APPENDIX H
AIR QUALITY

This appendix provides additional detail concerning the information presented in Sections 3.6 and 4.6 of the EIS. The appendix provides information on the methodology and information used to estimate rail emissions that would be associated with construction and operation of the Proposed Action and Alternatives. In addition, it describes development of estimated emissions resulting from changes in grade crossing delays associated with the Proposed Action and Alternatives.

H.1 AIR EMISSIONS FROM CONSTRUCTION AND OPERATION

SEA estimated emissions from both the construction and operational phases of the proposed project. Because the Houston area is in attainment for CO and SO_2, SEA only investigated ozone precursor emissions of NO_X and VOCs.[1] Because nearly all of the emission sources associated with the Proposed Action and Alternatives would be associated with the combustion of diesel fuel, which emits very small amounts of VOCs relative to NO_X, SEA developed quantitative estimates only of emissions of NO_x and diesel PM.

H.1.1 Construction

Development of a quantitative estimate of the emission rate associated with the construction phase of the proposed project requires information on the duration of the construction activities, the amount of material that would need to be moved, how that material would be moved (e.g., truck, rail, front-end loaders), and the need for and use of other support equipment (e.g., pile driver, tamper, water trucks). SEA used information based on the Applicants' preliminary engineering for the project.

The Applicants estimated that construction would take place over a period of between 16 months and 21 months. For purposes of estimating air emissions, SEA made the conservative assumption that construction would be completed over a 16-month period. This is a conservative assumption (from an air emissions impact assessment perspective) because it results in the largest number of pieces of construction equipment in operation per day. SEA also assumed that construction would occur using a five-day workweek at eight hours per day. This schedule allows some flexibility for construction efforts to catch up in the event of weather-related or other delays.

[1] In comments submitted during scoping, NASA indicated concern that emissions from operation of the proposed rail line might increase ambient CO concentrations at Sonny Carter Training Facility (SCTF), based on a "simple environmental air dispersion screening model run." Subsequent review of these preliminary results led NASA to conclude that the potential maximum CO concentration would likely be considerably lower than their initial estimate. Thus, air emissions from the proposed rail line would not result in a material increase in CO concentrations, which are currently substantially below the limit established for the breathing apparatus at SCTF and also ambient air quality standards for CO.

Construction would be staged at three-mile intervals and materials would be delivered by rail. The railroad-bed would require approximately 325,000 cubic yards of fill material and 5,600 tons of lime. The track structure would require approximately 97,000 cubic yards of sub-ballast, 52,000 cubic yards of ballast, 47,000 ties, and 3,400 tons of rail. In addition, an estimated 15,000 cubic yards of concrete would be required for approximately 22 land bridges over pipelines and the grade separation at Red Bluff Road, the two primary items to be constructed of cast-in-place concrete, as well as miscellaneous facilities and contingencies.

The equipment used in the analysis of the project is based on the material needed during the construction and the equipment used to transport the material and construct the rail line. The estimated construction equipment usage is based on preliminary engineering for the project and industry experience. All equipment anticipated to be used would be diesel fueled. SEA estimated emissions from construction from on-road equipment and off-road equipment as well as a switch locomotive used as a material train. Off-road equipment includes caterpillars, backhoes, road graders, front-end loaders, pile drivers, diesel generators for welding operations, and a tamper. On-road equipment includes concrete delivery trucks, equipment maintenance trucks, water trucks, and 18-wheeler trucks.

SEA used horsepower rating and load factors from the Nonroad Engine and Vehicle Emission Estimates Study (NEVES), EPA 450/3-91-02, November 1991, and the more recent USEPA Report No. NR-005A, “Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling,” June 1998. SEA based in-use adjustment and emission factors on values reported in USEPA Report No. NR-009A, “Exhaust Emission Factors for Nonroad Engine Modeling – Compression-Ignition”. SEA estimated switch locomotive emissions using the rates as reported in Table 1 from USEPA’s “Emission Factors for Locomotives,” EPA–420-F-97-051, December 1997. SEA determined the emission factors for on-road mobile sources used in Table H-2 using USEPA’s MOBILE6 model based on a 2001 fleet average for heavy-heavy duty diesel trucks.

For the off-road equipment and rail activity associated with construction activity, SEA estimated the annual average emission rates for NO_X and PM using the following equation:

$$\text{Annual Average Emission Rate (ER)} = H \times B \times L \times A \times EF \times 0.75$$

where:

ER = Annual average emission rate for NO_X or PM, as appropriate, in grams/year.

H = Total unit hours of equipment use.

B = Brake horsepower rating, or bhp. The rating is determined by nonroad equipment type.

