for this analysis and the calculation of LOS, delay and queuing can be found in Appendix B.

The future AADT was used to evaluate vehicle traffic delays and queuing at the study area crossings using the same traffic analysis methodology as applied for existing conditions. This methodology considered the increase in roadway traffic as well as train traffic. The findings show that the average delay for each vehicle that was delayed due to train movements was between 3.6 and 6.9 minutes having an increase of about 20 to 90 percent over existing conditions. Time of delay averaged over total traffic using the crossing ranged from 31 seconds to 59 seconds representing an increase of almost 200 percent at 65th Street and about 90 percent at the other two crossings. The average queue length of motor vehicles stopped at the crossing was calculated at approximately eight to nine cars at 65th Street due to a

train movement and a queue of two cars for 66th and 67th Streets. Under Future 2030 conditions, the crossing at 65th Street will operate at LOS E; the crossings at 66th and 67th Streets will operate at LOS D.

Table 2-1: Average Daily Traffic, Level-of-Service, Queuing and Delay Existing and Future 2030 Conditions

Cross Street Name	Annual Average Daily Traffic	Level-of-Service	Average Delay for each Vehicle Delayed (minutes)	Average Delay per Vehicle (seconds)	Average Queue Length per Lane (feet)
65th Street					
Existing	5,400	C	3.6	20.0	45
Future[3]	8,500	E	6.9	59.3	210
66th Street					
Existing	2,100	C	3.2	17.1	10
Future[3]	3,300	D	3.8	32.7	35
67th Street					
Existing	2,200	C	3.0	16.4	15
Future[3]	3,500	D	3.6	30.9	45

Source: Adavant Consulting, 2008

[3] Future daily traffic volume estimates shown in this table are based in the Alameda County CMA travel demand forecasting model which cannot account for potential reassignment of local traffic among the three streets that may be caused by differences in vehicle delay at the crossings.

CHAPTER 3: PERFORMANCE OF THE QUIET ZONE

The purpose of this analysis is to identify the potential for a quiet zone in the City of Emeryville. A quiet zone is defined as a segment of rail line encompassing one or more consecutive public highway-rail grade crossings at which routine sounding of locomotive horns is restricted pursuant to 49 CFR Part 222. Quiet zones which were established before October 9, 1996 and continued to be in operation on December 18, 2003 are defined as Pre-Rule Quiet Zones. Intermediate Quiet Zones were placed in operation between these two dates. As no quiet zone currently exists in Emeryville, any quiet zone established in the City would be considered a New Quiet Zone.

The process for creating a new quiet zone as defined by the Federal Railroad Administration (FRA) is attached in Appendix C. There are three measurements of risk used in the calculation of a quiet zone. They are:

- The Nationwide Significant Risk Threshold (NSRT), which is calculated on a nationwide basis. The NSRT reflects the average level of risk at public highway-rail grade crossings equipped with flashing lights and gates and at which locomotive horns are sounded.
- The Risk Index with Horns (RIWH), which is a measure of risk to the motoring public when locomotive horns are routinely sounded at every public highway-rail grade crossing within a quiet zone.
- The Quiet Zone Risk Index (QZRI), which is the average risk index for all public crossings in a proposed quiet zone taking into consideration the increased risk caused by the absence of train horns and any decrease in risk attributable to the use of supplementary or alternative safety measures (discussed below) . The QZRI is the measurement used to determine if a quiet zone can be established and which, if any, improvements will be necessary.

These measurements of risk are calculated using the FRA's Quiet Zone Calculator. The process for running the Calculator is described in the Methodology discussion below. A quiet zone may be established if the QZRI is at, or below, the NSRT. The QZRI may be reduced by implementation of supplementary safety measures (SSMs), which include temporary or permanent street closures, one-way streets equipped with gates that fully block the street, four-quadrant gates, and two-quadrant gates with medians or channelization devices. If SSMs are added to every public crossing within the quiet zone, the quiet zone is qualified and can be designated by the local public authority having jurisdiction over traffic enforcement following proper notifications and installation of signage. In the case of this study, the designating agency is the City of Emeryville.

If SSMs are used at some but not every public crossing, the zone may also qualify for quiet zone status if the QZRI is lower than either the RIWH or the NSRT.

The QZRI may also be reduced by implementing one or more alternative safety measures (ASMs) which include modified SSMs (an SSM which has been modified to accommodate the unique characteristics of

the crossing), engineering ASMs (engineering improvements other than modified SSMs which address underlying geometric conditions which are a source of increased risk at the crossing), and non-engineering ASMs (public education programs, photo enforcement, or engineering measures that reduce risks).

The following summary analysis focuses on four concepts for a New Quiet Zone in the study area. The study area consists of Union Pacific Railroad (UP) track between 65th Street on the south and 67th Street on north. The three UP crossings at 65th, 66th and 67th Streets are the only at-grade crossings in Emeryville. Within this area, the study team employed a combination of SSMs and modified SSMs to generate a QZRI which was below the NSRT. A temporary or permanent street closure was not considered in these concepts as it was felt that a closure would negatively impact local businesses.

METHODOLOGY

The study team first inventoried all three crossings in the study area. The team visited each crossing early in 2008 and captured detail on the crossing characteristics, e.g. warning devices, number of railroad tracks, number of roadway lanes, paving status, and pavement markings pertaining to crossings. The team photographed each crossing. The team supplemented this detail with information on the number and speed of trains obtained from available documents. 24-hour hose counts were taken at the grade crossing locations in January 2008 to measure average daily traffic. Future traffic volumes were generated from output of the Alameda County Congestion Management model (see Chapter 2). The team relied on accident history provided through the FRA Highway-Rail Grade Crossing Accident/Incident Reports. This data, to be used in the FRA Quiet Zone Calculator, was combined into the Emeryville Railroad Crossing Database. The summary products of this effort can be found in Chapter 1: Existing Conditions and Chapter 2: Future Conditions.

The team also obtained demographic information available from the 2000 U.S. Census and other available sources, reviewed the City's General Plan Update and other development plans, and developed motor vehicle and train traffic estimates for 2030. The summary product of this effort can be found in Chapter 2: Future Conditions.

The goal of these efforts was to capture the detail required for running of the FRA's Quiet Zone Calculator for both existing and future conditions. This calculator develops the QZRI by first assessing the risk at each crossing and then by averaging the cumulative risk over the number of crossings in a quiet zone. The calculator determines the risk at each crossing given 10 variables:

1. Type of warning device
2. Number of vehicles per day
3. Number of trains per day
4. Number of trains per daylight hours
5. Number of tracks
6. Paved roadway: yes or no
7. Maximum train speeds
8. Number of highway lanes
9. Number of years for accident analysis
10. Number of accidents during analysis years

The study team entered the first eight variables. The calculator provides the latter two variables from a link with other FRA data. Ultimately, the team identified four potential scenarios for establishing a quiet zone in Emeryville.

QUIET ZONE CONCEPTS

SCENARIO 1

This concept assumes that the existing two-quadrant gates and lights are upgraded to four-quadrant gates and lights at all three crossings. The installation of four-quadrant gates would include a Vehicle Presence System, which will permit vehicles inside a crossing to clear the crossing before gates come down. A schematic of Scenario 1 is presented in Figure 3-1 at the end of this analysis.

SCENARIO 2

This concept assumes 66th Street and 67th Street are turned into a one-way couplet, with 66th Street serving eastbound traffic and 67th Street serving westbound traffic.[1] In this scenario, two-quadrant gates are assumed for both lanes of 66th Street west of the UP tracks and for both lanes of 67th Street east of the UP tracks. 65th Street would be protected by four-quadrant gates. A schematic of Scenario 2 is shown in Figure 3-2 at the end of this analysis.

SCENARIO 3

This concept assumes two-quadrant gates on both lanes of 66th Street west of the tracks, along with a median and a gate across the westbound lane of 66th Street east of the tracks. This three-quadrant plus median arrangement is assumed for 67th Street as well. 65th Street would be protected by four-quadrant gates. It should be noted, this exact scenario cannot be tested with the calculator. Rather, the study team used a scenario of two-quad gates and non-traversable medians on both sides of the UP tracks as a surrogate. A schematic of Scenario 3 is included in Figure 3-3 at the end of this analysis.

SCENARIO 4

This concept assumes four-quadrant gates on 65th and 66th Streets, but no improvements to 67th Street. A schematic of Scenario 4 appears as Figure 3-4 at the end of this analysis.

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[1] A traffic count on April 25, 2008, revealed that the predominant travel direction for both 66th and 67th Streets during the PM peak period is westbound, with the westbound traffic turning right onto Shellmound Street to access I-80 northbound. Of the two streets, 67th ***has more 50 percent more of this traffic***. Only a quarter of 67th Street volume turned left onto Shellmound during this period. Accordingly, a one-way couplet, with 66th Street eastbound and 67th Street westbound, is the practical concept.

QUIET ZONE UNDER EXISTING CONDITIONS

Table 3-1 presents the calculation of QZRI for each of the three crossings of the Emeryville quiet zone under existing conditions based upon the existing warning devices and existing train and motor vehicle volumes. The table identifies the crossings in the zone, the AADT, the trains per day, and the type of warning device in place. The resulting QZRI is well above the current NSRT of 19,047.00 – a figure provided by FRA. Accordingly, the crossings as they exist today would not be eligible for consideration as a quiet zone.

Table 3-1: Emeryville Quiet Zone Risk Index
No Improvements – Existing Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	5,400	74	2-quad gates	As is	59,834.55
751152U	66th St.	2,100	74	2-quad gates	As is	47,513.92
751154H	67th St.	2,200	74	2-quad gates	As is	45,291.25
					QZRI	**50,879.90**

Tables 3.2 to 3.5 summarize the calculation of QZRI for each of the four potential quiet zone scenarios under existing conditions. Each scenario results in a QZRI figure well below the aforementioned NSRT and RIWH figures.