L = Load factor, or fraction of available power. The load factors in this study are based on USEPA surveys of equipment users. The fraction of load is based on the estimate of hours of usage per year, the fuel consumption per year, and the fuel consumption rate at rated power for each engine in the field that was surveyed.

The reported value for a load factor is the median fraction of available power based on specific applications.

A = In-use adjustment factor. Nonroad engines often operate under conditions unlike those of the steady-state testing procedure used in emissions testing. This alternate operation can cause a change in the emission characteristics of nonroad engines. To account for these in-use operations, an adjustment is applied to emission factors to represent operational behavior of nonroad equipment.

EF = Emission factor for NO_X or PM, as appropriate, in grams/bhp-hour.

0.75 = Annual adjustment factor. The construction phase is estimated to take 16 months. The adjustment factor of 0.75 (or 12/16) was applied to calculate the total volume of emissions that would occur during one year (12 months).

For the on-road mobile sources associated with construction activity, SEA estimated the annual average emission rates for NO_X and PM using the following equation:

$$\text{Annual Average Emission Rate (ER)} = M \times EF_{M6}$$

where:

ER = Annual average emission rate for NO_X or PM, as appropriate, in grams/year.

M = Total miles of the daily average traffic activity associated with the construction activity. Total miles were calculated based on the number of days of activity, number of trips per day, and number of miles per trip.

EF_{M6} = Emission factor for NO_X or PM, as appropriate, in grams/mile, as determined using USEPA's MOBILE6 model.

Tables H-1 and H-2 show the estimated diesel particulate matter emissions associated with the construction activity for the off-road equipment and rail activity and on-road mobile sources. Similarly, Tables H-3 and H-4 show the NO_X emissions associated with the construction activity for the off-road equipment and rail activity and on-road mobile sources.

H.1.2 Operation

SEA estimated emissions based on an average of two line-haul locomotives per train trip and an average of two train trips per day. The two train trips per day, on average, would displace the same number of train cars as currently operated by UP. Thus, SEA estimated that emissions from line-haul operations would only increase as a result of operation of two additional line-haul locomotives (rather than as a result of the line-haul locomotives plus the rail cars they would haul). SEA estimated that construction and operation of the Proposed Action or any of the Alternatives, except the No-Action Alternative, would result in a decrease in the number of trains run by UP. To ensure that the estimated change in air emissions that would result from the proposed project is a conservative estimate, SEA did not include any emission reductions associated with the anticipated reduction in UP train traffic.

Table H-1
Estimated Particulate Matter Emissions from Off-Road Equipment and Locomotives During Construction

Nonroad Equipment Type	Total Unit Hours	Brake Horsepower Rating	Load Factor	In-use Adj Factor (PM)	PM Emission Factor (g/bhp-hr)	Annual Adj Factor	Annual Average PM Emission Rate (g/yr)	Annual Average PM Emission Rate* (metric tons/yr)
D-7 Catepillar	6,224	134	0.64	1.21	0.4	0.75	193,759	0.19
Truck-mount backhoe	1,424	71	0.55	2.04	0.72	0.75	61,257	0.06
Large front-end loader	1,328	356	0.68	1.21	0.4	0.75	116,698	0.12
Road grader	1,136	147	0.61	1.21	0.4	0.75	36,977	0.04
Asphalt re-claimer	192	127	0.78	1.21	0.4	0.75	6,904	0.01
Pile driver/hammer	1,224	161	0.62	1.21	0.4	0.75	44,351	0.04
Large crane	5,248	194	0.43	1.21	0.4	0.75	158,917	0.16
Welder generator	5,784	35	0.45	1.00	0.8	0.75	54,659	0.05
Maintenance Truck	536	280	0.25	2.04	0.4	0.75	22,962	0.02
Tamper	240	250	0.56	1.21	0.4	0.75	12,197	0.01
Pup-Tamper	240	190	0.56	1.21	0.4	0.75	9,270	0.01
Regulator	240	170	0.62	1.21	0.4	0.75	9,182	0.01
Switch Locomotive	256	2,500	0.20	1.00	0.44	0.75	42,240	0.04
						Subtotal	769,373	0.77
						Average Daily (kg/day)	2.1	

* Sum of individual values shown differs from total due to rounding.