It should be noted that 49 CFR Part 222.39 specifies that a "quiet zone may be established by implementing, at every public highway-rail grade crossing within a quiet zone, one or more SSMs…" Scenarios 1 through 3 do so, and if implemented as envisioned, FRA approval of a quiet zone is not even required. In follows then that the calculations below are not required for establishment of a quiet zone, since the FRA considers these SSMs, deployed at all quiet zone crossings, sufficient to lowering the risk of train-motor vehicle accidents below the NSRT.[2] Still, the calculations are illustrative of the degree to which the SSMs lower risk. Also, they provide a means of comparing one scenario versus another. As Scenario 4 does not assume SSMs implemented at all three crossings, it did require running the calculator to determine whether or not it was below either the NSRT or the RIWH. Once this scenario's envisioned improvements at 65th and 66th Streets are done, FRA approval also is not required.

[2] 49 CFR 222 Appendix C Section 1B.

Table 3-2: Emeryville Quiet Zone Risk Index
Scenario 1 – Existing Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	5,400	74	2-quad gates	4-quad gates	13,761.95
751152U	66th St.	2,100	74	2-quad gates	4-quad gates	10,928.20
751154H	67th St.	2,200	74	2-quad gates	4-quad gates	10,416.99
					QZRI	**11,702.83**

Table 3-3: Emeryville Quiet Zone Risk Index
Scenario 2 – Existing Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	5,400	74	2-quad gates	4-quad gates	13,761.95
751152U	66th St.	2,100	74	2-quad gates	2-quad gates on west; 1-wy EB	8,552.51
751154H	67th St.	2,200	74	2-quad gates	2-quad gates on east; 1-wy WB	8,152.42
					QZRI	**10,155.63**

Table 3-4: Emeryville Quiet Zone Risk Index
Scenario 3 – Existing Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	5,400	74	2-quad gates	4-quad gates	13,761.95
751152U	66th St.	2,100	74	2-quad gates	2-quad gates on west; gate and median on east	9,502.78
751154H	67th St.	2,200	74	2-quad gates	2-quad gates on west; gate and median on east	9,058.25
					QZRI	**10,774.33**

Table 3-5: Emeryville Quiet Zone Risk Index
Scenario 4 – Existing Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	5,400	74	2-quad gates	4-quad gates	13,761.95
751152U	66th St.	2,100	74	2-quad gates	4-quad gates	10,928.20
751154H	67th St.	2,200	74	2-quad gates	As is	45,291.25
					QZRI	**23,327.13**

Of Scenarios 1-3 which include installation of SSMs at each intersection, Scenario 1, with all four-quadrant gates and vehicle presence detection, has the highest resulting QZRI. The four-quadrant gate has a lower effectiveness rating than other SSMs "because motorists may learn to delay the lowering of the exit gates by driving onto the opposing lane of traffic immediately after an opposing car has driven over the grade crossing," according to federal regulations.[3] This fact would increase the potential for a crossing collision. Still it seems a reasonable safety precaution to have presence detection systems with four-quadrant gates so that motorists on the crossing when warning bells sound can clear the crossing without fear of a gate closing before them.

Scenario 3, suggests the use of non-traversable medians on the east side of the 66th and 67th Street crossings. This scenario is only realizable if the commercial property driveways within 60 feet of the gates could be closed or relocated. This is because, according to federal regulations, these driveways are considered intersections. As these driveways are in use today, and are likely to remain so for the near future, Scenario 3 does not seem a practical solution for Emeryville.

Scenario 4, which assumes four-quadrant gates on 65th and 66th Streets and no improvements on 67th Street, generates a QZRI below the RIWH figure of 30,503.54.

Thus, Scenarios 1, 2 and 4 would be more eligible for consideration for implementation of an Emeryville quiet zone in the near future.

[3] 49 CFR Part 222 Appendix A.

QUIET ZONE WITH FUTURE CONDITIONS

The four tables below summarize the calculation of QZRI for each of the four potential quiet zone concepts for Emeryville, given future conditions, that is, with train and motor vehicle traffic as they are estimated to be in 2030 based upon the analysis described in Chapter 2. The number of mainline tracks and other tracks is also a factor used by the Quiet Zone Calculator. As mentioned in earlier chapters, there are plans to increase the number of mainline tracks from the existing two tracks to either three or possibly four tracks in the future. Since these plans are still under consideration, the quiet zone scenarios under future conditions were calculated with the existing track configurations. However, each scenario was also tested with four mainline tracks. It was found that each scenario resulted in a QZRI figure well below the NSRT of 17,610.00 or the RIWH of 34,426.22 whether with two or four mainline tracks.

Table 3-6: Emeryville Quiet Zone Risk Index
Scenario 1 – Future Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	8.500	106	2-quad gates	4-quad gates	15,334.21
751152U	66th St.	3,300	106	2-quad gates	4-quad gates	12,426.28
751154H	67th St.	3,500	106	2-quad gates	4-quad gates	11,861.34
					QZRI	**13,207.28**

Table 3-7: Emeryville Quiet Zone Risk Index
Scenario 2 – Future Conditions

FRA X'ing	Street	AADT	Trains/Day	Warning Device	Improvement	Risk
751151M	65th St.	8.500	106	2-quad gates	4-quad gates	15,334.21
751152U	66th St.	3,300	106	2-quad gates	2-quad gates on west; 1-wy EB	9,724.92
751154H	67th St.	3,500	106	2-quad gates	2-quad gates on east; 1-wy WB	9,282.78
					QZRI	**11,447.30**

Table 3-8: Emeryville Quiet Zone Risk Index *Scenario 3 – Future Conditions*						
FRA X'ing	**Street**	**AADT**	**Trains/Day**	**Warning Device**	**Improvement**	**Risk**
751151M	65th St.	8.500	106	2-quad gates	4-quad gates	15,334.21
751152U	66th St.	3,300	106	2-quad gates	2-quad gates on west; gate and median on east	10,825.46
751154H	67th St.	3,500	106	2-quad gates	2-quad gates on west; gate and median on east	10,314.20
					QZRI	**12,151.29**

Table 3-9: Emeryville Quiet Zone Risk Index *Scenario 4 – Future Conditions*						
FRA X'ing	**Street**	**AADT**	**Trains/Day**	**Warning Device**	**Improvement**	**Risk**
751151M	65th St.	8.500	106	2-quad gates	4-quad gates	15,334.21
751152U	66th St.	3,300	106	2-quad gates	4-quad gates	12,426.28
751154H	67th St.	3,500	106	2-quad gates	As is	51,571.02
					QZRI	**26,443.84**

As with existing conditions, the QZRI figures for Scenarios 1 through 3 above are in a relatively tight range, with the high end well below the NSRT figure. Also, as with existing conditions, the highest QZRI figure of the three occurs with Scenario 1 (all four-quadrant gate concept); and the lowest with Scenario 2 (66th and 67th Streets as a one-way couplet). Scenario 4's QZRI is above the NSRT but below the RIWH.

As opposed to existing conditions, Scenario 3 might be realizable in the future. This is because 67th Street is identified in the City's General Plan Update as an area of potential land use change. If land uses shift from the existing industrial and light industrial uses, implementing a non-traversable median running east from the crossing gates could be possible.

Thus, Scenarios 1, 2, and 4 would be eligible for consideration for implementation of an Emeryville quiet zone in the future. Scenario 3 would also qualify given significant land use changes in the long-term.

CONCEPTUAL COST ESTIMATES

Appearing below are conceptual, order-of-magnitude capital and operating cost estimates for quiet zone improvements in Emeryville. Capital costs are stated on a per improvement basis. They are based on costs developed in the course of a recent rail line improvement study in Northern California.[4] Also included below are conceptual operating cost estimates for maintenance of quiet zones. These estimates were obtained from the UP Web site.

SCENARIO 1

This concept would require four-quadrant gates for 65th, 66th and 67th Streets. According to the UP Web site, a four-quadrant gate implementation could cost about $500,000. However, it is the study team's opinion that this cost is out-of-date. A realistic cost estimate for a new two-quadrant gate is $600,000. With a four-quadrant gate, the cost would be less than twice this figure, that is, more like $1 million. This is because, with a four-quadrant gate, there will be some economy as all four gates would be governed by one controlling device. Thus, an all four-quadrant gate solution at the three crossings should cost $3 million to construct.

An obvious question would be, why not use the existing gates and add to them as a way of lowering costs? While this seems reasonable enough, a conversation with a former UP civil engineer[5] revealed that the UP typically prefers all new warning device equipment when crossing configurations are modified. In an effort to be conservative, this report costs assuming all new warning devices.

SCENARIO 2

This concept would also require new warning devices at all three crossings including a new four-quadrant gate system on 65th Street ($1 million), two new gates on the west side of the 66th Street crossing ($600,000), and two new gates of the east side of the 67th Street crossing (600,000). Construction costs are estimated to be $2.2 million.

SCENARIO 3

This concept would require a new four-quadrant gate on 65th Street ($1 million) and three-quadrant gates on 66th and 67th Streets ($1.5 million) along with 60- to 100-foot non-traversable medians on the east side of the 66th and 67th Street crossings ($30,000). Construction costs for this scenario are estimated to be $2.53 million.

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4 *Service Expansion Analysis*, San Joaquin Regional Rail Authority, ongoing.

5 Per conversation with Richard Gonzalez, formerly of UP and now of J.L. Patterson and Associates, in early April, 2008.

SCENARIO 4

This concept would require new four-quadrant gates on 66th Street ($1 million) and 66th Street ($1 million). Construction costs are estimated at $2 million.

Table 3-10 cites the construction costs for all four scenarios and adds soft costs for engineering design and construction management (engineering) and for construction and engineering contingencies (contingencies). Of all scenario, Scenario 4 would be the least expensive to implement.