Table H-2
Estimated Particulate Matter Emissions from On-Road Mobile Sources During Construction

Truck Type	Days	Trips/ Day	Total Trips	Miles/ Trip	Total Miles	MOBILE6 Emission Factors (g/mile)	Annual Average PM Emission Rate (g/yr)	Annual Average PM Emission Rate* (metric tons/yr)
6-wheelers	1,447	16	23,152	8	185,216	0.8	148,173	0.15
6-wheelers	210	24	5,040	8	40,320	0.8	32,256	0.03
Water trucks	236	4	944	6	5,664	0.8	4,531	0.004
Concrete trucks	N/A	N/A	1,500	10	15,000	0.8	12,000	0.01
18-wheelers - pup	376	16	6,016	6	36,096	0.8	28,877	0.03
18-wheelers - lime	51	6	306	6	1,836	0.8	1,469	0.001
						Subtotal	227,306	0.23
						Average Daily (kg/day)	0.62	

* Sum of individual values shown differs from total due to rounding.

Table H-3
Estimated NO_X Emissions from Off-Road Equipment and Locomotives During Construction

Nonroad Equipment Type	Total Unit Hours	Brake Horsepower Rating	Load Factor	In-use Adj Factor (NO_X)	NO_X Emission Factor (g/bhp-hr)	Annual Adj Factor	Annual Average NO_X Emission Rate (g/yr)	Annual Average NO_X Emission Rate (metric tons/yr)
D-7 Catepillar	6,224	134	0.64	0.99	8.38	0.75	3,321,198	3.32
Truck-mount backhoe	1,424	71	0.55	1.03	8.30	0.75	356,539	0.36
Large front-end loader	1,328	356	0.68	0.99	8.38	0.75	2,000,311	2.00
Road grader	1,136	147	0.61	0.99	8.38	0.75	633,820	0.63
Asphalt re-claimer	192	127	0.78	0.99	8.38	0.75	118,342	0.12
Pile driver/hammer	1,224	161	0.62	0.99	8.38	0.75	760,220	0.76
Large crane	5,248	194	0.43	0.99	8.38	0.75	2,723,984	2.72
Welder generator	5,784	35	0.45	1.00	6.90	0.75	471,432	0.47
Maintenance Truck	536	280	0.25	1.03	8.38	0.75	242,888	0.24
Tamper	240	250	0.56	0.99	8.38	0.75	209,064	0.21
Pup-Tamper	240	190	0.56	0.99	8.38	0.75	158,889	0.16
Regulator	240	170	0.62	0.99	8.38	0.75	157,396	0.16
Switch Locomotive	256	2,500	0.20	1.00	17.4	0.75	1,670,400	1.67
						Subtotal	12,824,483	12.82
						Average Daily (kg/day)	35.1	

Table H-4
Estimated NO_X Emissions from On-Road Mobile Sources During Construction

Truck Type	Days	Trips/ Day	Total Trips	Miles/ Trip	Total Miles	MOBILE6 Emission Factors (g/mile)	Annual Average NO_X Emission Rate (g/yr)	Annual Average NO_X Emission Rate (metric tons/yr)
6-wheelers	1,447	16	23,152	8	185,216	19.94	3,693,207	3.69
6-wheelers	210	24	5,040	8	40,320	19.94	803,981	0.80
Water trucks	236	4	944	6	5,664	23.17	131,235	0.13
Concrete trucks	N/A	N/A	1,500	10	15,000	23.17	347,550	0.35
18-wheelers - pup	376	16	6,016	6	36,096	23.17	836,344	0.84
18-wheelers - lime	51	6	306	6	1,836	23.17	42,540	0.04
						Subtotal	5,854,857	5.85
						Average Daily (kg/day)	16.0	

SEA used the following equation to estimate the annual fuel consumption for line-haul locomotives used during operation:

$$\text{Annual Fuel Consumption (FC)} = \frac{2 \text{ x } A_L \text{ x } W \text{ x } 365}{F_L}$$

where:

FC = Estimated annual fuel consumption for line-haul locomotives during operation, in gallons per year.

2 = Number of trips per day.

A_L = Length, in miles, of the route along which the line-haul locomotives would operate.

W = Weight of two line-haul locomotives, in tons.

365 = Number of operating days per year.

F_L = Locomotive fuel consumption rate provided by BNSF, in gross-ton-miles per gallon.

SEA calculated fuel consumption using an average locomotive weight of 210 tons and the BNSF locomotive fuel consumption rate of 745.8 gross-ton-miles per gallon. The typical main line road locomotive weighs 190 to 210 tons fully fueled, sanded, and ready for use. This is true of the newer locomotives from both General Motors and General Electric. The models of locomotives that can be expected to be used over the main line are SD40-2, SD60, C40-8, C44-9W, AC4400, SD70, and SD90 units (Simmons-Boardman, 1980 and 1997). To be conservative, SEA assumed the heavier locomotive weight of 210 tons to estimate the annual average emissions due to line-haul activity. SEA estimated that annual average fuel usage for operating two-line haul locomotives twice a day between the CMC Dayton Yard and the Bayport Rail Terminal east of Red Bluff road would be 26,516 gallons per year for the Proposed Action. Table H-5 shows the estimated annual average fuel consumption for each alternative.

In addition to line-haul operations, the Proposed Action and Alternatives would result in additional switching operations. The Applicants have indicated that service to customers in the Bayport Loop would be provided by one switch locomotive. A second switching locomotive could be added, if required by growth in business volume. To be conservative, SEA assumed for this analysis that the Proposed Action and Alternatives would involve the use of two switch locomotives operating an average of 12 hours per day, 365 days per year. These equipment are all diesel powered. Again, SEA estimated that emissions from switching operations would only increase as a result of operation of two additional switching locomotives because the rail cars that would be switched would otherwise be switched by UP.

Table H-5
Fuel Consumption for Bayport Loop Locomotives During Operation

Locomotive Engines	Proposed Route	Alignment Length (miles)	Weight of Locomotives (tons)	Locomotive Fuel Consumption Rate (gross ton miles/gal)	Operating Days per Year	Estimated Annual Fuel Consumption (gallons/year)
Line-haul locomotives (2 per day)	Proposed Action (includes 1B)	64.5	420	745.8	365	26,516
Line-haul locomotives (2 per day)	Alternative 1C	65.1	420	745.8	365	26,763
Line-haul locomotives (2 per day)	Alternative 2B	63.3	420	745.8	365	26,023
Line-haul locomotives (2 per day)	Alternative 2D	63.0	420	745.8	365	25,899
Line-haul locomotives (2 per day)	No-Build Alternative	63.4	420	745.8	365	26,064

Locomotive Engines	Average Number of Cars per day	Average Weight of Cars (tons)	Weight of Locomotives (tons)	Annual Fuel Consumption for Bayport Loop (gallon/year)	Operating days per Year	Average Fuel Consumption for Bayport Loop Switching Operations (gallons/ton)	Switch Locomotives Annual Fuel Consumption (gallons/year)
Switch Locomotives (2 per day)	66	80	360	82,000	365	0.0398	5,234

SEA used the following equation to estimate the annual fuel consumption for switching locomotives used during operation:

$$\text{Annual Fuel Consumption (FC)} = \frac{F_S}{\{[W + (C_{AV} \text{ x } W_{AV})] \text{ x } 365\}}$$

where:

FC	=	Estimated annual fuel consumption for switching locomotives during operation, in gallons/year
F_S	=	Average yard locomotive fuel consumption provided by BNSF, in gallons/year.
W	=	Weight of two switching locomotives, in tons.
C_{AV}	=	Average number of cars switching per day.
W_{AV}	=	Average weight of cars switching per day, in tons.
365	=	Number of operating days per year.

The weight of a locomotive used for switching ranges from 130 to 180 tons. The locomotives that BNSF will likely use at the Bayport Loop are rebuilt locomotives that were used in main line service when they were new, rather than the smaller locomotives built specifically for switching work. UP uses similar locomotives on the Bayport Loop. The models of locomotives that can be expected to be used are GP-38-2, GP-39, B23-7 units which have an operating weight of 170 to 180 tons (Simmon-Boardman, 1980 and 1997). To be conservative, SEA assumed the heavier locomotive weight of 180 tons to estimate the annual average emissions due to switching operations.

Given the range of 36 to 66 cars per day in the application, SEA used 66 cars as the number of cars per shift that would be switched into and out of the Bayport loop. Conservatively, a total of 132 cars would likely be handled over two different shifts in one day, or four movements, in order to provide adequate service to the Bayport Loop customers (i.e., four trains per day between the Bayport Terminal Yard and the shippers in the Loop). Ultimately, this equals an average number of 66 cars per switching locomotive per shift.

SEA used an average weight of 80 tons for freight cars serving the Bayport Loop industries based upon an empty car weight of 25 to 30 tons and a typical loaded car weight of 100 tons. While many of the freight cars used for Bayport Loop traffic can have a gross weight of 130 to 140 tons, many others will only have a gross weight of 70 to 80 tons because the product will "cube-out" before it "weighs-out." This applies to tank cars as well as covered hopper cars (Simmon-Boardman, 1980 and 1997). SEA calculated an average weight of 80 tons based on the mean of the weight of an empty car (30 tons) and the gross weight of a loaded car (100 tons load + 30 tons empty weight = 130 tons), or (130 + 30)/2 = 80 tons.