In addition to the capital costs of installing the quiet zone improvements, UP may insist that Emeryville cover their ongoing maintenance costs. UP estimates these at between $4,000 and $10,000 per warning quiet zone.

Table 3-10: Conceptual Cost Estimates for Quiet Zone Improvements (2008 Dollars)

Scenario	Improvement	Units	Unit Cost	Total
1	4-quad gates	3	1,000,000	3,000,000
	Construction Cost			*3,000,000*
	Engineering	15%		450,000
	Contingencies	30%		1,035,000
	Total Cost			*4,485,000*
2	4-quad gates	1	1,000,000	1,000,000
	2-quad gates	2	600,000	1,200,000
	Construction Cost			*2,200,000*
	Engineering	15%		330,000
	Contingencies	30%		759,000
	Total Cost			*3,289,000*
3	4-quad gates	1	1,000,000	1,000,000
	3-quad gates	2	750,000	1,500,000
	100' median	2	15,000	30,000
	Construction Cost			*2,530,000*
	Engineering	15%		379,500
	Contingencies	30%		872,850
	Total Cost			*3,782,350*
4	4-quad gates	2	1,000,000	2,000,000
	Construction Cost			*2,000,000*
	Engineering	15%		300,000
	Contingencies	30%		690,000
	Total Cost			*2,990,000*

CONSIDERATIONS FOR A PARTIAL QUIET ZONE

A partial quiet zone is a quiet zone in which locomotive horns are not routinely sounded at public grade crossings for a specified period of time each day. For a New Partial Quiet Zone, which would apply in the City of Emeryville, the quiet zone would be in effect during the hours of 10 p.m. and 7 a.m. Per the Code of Federal Regulations[6], "New Partial Quiet Zones must comply with all of the requirements for New Quiet Zones". Based upon this regulation, there would be no cost savings to implement a partial quiet zone. In addition, the land uses in operation during daytime hours, such as the EmeryTech office building and Expression College for Digital Arts, would continue to be impacted by train noise with a partial quiet zone. Hence, implementation of the partial quiet zone was not further investigated.

ASM APPLICATIONS

Discussed briefly above are various ASMs which can be used to lower the QZRI. Some of these solutions could be very specific to conditions at individual crossings as opposed to the standardized SSMs. Conceivably, these could lower total capital costs for implementation. However, these are not analyzed here for two reasons. First, their application would require the approval of the FRA and the acceptance by the railroads and especially by the California Public Utilities Commission (CPUC) which has jurisdiction over modifications to crossing configurations. Seeking the FRA's approval will lengthen the implementation timeline. Second, the less standardized the solutions may be, the more difficult it will be to acquire the acceptance of the railroads and the CPUC.

WAYSIDE HORNS

One alternative which obviates the need for trains to blow their horns at crossings is installations of automated train horns, also known as wayside horns. These horns are mounted on poles at crossings and directed down the cross streets away from crossings. If they are in place, locomotive engineers do not have to blow their horns at crossings, as the wayside horn will blow automatically as trains approach and accomplish the same task of warning drivers, pedestrians and bicyclists of the oncoming train. Cost and installation of the horns are minor compared to the cost of two-, three- and four-quadrant gates. With wayside horns, there is no requirement for new gates.

These horns, which can be incorporated in a quiet zone, would seem a good solution for 66th and 67th Streets, where they can be directed eastward from the crossings through the industrial and light industrial land uses at westbound approaching traffic. The difficulty arises with regard to the west side of these streets, where the distance from the gates to Shellmound Street is about 30-feet. To be effective, a total of six wayside horns on the west side of the two crossings could be required.

- 66th Street – One horn facing west from the 66th Street crossing, one facing north on Shellmound Street from 66th Street, and another facing south on Shellmound from 66th Street.

[6] 49 CFR Part 222 Appendix C.

- 67th Street – One horn facing west from the 67th Street crossing, one facing north on Shellmound Street from 67th Street, and another facing south on Shellmound from 67th Street.

The south facing horns would generate sound impacts to residents on the south side of 66th Street, and therefore would serve to counteract the purpose of a quiet zone. They are therefore not recommended here.

COMMENTS FROM THE CPUC AND FRA

The study team visited the proposed Emeryville quiet zone location on March 11, 2008 with representatives of the California Public Utilities Commission and the Federal Railroad Administration. The CPUC and the FRA share safety oversight responsibility for highway-rail at-grade crossings.

CPUC COMMENTS

Kevin Schumacher, of the CPUC's Rail Crossing Engineering Section (RCES), noted a few items that he felt needed consideration at this crossing. These were:

- *Sidewalk construction*. While signs and railings make clear that pedestrians are not to use the north side of the crossing, pedestrians do anyway.
- *Use of limited-service rather than all-flash-red under the railroad preemption hold phase*. This would permit north-south traffic to proceed on Shellmound Street when gates are down across the 65th Street crossing.
- *Review of turn prohibition sign operation.* These signs, which are to prevent right turns onto eastbound 65th Street from Shellmound Street, at times do not seem to work properly.
- *Review of railroad signal activation timing.* Signals appear to become activated at times when no train is approaching.
- *Relocation of the advance warning sign to improve signal visibility, if not done already.* Mr. Schumacher was referring to a CPUC suggestion to the City of Emeryville resulting from a 2007 CPUC site visit.
- *Improvement of the raised median configuration.*. There is a raised median on the east side of the crossing. This median is short, about 20 feet in length, and its shortness would appear to be of limited use in deterring westbound drivers seeking to drive down westbound gates. Mr. Schumacher feels the utility of this median regarding enhancing safety needs further review.

Referring to potential quiet zone improvements, Mr. Schumacher suggested that 66th Street and 67th Street be turned into a one-way couplet, which is utilized in Scenario 2.

As regards wayside horns, Mr. Schumacher said safety is reduced since train direction and the approach of a second-train cannot be determined based on a wayside horn. He noted that the quiet zone

calculations do not take wayside horns and their limitations into account. Since this urban corridor has had incidents related to the approach of second train from behind another, he felt the limitations of wayside horns must be considered. Wayside horns will reduce the geographic area affected by the train horns, but they will increase the duration and volume of the horns near roadway approaches to the crossing.

As noted above, the study team concludes that wayside horns are not a practical solution for Emeryville.

FRA COMMENTS

Also joining the study team that day was LeeAnn Dickson of the FRA. Ms. Dickson reiterated that the existence of a quiet zone does not preclude the ability of the locomotive engineer from blowing trains horns when the engineer feels it necessary to do so to ensure safety of pedestrians and motor vehicles at crossings. These instances of horn blowing are particular concerns in an urban area such as Emeryville where loitering on or near the tracks can be common and was indeed observed during the site visit.

Ms. Dickson also commented that wayside horns can replace the need for train horns to be sounded.

HORN BLOWING AT EMERYVILLE STATION

Implementation of a quiet zone in Emeryville will not result in an end to train horn blowing in the City. As noted in 49 CFP 222.23, "a locomotive engineer may sound the locomotive horn to provide a warning to animals, vehicle operators, pedestrians, trespassers or crews on other trains in an emergency situation if, in the locomotive engineer's sole judgment, such action is appropriate in order to prevent imminent injury, death, or property damage." It is not difficult to imagine that such instances requiring horn blowing will occur in the future as they do today, with or without a quiet zone. Ergo, horn blow can be expected.

Also, prior to proceeding from a stop at the Emeryville Station, a passenger train locomotive engineer will continue to blow his train horn, as specified in Section 5.8.2 per the General Code of Operating Rules adhered to by Amtrak, UP and most other North American railroads. Considering that the 65th Street crossing is about 0.3 miles from the Emeryville Station, the study area will continue to be affected by these horns.

Nevertheless, neither passenger trains nor freight trains will be required by federal statute (49 CFR 222.21) to blow their horns through the three Emeryville crossings. That means that the 74 trains today and an anticipated 106 trains by 2030 will not sound their horns while crossing 65th, 66th and 67th Streets. As a result, Emeryville will be that much quieter a place.