As shown in Table H-5, SEA estimated that annual average fuel usage for switching locomotives would be 5,234 gallons per year assuming an average switching locomotive weight of 180 tons, an average number of cars switching per day of 66 cars, and an average weight for cars switching per day of 80 tons.

SEA used the following equation to estimate NO_X and PM emissions from both line-haul and switching operations:

$$\text{Annual Average Emission Rate (ER)} = E \times FC \times EEF \times 365$$

where:

ER	=	Annual average emission rate for NO_X or PM, as appropriate, in grams/year.
E	=	Estimated baseline in-use emissions rate, as reported in Table 4-8 from USEPA's regulatory support document, "Locomotive Emission Standards," April 1998, in g/bhp-hr.
FC	=	Estimated annual fuel consumption for line-haul or switching locomotives, as appropriate, during operation, in gallons/year.
EEF	=	Average fuel consumption energy efficiency factor, in bhp-hours/gallon.
365	=	Number of operating days per year.

Tables H-6 and H-7 show the estimated NO_X and diesel PM emissions from both switching and line-haul operations. SEA estimated switch and line-haul locomotive emissions based on the rates as reported in Table 1 from USEPA's "Emission Factors for Locomotives", EPA –420-F-97-051, December 1997. The fuel consumption energy conversion factor was obtained from the Southwest Research Institute report on "Emission Measurements for Locomotives", SWRI Report for EPA, August 1995. For the combination of switching operations and the alternative with the longest overall length (Alternative 1C), SEA estimated that average daily NO_x emissions would be 25.0 kg/day and for diesel PM 0.62 kg/day.

H.2 AIR EMISSIONS FROM HIGHWAY/RAIL AT-GRADE CROSSINGS

Nearly all of the emissions sources associated with vehicle delays at grade crossings for the Proposed Action and Alternatives would be associated with the combustion of gasoline fuel. Thus, SEA investigated emissions for CO, ozone precursor emissions of NO_X, and VOCs, as well as PM, because the area has the potential to be designated non-attainment for $PM_{2.5}$. SEA quantified estimates of emission for CO, VOCs, NO_X, and PM and provided a comparison with countywide total emissions for assessment of significance.

SEA estimated increased emissions from idling vehicles delayed at highway/rail at-grade crossings. SEA used the estimated vehicle delay time in combination with the number of days per year, average daily traffic volume (ADT), and fleet average emission factors to estimate the increase in air emissions from delayed idling vehicles.

Table H-6
Estimated NO_X Emission Rate for Bayport Loop Locomotives During Operation

Locomotive Engines	Proposed Route	NO_X Emissions g/bhp-hr	Fuel Consumption (gal/yr)	Average Fuel Consumption Energy Efficiency Factor (bhp-hr/gal)	Annual Average NO_X Emission Rate (g/day)	Annual Average NO_X Emission Rate (metric tons/yr)
Line-haul Locomotive (2 trains)	Proposed Action (includes 1B)	13.0	26,516	20.8	19,644	7.2
Line-haul Locomotive (2 trains)	Alternative 1C	13.0	26,763	20.8	19,826	7.2
Line-haul Locomotive (2 trains)	Alternative 2B	13.0	26,023	20.8	19,278	7.0
Line-haul Locomotive (2 trains)	Alternative 2D	13.0	25,899	20.8	19,187	7.0
Line-haul Locomotive (2 trains)	No-Build Alternative	13.0	26,064	20.8	19,309	7.0
Switch Locomotives (2 trains)	Bayport Loop Switching Operations	17.4	5,234	20.8	5,190	1.9
				Average Daily Switching and Line Haul (kg/day)	25.0	

Table H-7
Estimated Diesel PM Emission Rate for Bayport Loop Locomotives During Operation

Locomotive Engines	Proposed Route	PM Emissions g/bhp-hr	Fuel Consumption (gal/yr)	Average Fuel Consumption Energy Efficiency Factor (bhp-hr/gal)	Annual Average PM Emission Rate (g/day)	Annual Average PM Emission Rate (metric tons/yr)
Line-haul Locomotive (2 trains)	Proposed Action (includes 1B)	0.3	26,516	20.8	484	0.18
Line-haul Locomotive (2 trains)	Alternative 1C	0.3	26,763	20.8	488	0.18
Line-haul Locomotive (2 trains)	Alternative 2B	0.3	26,023	20.8	475	0.17
Line-haul Locomotive (2 trains)	Alternative 2D	0.3	25,899	20.8	472	0.17
Line-haul Locomotive (2 trains)	No-Build Alternative	0.3	26,064	20.8	475	0.17
Switch Locomotives (2 trains)	Bayport Loop Switching Operations	0.44	5,234	20.8	131	0.05
				Average Daily Switching and Line Haul (kg/day)	0.62	

SEA used the following procedure to estimate system-wide emissions from idling vehicles at highway/rail at-grade crossings under conditions before and after the proposed Bayport Loop Build-Out. SEA then calculated the changes in emissions resulting from the increased number of vehicles delayed at the highway/rail at-grade crossings.