Figure 3-1
QUIET ZONE IMPROVEMENTS - SCENARIO 1

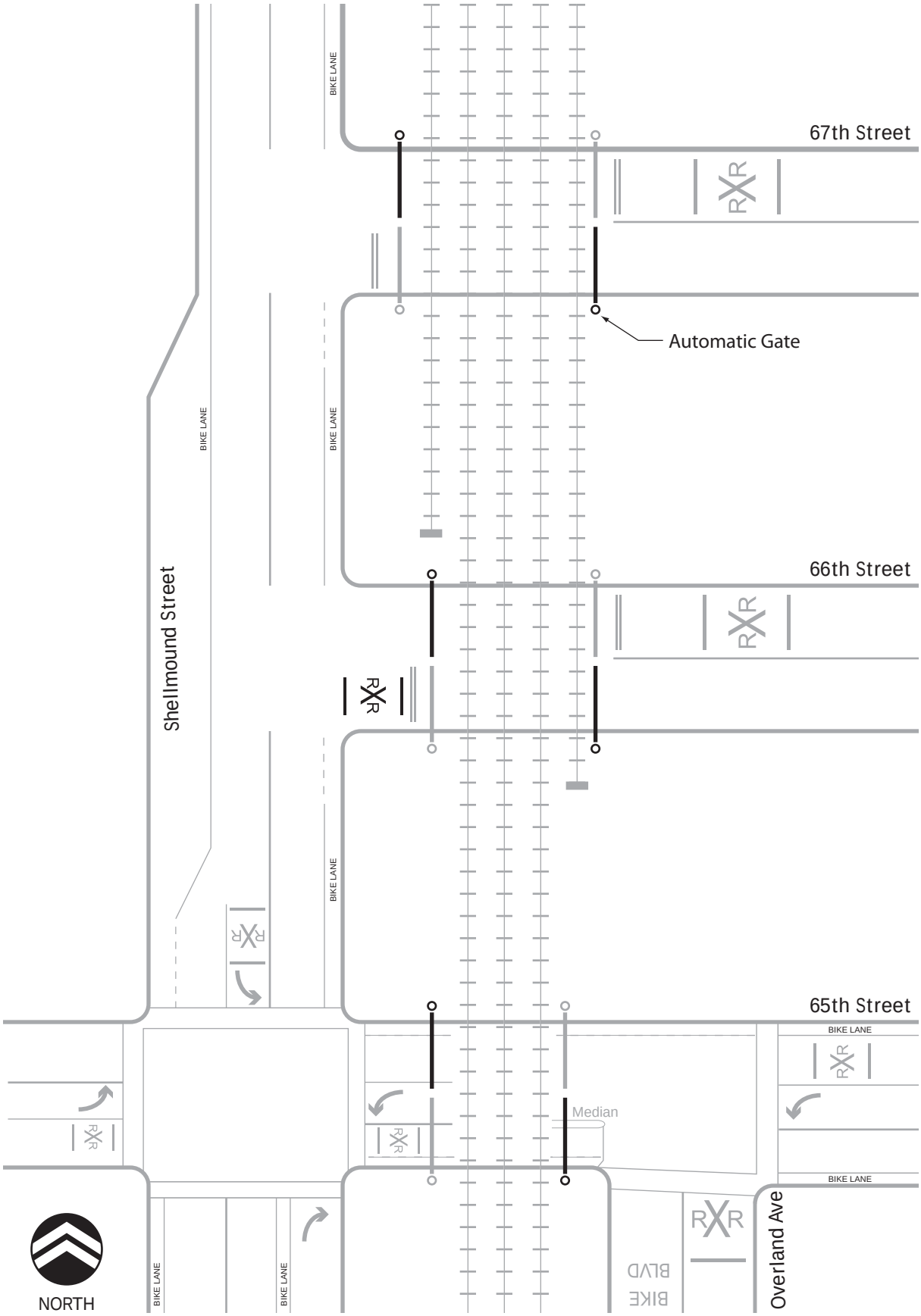


Figure 3-2
QUIET ZONE IMPROVEMENTS - SCENARIO 2

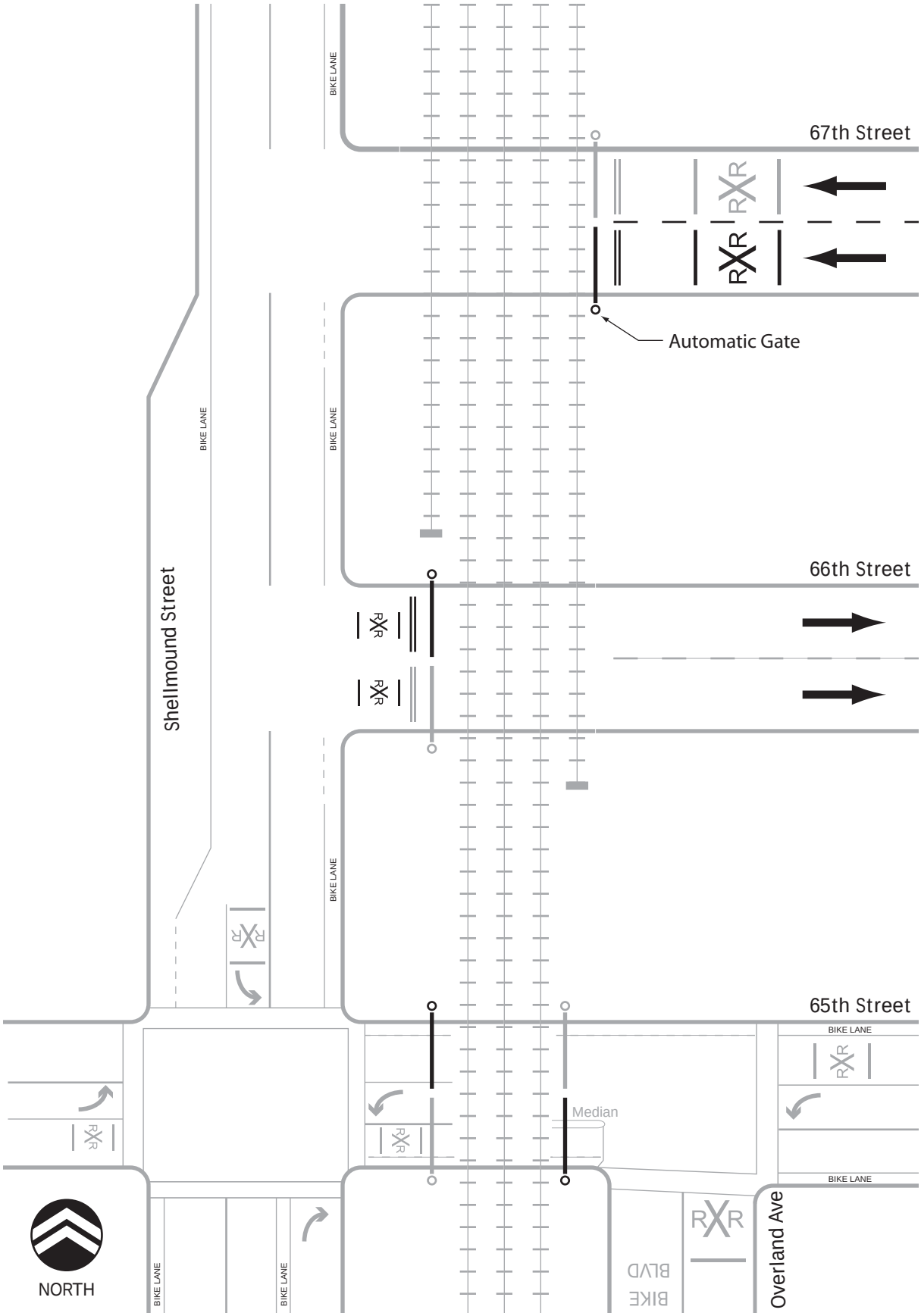


Figure 3-3
QUIET ZONE IMPROVEMENTS - SCENARIO 3

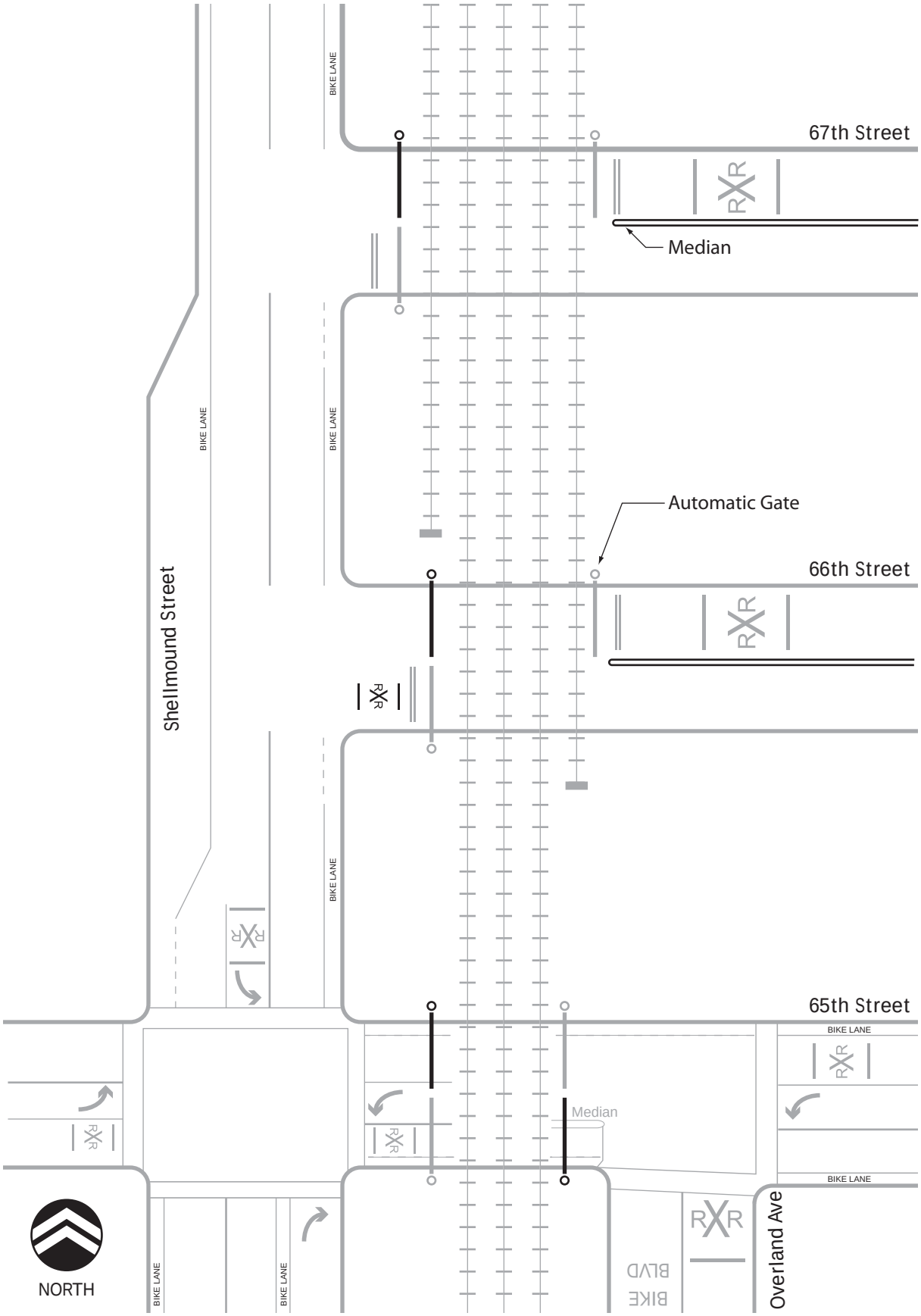
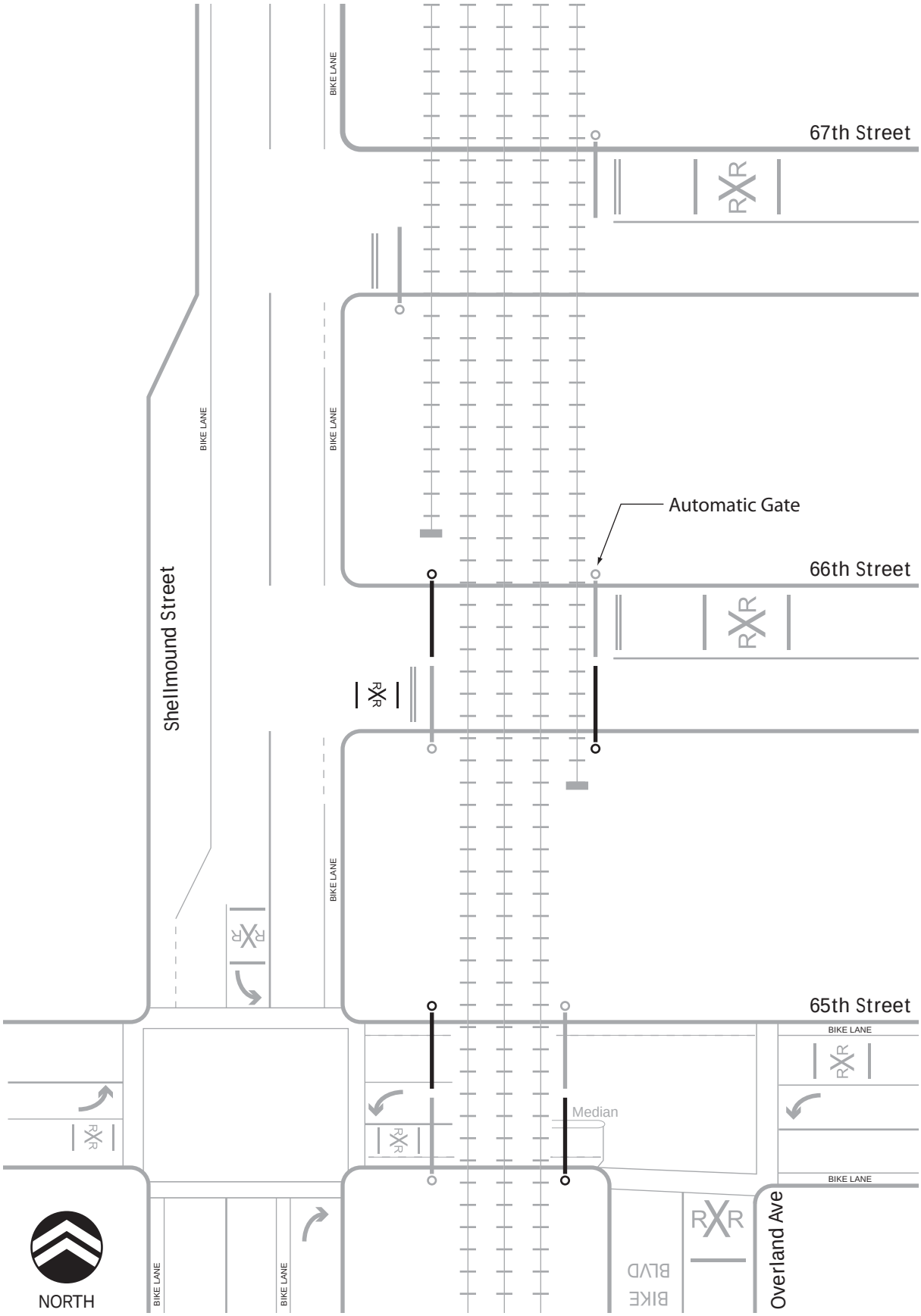


Figure 3-4
QUIET ZONE IMPROVEMENTS - SCENARIO 4



CHAPTER 4: NEXT STEPS

Chapter 3 indicated that all four scenarios were feasible. That is to say, Scenarios 1, 2, and 3 assumed SSMs at all crossings, and Scenario 4 had a QZRI lower than its RIWH under both existing and future conditions. Thus, any of the four would appear to be implementable without the approval of the FRA. Two questions then remain. First, which concept makes the most sense? And second, what are the next steps toward implementation of an Emeryville quiet zone?

EVALUATION OF ALTERNATIVES

Presented below is one approach to finding an answer to the first question. The study team evaluated the four alternatives on five criteria. These were overall safety, pedestrian safety, cost, local impact, and review requirements. The alternatives were assigned a score of between 3 and 1, with 3 representing optimum performance on a particular criterion. The results appear in Table 4-1.

Table 4-1: Evaluation of Quiet Zone Scenarios

Criteria	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Overall Safety	3	3	3	1
Pedestrian Safety	3	2	2	1
Capital Cost	2	3	2	3
Local Impact	3	2	3	3
FRA Review Requirements	3	3	3	2
Total	14	13	13	10

OVERALL SAFETY

Scenarios 1, 2, and 3, all with SSMs in place at the three crossings, have far lower QZRI figures than does Scenario 4, with SSMs at just two crossings. Thus, 1, 2, and 3 receive higher scores on this criterion. It is recognized that Scenario 2 will require a change in driver behavior. Drivers who exit northbound I-80 and use 67th Street to cross the UP tracks from Shellmound Street will need to use 66th Street instead. To prevent these drivers from turning east across 67th Street, extensive "one-way" and "no left turn" signage likely will be required to enhance safety there.

PEDESTRIAN SAFETY

Four-quadrant gates would be installed in such as way to come down across both sidewalks and traffic lanes, thereby deterring pedestrians from entering crossings more effectively than the other scenarios where the automatic gates are installed only on one side of the crossing. Thus, Scenario 1 is superior to all other options on this criterion. Scenario 4, which has no SSMs on 67th Street and where the gates do not fully block the pedestrians' pathways, is inferior to the other options on this criterion.

CAPITAL COST

Costs for implementing Scenarios 2 and 4 are close, each around $3 million. Costs for Scenarios 1 and 3, each requiring more extensive modifications, are higher. Thus, Scenarios 2 and 4 score better on this criterion.

LOCAL IMPACT

With a one-way couplet involving 66th and 67th Street, Scenario 2 would change local traffic patterns on these two crossings and approaches. The other three scenarios would require no changes to existing patterns. Thus, 1, 3, and 4 receive higher scores on this criterion.

FRA REVIEW REQUIREMENTS

While none of the scenarios would trigger a need for annual review by the FRA, there are still periodic reporting requirements. With SSMs installed at each crossing, Scenarios 1, 2, and 3 would trigger have less onerous reporting requirements than Scenario 4. Emeryville would have to provide the FRA an updated crossing inventory form every 4.5 to 5 years with these scenarios. On the other hand, Emeryville would have to provide the FRA with an updated form every 2.5 to 3 years with Scenario 4.

SUMMARY EVALUATION

By the evaluation method utilized above, the first three scenarios, assuming SSMs at all three crossings, appear the clear winners, with Scenario 1 having a slight advantage over Scenarios 2 and 3. As noted in Chapter 3, Scenario 3 appears impractical, given the current land uses. Accordingly, the choice boils down to Scenarios 1 and 2, that is, to a question of what may be more important: capital cost or impact on existing travel patterns.

As land uses along 66th and 67th Streets are either industrial or light industrial, truck access from both directions would appear very important, as this is what businesses along these streets enjoy today. It is likely, therefore, that the business would resist an attempt to change the traffic patterns on these streets. Thus, the City may in the end be left with just Scenario 1.

NEXT STEPS

If the City of Emeryville seeks to move forward with any of the scenarios, the first requirement will be to provide a Notice of Intent to create a new quiet zone, which will trigger a 60-day comment period. The Notice of Intent will need to be provided to the railroads that would operate through the quiet zone and to the CPUC for their comment. The railroads and the CPUC have 60 days to submit comments.

The Notice of Intent must include five items:

1. A listing of each crossing in the quiet zone.
2. A statement of the time period within which horn blowing restrictions would apply (i.e. 24 hours a day)
3. A brief explanation of Emeryville's tentative plans for implementing improvements within the quiet zone.
4. The name and title of Emeryville's contact person for the quiet zone project.
5. A list of names and addresses of each party that will receive a copy of the Notice of Intent.

Emeryville will not be able to establish a quiet zone within the 60-day comment period unless the railroads and the CPUC waive their right to provide comment on the Notice of Intent.

After the 60-day comment period, Emeryville would be able to issue a Notice of Quiet Zone Establishment. The purpose of this notice is to provide a means for Emeryville to formally advise affected parties that a quiet zone is being established. The notices must be addressed to the railroads operating through the quiet zone, to the CPUC, and to the Assistant Administrator of the FRA. Just as for the Notice of Intent, there are numerous specific items which must be included, all cited in 49 CFR 222 Appendix C Section IV – Required Notifications.

Prior to the establishment of the quiet zone, the SSMs must be designed and installed. As the design is initiated, it is necessary to contact the CPUC to request "Staff for Authorization to Alter a Highway-Rail Crossing Pursuant to General Order 88-B". GO-88B requires CPUC staff to authorize changes "in the type or addition of an automatic signaling device, crossing gate, crossing flagman or other forms of crossing protection or reduction of hours during which any such protection is maintained, or other minor alterations."

The CPUC staff will provide information on the GO 88-B process, and advise on arranging a field diagnostic meeting to review proposed alterations to the crossings. The diagnostic meeting will then be held with all interested parties, namely the City of Emeryville, its consultants, CPUC, FRA and the railroads. Thus, it is advisable to seek direct input from the railroads and FRA at the initiation of the design phase.