- SEA calculated the blocked crossing time per train (D_C) and crossing delay per stopped vehicle (D_A) at highway/rail at-grade crossings affected by the Proposed Action and Alternatives. SEA also calculated the change in total number of vehicles delayed per day (T_D) as a function of blocked crossing time, ADT, and the change in the number of trains per day.

- SEA multiplied the number of vehicles delayed (per day) by the average crossing delay (per stopped vehicle) to obtain the total daily time all vehicles would be delayed. SEA assumed all vehicles would have to wait at a highway/rail at-grade crossing to allow a train to pass.

- SEA multiplied the daily vehicle delay time by 365 days per year to obtain the total annual vehicle delay at a highway/rail at-grade crossing.

- SEA used the MOBILE6 (for VOCs, NO_X, and CO) and PART5 (for PM) emissions factor models to obtain emissions factors in units of grams per vehicle-mile, then multiplied those numbers by 2.5 miles per hour to produce an emissions factor representative of an idling vehicle in units of grams of pollutant per vehicle hour of operation. SEA conservatively incorporated all sources of VOCs emissions (such as refueling, diurnal, and hot soak emissions) in emissions factors calculations. Table H-8 summarizes the emissions factors used in SEA's analysis.

Table H-8
Composite Emissions Factors for Vehicles
Delayed at Highway/Rail At-Grade Crossings

Pollutant	Emissions Factor (grams/hour)
VOCs	29.21
CO	148.95
NO_X	11.26
Exhaust PM	0.2625

- SEA incorporated national average data for vehicle ages and types and for operating conditions. SEA also used national default values for the vehicle miles traveled, vehicle mix, registration/mileage accumulation, and tampering rates. SEA also: (1) assumed that no inspection/maintenance or anti-tampering programs were in place, (2) did not consider the effects of oxygenated and reformulated fuel in its analysis, and (3) assumed that Reid vapor pressure was 7.0 psi and that operating modes were set at default values. These are all conservative assumptions.

- SEA assessed the significance of the potential impact based on the relative percentage change in emissions for the criteria pollutant to the total countywide emissions inventory for that pollutant. SEA identifies a level of significant change if the increase in emissions exceeds 1.0 percent of total emissions in non-attainment areas such as Harris County.

H.2.1 Blocked Crossing Time per Train Calculation

SEA estimated the blocked crossing time per train (D_C)—the time required for a train to pass by the highway/rail at-grade crossing—using the following equation:[2]

$$\text{Blocked crossing time } (D_C) = \left(\frac{L}{V \times 88} \right) + 0.5 \text{ minutes}$$

where:

D_C	=	Time required, in minutes, for the train to pass the highway/rail at-grade crossing, including the time required for gate closing and opening.
L	=	Length of the train, in feet.
V	=	Train speed, in miles per hour, over the highway/rail at-grade crossing.
88	=	Conversion factor from miles per hour to feet per minute (1 mile per hour = 88 feet per minute).
0.50	=	Time required, in minutes, for gate closing and opening before and after train passage.[3]

SEA used the value for blocked crossing time D_C to estimate the crossing delay per stopped vehicle and average delay for all vehicles, as discussed in the following sections.

H.2.2 Crossing Delay per Stopped Vehicle Calculation

The crossing delay per stopped vehicle (D_A) represents the average amount of time that a driver would have to wait at highway/rail at-grade crossing for a train to pass. SEA calculated the crossing delay per stopped vehicle for each highway/rail at-grade crossing for conditions both before and after the Proposed Action and Alternatives to estimate the change in crossing delay. For ease of analysis, SEA assumed that vehicles arrive at a highway/rail at-grade crossing in a uniform distribution, although under actual conditions this generally would not be the case. SEA used the following equation to calculate the crossing delay per stopped vehicle.[4]

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[2] Federal Railroad and Highway Administration. *Stanford Research Institute Report*, RP-31, Volume 3, Appendix C, August 1974.

[3] Not all crossings have gates as warning devices and thus blocked crossing times for such cases may be over-estimated.