The diagnostic team will evaluate the proposed modifications to the crossings and identify any other matters that should be addressed as part of the modifications proposed. The City and its consultants will

then be able to determine whether CPUC staff is in agreement with the proposed modifications and allow the other parties to form a basis for providing the required evidence of agreement.

After the field diagnostic meeting is held and modifications are generally agreed to, it is necessary to complete the GO 88-B authorization request form provided by the CPUC which among other things includes information about the applicant (the City of Emeryville), the crossing proposed to be altered, a description of the proposed alterations, a description of the public benefits to be achieved by the proposed alterations, an explanation about why a separation of grades is not practical, a description of the existing and proposed crossing warning devices, a statement of temporary traffic controls to be provided during construction and evidence of agreement among the interested parties.

After the approval is granted by the CPUC, construction of the improvements can be initiated. After construction an updated crossing inventory form with the description of the crossing devices and conditions needs to be provided to the FRA prior to the implementation of the quiet zone.

Once the quiet zone has been established, Emeryville will need to make periodic updates to the crossing inventory form to the FRA, as noted in the preceding section.

APPENDICES

Appendix A
At-Grade Crossing Inventory Report

Crossing Name: 65th Street

Project Number: 1

FRA No: 751151M

Railroad: Union Pacific Railroad

Milepost: 4.75

Crossing Information

Warning Device:	Automatic gate & flashing lights
No. of Tracks:	3
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	50 (passenger) - 40 (freight)

Land Use Information

Type of Development:	Residential/Office/Industrial

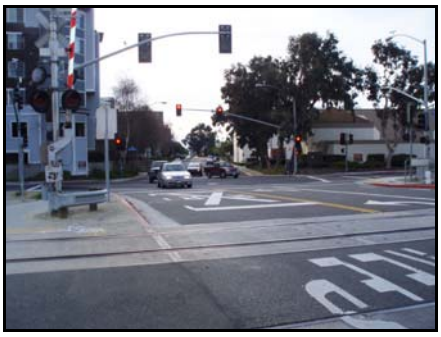
Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	5,400
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	Yes
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East



Highway Looking West

Crossing Surface:
concrete

Crossing Name: 66th Street

Project Number: 2

FRA No: 751152U

Railroad: Union Pacific Railroad

Milepost: 4.82

Crossing Information

Warning Device:	Automatic gate & flashing lights
No. of Tracks:	4
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	50 (passenger) - 40 (freight)

Land Use Information

Type of Development:	Industrial/Office

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	No
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	2,100
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:
concrete

Crossing Name: 67th Street

Project Number: 3

FRA No: 751154H

Railroad: Union Pacific Railroad

Milepost: 4.90

Crossing Information

Warning Device:	Automatic gate & flashing lights
No. of Tracks:	5
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	50 (passenger) - 40 (freight)

Land Use Information

Type of Development:	Industrial

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	No
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	2,200
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	0

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:
concrete

Appendix B
Queuing, LOS and Delay Analysis
Existing and Future Conditions

ASSUMPTIONS

ADT Growth Projections
Average annual growth rate from 2007 to 2030: 2.0% per year

Estimated train length
Local: 700 feet
Through: 5,000 feet

Gate down time (per train)
t= [Wt + [(3600 * (L+xw)) / (5280* Savg)]]/60

where: Wt = 40 represents the number of seconds the warning device is active; 25 sec before the train arrives and 15 sec after the train leaves
t = amount of time per train the crossing is closed (min.)
L = train length (feet)
xw = crossing width (feet)
Savg = average train speed at the crossing (mph)

Probability of delay per day
P = T / m

where: P = probabiliy of delay per day
T = total amount of time the crossing is closed during the day (min.)
m = 1,440 minutes in a day

Vehicles delayed per day
N = P * V

where: N = number of vehicles delayed per day
P = probability of delay per day
V = ADT

Duration of daily delay
D = [(T/2 + 0.167) * N + (N/n)^2] /3600

where: D = total delay per day (vehicle-hours)
N = number of vehicles delayed per day
n = number of highway lanes
(N/n)^2 = total delay from queue dissipation
T = total amount of time the crossing is closed during the day (min.)
(T/2 is the average delay per vehicle delayed by the train operation)
0.167 delay (in minutes, eq. 10 seconds) attributable to deceleration and acceleration and delay experienced while waiting for traffic to flow freely after the train has passed

Average delay for each vehicle delayed
A = 60 * D / N

where: A = average daily delay for each vehicle delayed (min./veh.)
D = total delay per day (vehicle-hours)
N = number of vehicles delayed per day

Average delay for all vehicles
a = 3600 * D / V

where: a = average daily delay per vehicle (sec./veh.)
D = total delay per day (vehicle-hours)
V = ADT

Level of service

Stopped delay per vehicle (sec)	Level of service
0.0	A
5.0	B
15.0	C
25.0	D
40.0	E
60.0	F

Average queue length per lane
Lq = (C * P * A * Vh) / 60

where: Lq = length of queue (feet)
C = average vehicle lengt 25 feet
P = probabiliy of delay per day
A = average daily delay for each vehicle delayed (min./veh.)
Vh = number of vehicles per hour per lane in the primary direction
Vh = (phf * V * Ds) / n * f
where:
phf = peak hour factor
V = ADT
Ds = directional split for primary direction
n = number of highway lanes for the primary direction

f = lane use adjustment factor

Source: HCM 2000, Table 10-23, p. 10-26

No. of lanes in lane group	Traffic in most heavily traveled lane	Lane utilization adjustment factor (f)
1	100.0%	1.000
2	52.5%	0.952
3	36.7%	0.908
4	30.0%	0.833

Table B: Vehicular Traffic, Delays, LOS and Queuing at Study Area Crossings

Xing No.	Mile Post Number	Cross Street Name	Crossing width (ft.)	No. of Highway Lanes	Average daily traffic	Peak Hour Factor (phf)	Direct. Split for primary direction (Ds)	Average Train Speed at the Crossing (mph)		Estimated average number of trains per day		Average gate down time per train (min.)		Probability of delays per day	Average no. of vehicles delayed per day	Average delay per day (veh-hours)	Average delay for each vehicle delayed (min./veh.)	Average delay per vehicle (sec./veh.)	Estimated Level of Service at the Crossing	Avg. veh, per hour per lane in the primary direction	Avg. queue length per lane (feet)
								Pax.	Freight	Pax.	Freight	Pax.	Freight								
YEAR 2007																					
751151M	4.75	65TH ST	45	2	5,400	10%	60%	35	25	44	30	1.0	3.0	9.2%	500	30	3.6	20.0	C	320	45
751152U	4.82	66TH ST	45	2	2,100	9%	55%	35	25	44	30	1.0	3.0	9.2%	190	10	3.2	17.1	C	100	10
751154H	4.90	67TH ST	45	2	2,200	11%	58%	35	25	44	30	1.0	3.0	9.2%	200	10	3.0	16.4	C	140	15
YEAR 2030																					
751151M	4.75	65TH ST	45	2	8,500	10%	60%	35	25	56	50	1.0	3.0	14.2%	1,210	140	6.9	**59.3**	**E**	510	210
751152U	4.82	66TH ST	45	2	3,300	9%	55%	35	25	56	50	1.0	3.0	14.2%	470	30	3.8	**32.7**	**D**	160	35
751154H	4.90	67TH ST	45	2	3,500	11%	58%	35	25	56	50	1.0	3.0	14.2%	500	30	3.6	**30.9**	**D**	220	45

Table 1 - Year 2005 and 2030
Daily, AM and PM Peak Hour Traffic Volumes

	Study Area Link Volumes from Alameda County CMA Model (vehicles)																	
	Year 2005									Year 2030								
Street Segment	Daily			AM Peak Hour			PM Peak Hour			Daily			AM Peak Hour			PM Peak Hour		
Powell	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Market to San Pablo	12,230	9,503	21,733	550	1,015	1,565	974	562	1,536	13,979	10,964	24,943	782	1,032	1,814	672	706	1,378
	11,120	8,339	19,459	413	941	1,354	905	455	1,360	12,993	9,917	22,910	645	985	1,630	617	577	1,194
San Pablo to Hollis	12,605	9,559	22,164	470	1,069	1,539	1,074	496	1,570	15,025	11,294	26,319	636	1,377	2,013	1,144	680	1,824
	12,558	9,484	22,042	424	1,048	1,472	1,056	461	1,517	14,944	11,177	26,121	600	1,369	1,969	1,134	652	1,786
	13,907	9,925	23,832	534	909	1,443	1,000	510	1,510	15,574	11,374	26,948	682	1,254	1,936	1,086	689	1,775
Hollis to Shellmound	16,050	11,761	27,811	630	1,128	1,758	1,347	665	2,012	18,921	13,503	32,424	799	1,524	2,323	1,527	830	2,357
	18,770	13,020	31,790	881	1,058	1,939	1,329	775	2,104	19,930	14,052	33,982	1,051	1,385	2,436	1,368	921	2,289
Shellmound to I-80	18,770	13,020	31,790	881	1,058	1,939	1,329	775	2,104	19,930	14,052	33,982	1,051	1,385	2,436	1,368	921	2,289
Street Segment Total	**116,010**	**84,611**	**200,621**	**4,783**	**8,226**	**13,009**	**9,014**	**4,699**	**13,713**	**131,296**	**96,333**	**227,629**	**6,246**	**10,311**	**16,557**	**8,916**	**5,976**	**14,892**
Alcatraz/65th	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Sacramento to San Pablo	2,283	1,664	3,947	207	180	387	157	216	373	5,693	1,904	7,597	604	704	1,308	596	333	929
	1,835	1,166	3,001	130	162	292	141	143	284	5,660	1,389	7,049	522	719	1,241	635	265	900
	1,157	600	1,757	77	115	192	101	97	198	4,828	737	5,565	455	692	1,147	573	178	751
San Pablo to Hollis	1,388	1,265	2,653	47	169	216	140	54	194	1,508	1,527	3,035	79	474	553	523	73	596
	820	1,442	2,262	62	81	143	66	104	170	1,375	1,649	3,024	96	397	493	452	83	535
Street Segment Total	**7,483**	**6,137**	**13,620**	**523**	**707**	**1,230**	**605**	**614**	**1,219**	**19,064**	**7,206**	**26,270**	**1,756**	**2,986**	**4,742**	**2,779**	**932**	**3,711**
65th St	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Hollis to Shellmound	3,617	4,625	8,242	100	377	477	280	348	628	4,721	5,518	10,239	336	577	913	424	346	770
	2,390	4,858	7,248	159	265	424	151	435	586	4,044	5,302	9,346	428	466	894	287	378	665
Shellmound to I-80	4,017	3,579	7,596	133	297	430	220	128	348	4,050	3,710	7,760	216	257	473	194	298	492
Street Segment Total	**10,024**	**13,062**	**23,086**	**392**	**939**	**1,331**	**651**	**911**	**1,562**	**12,815**	**14,530**	**27,345**	**980**	**1,300**	**2,280**	**905**	**1,022**	**1,927**
65 th St Link Total	**17,507**	**19,199**	**36,706**	**915**	**1,646**	**2,561**	**1,256**	**1,525**	**2,781**	**31,879**	**21,736**	**53,615**	**2,736**	**4,286**	**7,022**	**3,684**	**1,954**	**5,638**
Ashby	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Sacramento to San Pablo	12,354	15,785	28,139	713	1,121	1,834	1,415	861	2,276	13,886	23,456	37,342	849	1,744	2,593	1,801	904	2,705
	12,933	16,417	29,350	732	1,164	1,896	1,459	880	2,339	14,614	24,175	38,789	846	1,805	2,651	1,852	904	2,756
San Pablo to Hollis	11,805	14,841	26,646	412	1,049	1,461	1,709	736	2,445	18,620	17,394	36,014	950	1,222	2,172	1,630	1,414	3,044
	11,285	14,317	25,602	407	999	1,406	1,665	729	2,394	18,050	16,823	34,873	968	1,160	2,128	1,580	1,429	3,009
Hollis to Shellmound	12,458	15,072	27,530	693	740	1,433	1,493	948	2,441	18,310	16,367	34,677	1,190	959	2,149	1,560	1,490	3,050
	12,511	15,163	27,674	726	723	1,449	1,480	994	2,474	18,249	16,357	34,606	1,223	921	2,144	1,529	538	2,067
Street Segment Total	**73,346**	**91,595**	**164,941**	**3,683**	**5,796**	**9,479**	**9,221**	**5,148**	**14,369**	**101,729**	**114,572**	**216,301**	**6,026**	**7,811**	**13,837**	**9,952**	**6,679**	**16,631**
ALL EAST-WEST SEGMENTS	**215,617**	**205,005**	**420,621**	**9,839**	**16,491**	**26,330**	**20,119**	**12,135**	**32,254**	**280,844**	**243,509**	**524,353**	**16,376**	**24,551**	**40,927**	**24,394**	**15,586**	**39,980**
Shellmound	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**
Powell to 65th	4,664	4,489	9,153	243	270	513	266	254	520	6,074	6,555	12,629	352	925	1,277	959	383	1,342
	4,664	4,489	9,153	243	270	513	266	254	520	6,074	6,555	12,629	352	925	1,277	959	383	1,342
	68	331	399	0	133	133	45	0	45	521	1,342	1,863	13	754	767	783	55	838
65th to Ashby	4,619	1,976	6,595	115	306	421	475	61	536	4,233	3,457	7,690	264	1,008	1,272	877	162	1,039
Street Segment Total	**14,015**	**11,285**	**25,300**	**601**	**979**	**1,580**	**1,052**	**569**	**1,621**	**16,902**	**17,909**	**34,811**	**981**	**3,612**	**4,593**	**3,578**	**983**	**4,561**
Hollis	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**
Powell to 65th	314	380	694	0	83	83	278	11	289	1,219	1,129	2,348	119	761	880	820	129	949
	314	380	694	0	83	83	278	11	289	1,219	1,129	2,348	119	761	880	820	129	949
65th to Ashby	3,410	3,860	7,270	87	421	508	345	108	453	5,519	5,952	11,471	111	693	804	676	276	952
	3,410	3,860	7,270	87	421	508	345	108	453	5,519	5,952	11,471	111	693	804	676	276	952
	3,882	4,328	8,210	88	467	555	387	109	496	5,970	6,402	12,372	112	712	824	691	270	961
Street Segment Total	**11,330**	**12,808**	**24,138**	**262**	**1,475**	**1,737**	**1,633**	**347**	**1,980**	**19,446**	**20,564**	**40,010**	**572**	**3,620**	**4,192**	**3,683**	**1,080**	**4,763**
ALL NORTH-SOUTH SEGMENT	**25,345**	**24,093**	**49,438**	**863**	**2,454**	**3,317**	**2,685**	**916**	**3,601**	**36,348**	**38,473**	**74,821**	**1,553**	**7,232**	**8,785**	**7,261**	**2,063**	**9,324**
ALL ROADWAY SEGMENTS	**240,962**	**229,098**	**470,059**	**10,702**	**18,945**	**29,647**	**22,804**	**13,051**	**35,855**	**317,192**	**281,982**	**599,174**	**17,929**	**31,783**	**49,712**	**31,655**	**17,649**	**49,304**