[4] Institute of Transportation Engineers. *Transportation and Traffic Engineering Handbook*, 2nd Edition, 1982.

$$\text{Crossing Delay per Stopped Vehicle } (D_A) = \frac{D_C \text{ x } (S_C/(S_C - S_Q))}{2 \text{ minutes/vehicle}}$$

where:

- D_A = Crossing delay per stopped vehicle, in minutes.
- D_C = Blocked crossing time per train, in minutes.
- S_C = Vehicle departure rate, vehicles per hour per lane.
- S_Q = Average arrival rate, average daily traffic in vehicles per hour per lane.
- 2 = Denominator to reflect that vehicles do not experience delay for the entire time that the train blocks the highway/rail at-grade crossing, but arrive on average at the midpoint of the train crossing period.

SEA used the estimated value of D_A in the equation to calculate the average delay for all vehicles.

H.2.3 Example Emissions Calculation

The following example estimates vehicular CO emissions from idling vehicles at a highway/rail at-grade crossing before implementation of the Proposed Action with 10 trains over a 24-hour period and an ADT volume of 5,000 vehicles.

Pre-project blocked crossing time per train:

$$D_C = \frac{4{,}410 \text{ feet}}{20 \text{ miles per hour x } 88} + 0.5 = 3.0 \text{ minutes}$$

For this example, SEA used the following assumptions:

- Number of lanes = 2.
- S_C = 1,400 vehicles per hour per lane (23.3 vehicles per minute per lane).
- S_Q = 5,000 vehicles per day (1.7 vehicles per minute per lane).

Therefore:

$$\frac{S_C}{S_C - S_Q} = \frac{23.3 \text{ vehicles/minute-lane}}{23.3 \text{ vehicles/minute-lane} - 1.7 \text{ vehicles/minute-lane}} = 1.08$$

SEA calculated crossing delay per stopped vehicle (D_A):

$$D_A = \frac{3.0 \text{ minutes x } 1.08}{2} = 1.62 \text{ minutes}$$

SEA calculated the number of vehicles delayed per day (T_D):

$$T_D = \frac{3.0 \text{ minutes}}{1{,}440 \text{ minutes per day}} \text{ x } 10 \text{ trains/day x } \frac{5{,}000 \text{ vehicles}}{\text{day}} = 104.2 \ \frac{\text{vehicles delayed}}{\text{day}}$$

SEA calculated CO emissions from idling vehicles delayed at highway/rail at-grade crossings before implementation of the Proposed Action, as follows:

$$104.2 \ \frac{\text{vehicles delayed}}{\text{day}} \text{ x } 1.62 \ \frac{\text{minutes of crossing delay}}{\text{stopped vehicle}}$$

$$\text{x } 365 \ \frac{\text{days}}{\text{year}} \text{ x } \frac{1 \text{ hour}}{60 \text{ minutes}} \text{ x } 148.95 \ \frac{\text{grams of CO}}{\text{vehicle-hour}} \text{ x } \frac{1 \text{ pound}}{454 \text{ grams}} \text{ x } \frac{1 \text{ ton}}{2{,}000 \text{ pounds}}$$

$$= 0.17 \ \frac{\text{tons (CO)}}{\text{year}}$$

The following example calculation estimates vehicular CO emissions from idling vehicles at a highway/rail at-grade crossing with 12 trains over a 24-hour period and an ADT volume of 5,000 vehicles after implementation of the Proposed Action.

Blocked crossing time per train following the Proposed Action is:

$$D_C = \frac{4{,}410 \text{ feet}}{20 \text{ miles per hour x } 88} + 0.5 = 3.0 \text{ minutes}$$

$$\text{Assume: } \frac{S_C}{S_C - S_Q} = \frac{23.3 \text{ vehicles/minute-lane}}{23.3 \text{ vehicles/minute-lane} - 1.7 \text{ vehicles/minute-lane}} \ 1.08$$

SEA calculated crossing delay per stopped vehicle (D_A):

$$D_A = \frac{3.0 \text{ minutes x } 1.08}{2} = 1.62 \text{ minutes}$$

SEA calculated the number of vehicles delayed per day (T_D):

$$T_D = \frac{3.0 \text{ minutes}}{1{,}440 \text{ minutes per day}} \text{ x } 12 \text{ trains/day x } \frac{5{,}000 \text{ vehicles}}{\text{day}} = 125.0 \ \frac{\text{vehicles delayed}}{\text{day}}$$