Table 1 - Year 2005 and 2030
Daily, AM and PM Peak Hour T

	2005 to 2030 Growth Rate in Study Area Link Volumes																	
	2005 to 2030 Growth Fractor									2005 to 2030 Avg. Annual Growth								
Street Segment	**Daily**			**AM Peak Hour**			**PM Peak Hour**			**Daily**			**AM Peak Hour**			**PM Peak Hour**		
Powell	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Market to San Pablo	1.14	1.15	1.15	1.42	1.02	1.16	0.69	1.26	0.90	0.7%	0.7%	0.7%	1.8%	0.1%	0.7%	-1.8%	1.1%	-0.5%
	1.17	1.19	1.18	1.56	1.05	1.20	0.68	1.27	0.88	0.8%	0.9%	0.8%	2.3%	0.2%	0.9%	-1.9%	1.2%	-0.6%
San Pablo to Hollis	1.19	1.18	1.19	1.35	1.29	1.31	1.07	1.37	1.16	0.9%	0.8%	0.9%	1.5%	1.3%	1.4%	0.3%	1.6%	0.8%
	1.19	1.18	1.19	1.42	1.31	1.34	1.07	1.41	1.18	0.9%	0.8%	0.9%	1.8%	1.3%	1.5%	0.4%	1.7%	0.8%
	1.12	1.15	1.13	1.28	1.38	1.34	1.09	1.35	1.18	0.6%	0.7%	0.6%	1.2%	1.6%	1.5%	0.4%	1.5%	0.8%
Hollis to Shellmound	1.18	1.15	1.17	1.27	1.35	1.32	1.13	1.25	1.17	0.8%	0.7%	0.8%	1.2%	1.5%	1.4%	0.6%	1.1%	0.8%
	1.06	1.08	1.07	1.19	1.31	1.26	1.03	1.19	1.09	0.3%	0.4%	0.3%	0.9%	1.4%	1.1%	0.1%	0.9%	0.4%
Shellmound to I-80	1.06	1.08	1.07	1.19	1.31	1.26	1.03	1.19	1.09	0.3%	0.4%	0.3%	0.9%	1.4%	1.1%	0.1%	0.9%	0.4%
Street Segment Total	**1.13**	**1.14**	**1.13**	**1.31**	**1.25**	**1.27**	**0.99**	**1.27**	**1.09**	**0.6%**	**0.7%**	**0.6%**	**1.3%**	**1.1%**	**1.2%**	**-0.1%**	**1.2%**	**0.4%**
Alcatraz/65th	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Sacramento to San Pablo	2.49	1.14	1.92	2.92	3.91	3.38	3.80	1.54	2.49	4.7%	0.7%	3.3%	5.5%	7.1%	6.3%	6.9%	2.2%	4.7%
	3.08	1.19	2.35	4.02	4.44	4.25	4.50	1.85	3.17	5.8%	0.9%	4.4%	7.2%	7.7%	7.5%	7.8%	3.1%	5.9%
	4.17	1.23	3.17	5.91	6.02	5.97	5.67	1.84	3.79	7.4%	1.0%	5.9%	9.3%	9.4%	9.3%	9.1%	3.1%	6.9%
San Pablo to Hollis	1.09	1.21	1.14	1.68	2.80	2.56	3.74	1.35	3.07	0.4%	0.9%	0.7%	2.6%	5.3%	4.8%	6.8%	1.5%	5.8%
	1.68	1.14	1.34	1.55	4.90	3.45	6.85	0.80	3.15	2.6%	0.7%	1.5%	2.2%	8.3%	6.4%	10.1%	-1.1%	5.9%
Street Segment Total	**2.55**	**1.17**	**1.93**	**3.36**	**4.22**	**3.86**	**4.59**	**1.52**	**3.04**	**4.8%**	**0.8%**	**3.3%**	**6.2%**	**7.5%**	**7.0%**	**7.9%**	**2.1%**	**5.7%**
65th St	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Hollis to Shellmound	1.31	1.19	1.24	3.36	1.53	1.91	1.51	0.99	1.23	1.3%	0.9%	1.1%	6.2%	2.2%	3.3%	2.1%	0.0%	1.0%
	1.69	1.09	1.29	2.69	1.76	2.11	1.90	0.87	1.13	2.7%	0.4%	1.3%	5.1%	2.9%	3.8%	3.3%	-0.7%	0.6%
Shellmound to I-80	1.01	1.04	1.02	1.62	0.87	1.10	0.88	2.33	1.41	0.0%	0.2%	0.1%	2.5%	-0.7%	0.5%	-0.6%	4.3%	1.7%
Street Segment Total	**1.28**	**1.11**	**1.18**	**2.50**	**1.38**	**1.71**	**1.39**	**1.12**	**1.23**	**1.2%**	**0.5%**	**0.9%**	**4.7%**	**1.6%**	**2.7%**	**1.7%**	**0.6%**	**1.1%**
65 th St Link Total	**1.82**	**1.13**	**1.46**	**2.99**	**2.60**	**2.74**	**2.93**	**1.28**	**2.03**	**3.0%**	**0.6%**	**1.9%**	**5.6%**	**4.9%**	**5.2%**	**5.5%**	**1.2%**	**3.6%**
Ashby	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**
Sacramento to San Pablo	1.12	1.49	1.33	1.19	1.56	1.41	1.27	1.05	1.19	0.6%	2.0%	1.4%	0.9%	2.2%	1.7%	1.2%	0.2%	0.9%
	1.13	1.47	1.32	1.16	1.55	1.40	1.27	1.03	1.18	0.6%	2.0%	1.4%	0.7%	2.2%	1.7%	1.2%	0.1%	0.8%
San Pablo to Hollis	1.58	1.17	1.35	2.31	1.16	1.49	0.95	1.92	1.24	2.3%	0.8%	1.5%	4.3%	0.8%	2.0%	-0.2%	3.3%	1.1%
	1.60	1.18	1.36	2.38	1.16	1.51	0.95	1.96	1.26	2.4%	0.8%	1.6%	4.4%	0.7%	2.1%	-0.3%	3.4%	1.1%
Hollis to Shellmound	1.47	1.09	1.26	1.72	1.30	1.50	1.04	1.57	1.25	1.9%	0.4%	1.2%	2.7%	1.3%	2.0%	0.2%	2.3%	1.1%
	1.46	1.08	1.25	1.68	1.27	1.48	1.03	0.54	0.84	1.9%	0.4%	1.1%	2.6%	1.2%	2.0%	0.2%	-3.0%	-0.9%
Street Segment Total	**1.39**	**1.25**	**1.31**	**1.64**	**1.35**	**1.46**	**1.08**	**1.30**	**1.16**	**1.6%**	**1.1%**	**1.4%**	**2.5%**	**1.5%**	**1.9%**	**0.4%**	**1.3%**	**0.7%**
ALL EAST-WEST SEGMENTS	**1.30**	**1.19**	**1.25**	**1.66**	**1.49**	**1.55**	**1.21**	**1.28**	**1.24**	**1.1%**	**0.7%**	**0.9%**	**2.1%**	**1.6%**	**1.8%**	**0.8%**	**1.0%**	**0.9%**
Shellmound	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**
Powell to 65th	1.30	1.46	1.38	1.45	3.43	2.49	3.61	1.51	2.58	1.3%	1.9%	1.6%	1.9%	6.4%	4.7%	6.6%	2.1%	4.9%
	1.30	1.46	1.38	1.45	3.43	2.49	3.61	1.51	2.58	1.3%	1.9%	1.6%	1.9%	6.4%	4.7%	6.6%	2.1%	4.9%
	7.66	4.05	4.67	0.00	5.67	5.77	17.40	0.00	18.62	10.7%	7.2%	8.0%	0.0%	9.1%	9.2%	15.4%	0.0%	15.7%
65th to Ashby	0.92	1.75	1.17	2.30	3.29	3.02	1.85	2.66	1.94	-0.4%	2.8%	0.8%	4.2%	6.1%	5.7%	3.1%	5.0%	3.4%
Street Segment Total	**1.21**	**1.59**	**1.38**	**1.63**	**3.69**	**2.91**	**3.40**	**1.73**	**2.81**	**0.9%**	**2.3%**	**1.6%**	**2.5%**	**6.7%**	**5.5%**	**6.3%**	**2.8%**	**5.3%**
Hollis	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**	**NB**	**SB**	**Total**
Powell to 65th	3.88	2.97	3.38	0.00	9.17	10.60	2.95	11.73	3.28	7.0%	5.6%	6.3%	0.0%	11.7%	12.5%	5.6%	13.1%	6.1%
	3.88	2.97	3.38	0.00	9.17	10.60	2.95	11.73	3.28	7.0%	5.6%	6.3%	0.0%	11.7%	12.5%	5.6%	13.1%	6.1%
65th to Ashby	1.62	1.54	1.58	1.28	1.65	1.58	1.96	2.56	2.10	2.4%	2.2%	2.3%	1.2%	2.5%	2.3%	3.4%	4.8%	3.8%
	1.62	1.54	1.58	1.28	1.65	1.58	1.96	2.56	2.10	2.4%	2.2%	2.3%	1.2%	2.5%	2.3%	3.4%	4.8%	3.8%
	1.54	1.48	1.51	1.27	1.52	1.48	1.79	2.48	1.94	2.2%	2.0%	2.1%	1.2%	2.1%	2.0%	2.9%	4.6%	3.4%
Street Segment Total	**1.72**	**1.61**	**1.66**	**2.18**	**2.45**	**2.41**	**2.26**	**3.11**	**2.41**	**2.7%**	**2.4%**	**2.6%**	**4.0%**	**4.6%**	**4.5%**	**4.2%**	**5.8%**	**4.5%**
ALL NORTH-SOUTH SEGMENT	**1.43**	**1.60**	**1.51**	**1.80**	**2.95**	**2.65**	**2.70**	**2.25**	**2.59**	**1.5%**	**1.9%**	**1.7%**	**2.4%**	**4.4%**	**4.0%**	**4.1%**	**3.3%**	**3.9%**
ALL ROADWAY SEGMENTS	**1.32**	**1.23**	**1.27**	**1.68**	**1.68**	**1.68**	**1.39**	**1.35**	**1.38**	**1.1%**	**0.8%**	**1.0%**	**2.1%**	**2.1%**	**2.1%**	**1.3%**	**1.2%**	**1.3%**

Appendix C
New Quiet Zone Flow Chart

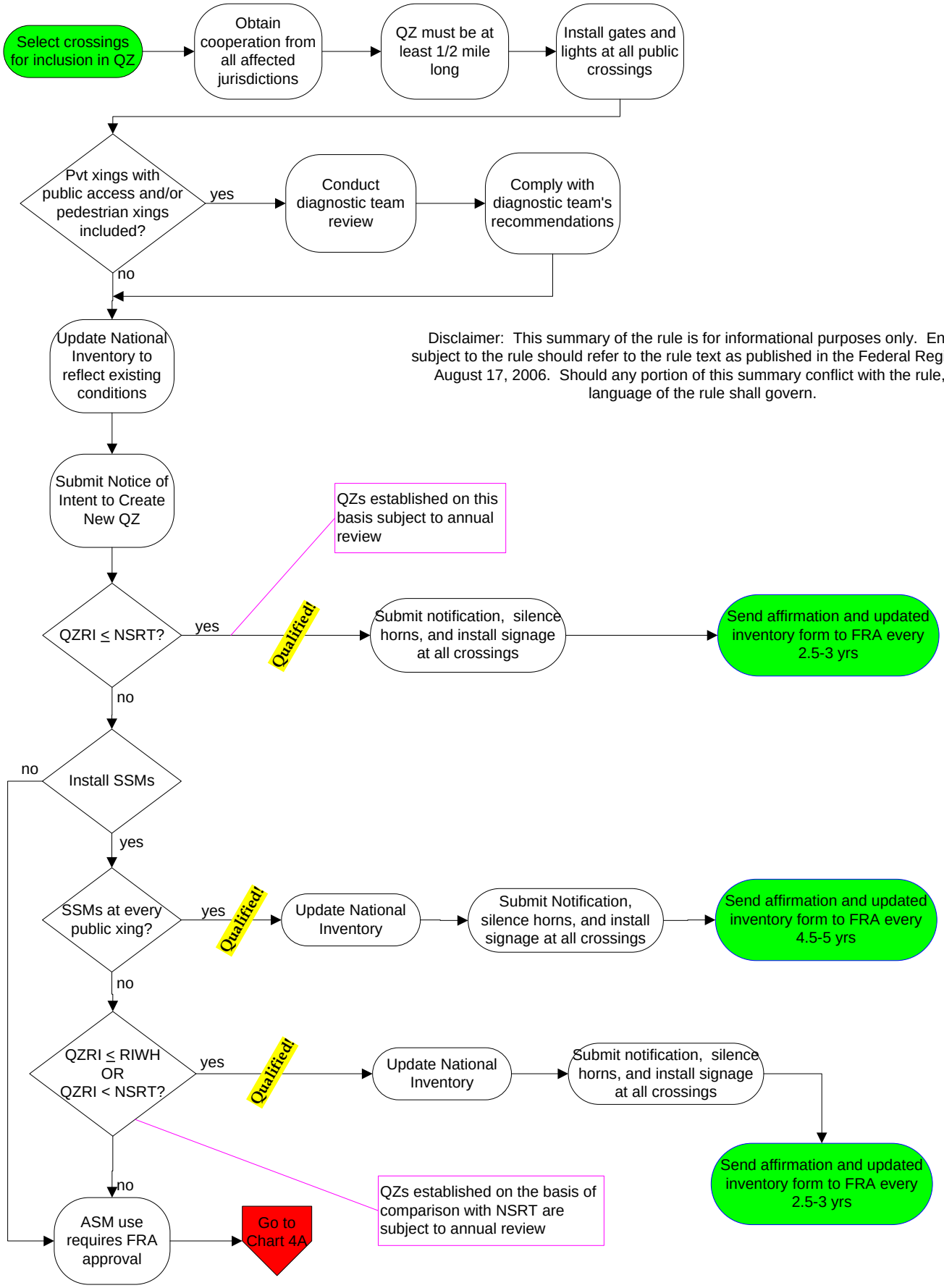



Chart 3 - Creating a New Quiet Zone or New Partial Quiet Zone using SSMs