SEA calculated CO emissions from idling vehicles delayed at highway/rail at-grade crossings after implementation of the Proposed Action, as follows:

$$125.0 \frac{\text{vehicles delayed}}{\text{day}} \times 1.62 \frac{\text{minutes of crossing delay}}{\text{stopped vehicle}}$$

$$\times 365 \frac{\text{days}}{\text{year}} \times \frac{\text{1 hour}}{\text{60 minutes}} \times 148.95 \frac{\text{grams of CO}}{\text{vehicle-hour}} \times \frac{\text{1 pound}}{\text{454 grams}} \times \frac{\text{1 ton}}{\text{2,000 pounds}}$$

$$= 0.20 \frac{\text{tons (CO)}}{\text{year}}$$

Therefore, SEA calculated the emissions change, as follows:

Post-project CO emissions – Pre-project CO emissions

= change in CO emissions resulting from vehicles delayed at highway/rail at-grade crossings

$$0.20 \frac{\text{tons (CO)}}{\text{year}} - 0.17 \frac{\text{tons (CO)}}{\text{year}} = 0.03 \frac{\text{tons (CO)}}{\text{year}}$$

H.2.4 Estimated Delay Emissions

Tables H-9 and H-10 show the emission changes for the Proposed Action and No-Build Alternative, respectively. The largest increase was approximately 4 tons per year for CO. Table H-11 summarizes the estimated changes in emissions at highway/rail at-grade crossings. Appendix F provides additional detail on ADT, vehicle and crossing delay, and blocked crossing time.

Table H-9
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the Proposed Action

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
New Grade Crossings	N/A	Old Hwy 146 (@ Port Rd)	0.000	0.003	0.003	0.000	0.001	0.001	0.0000	0.0000	0.0000	0.000	0.015	0.015
	N/A	Port Rd	0.000	0.005	0.005	0.000	0.002	0.002	0.0000	0.0000	0.0000	0.000	0.027	0.027
	N/A	Hwy 146--NB entrance ramp	0.000	0.001	0.001	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.005	0.005
	N/A	Hwy 146--SB exit ramp	0.000	0.001	0.001	0.000	0.001	0.001	0.0000	0.0000	0.0000	0.000	0.007	0.007
	N/A	Bay Area Blvd	0.000	0.394	0.394	0.000	0.152	0.152	0.0000	0.0035	0.0035	0.000	2.008	2.008
GH&H line	859598E	Brantley St.	0.003	0.005	0.002	0.001	0.002	0.001	0.0000	0.0000	0.0000	0.015	0.024	0.009
	859597X	Challenger 7 Pkwy	0.006	0.009	0.003	0.002	0.003	0.001	0.0001	0.0001	0.0000	0.029	0.045	0.017
	859596R	N. Gate	0.003	0.004	0.002	0.001	0.002	0.001	0.0000	0.0000	0.0000	0.014	0.022	0.008
	859592N	Genoa Red Bluff	0.075	0.119	0.044	0.029	0.046	0.017	0.0007	0.0011	0.0004	0.383	0.609	0.226
	859589F	Tiki Lane	0.002	0.003	0.001	0.001	0.001	0.000	0.0000	0.0000	0.0000	0.008	0.013	0.005
	859587S	Shaver	0.040	0.063	0.023	0.015	0.024	0.009	0.0004	0.0006	0.0002	0.202	0.321	0.119
	859584W	Coronation Drive	0.003	0.004	0.002	0.001	0.002	0.001	0.0000	0.0000	0.0000	0.014	0.022	0.008
	859583P	Edgebrook	0.047	0.075	0.028	0.018	0.029	0.011	0.0004	0.0007	0.0002	0.241	0.382	0.142
	859579A	Nevada	0.007	0.011	0.004	0.003	0.004	0.002	0.0001	0.0001	0.0000	0.035	0.056	0.021
	859578T	Spencer	0.058	0.092	0.034	0.022	0.035	0.013	0.0005	0.0008	0.0003	0.296	0.470	0.174
	859577L	Pennsylvania[1]	0.007	0.011	0.004	0.003	0.004	0.002	0.0001	0.0001	0.0000	0.036	0.057	0.021
	859576E	Virginia St	0.002	0.004	0.001	0.001	0.001	0.001	0.0000	0.0000	0.0000	0.012	0.019	0.007
	859575X	Kentucky St.	0.004	0.006	0.002	0.001	0.002	0.001	0.0000	0.0001	0.0000	0.018	0.029	0.011
	859574R	S. Richey St.	0.043	0.069	0.026	0.017	0.027	0.010	0.0004	0.0006	0.0002	0.222	0.352	0.130
	859570N	Howard Drive	0.038	0.061	0.023	0.015	0.024	0.009	0.0003	0.0005	0.0002	0.196	0.312	0.115
	859569U	Wyne St.	0.000	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.002	0.003	0.001
	859567F	Parkplace Blvd.	0.011	0.017	0.006	0.004	0.007	0.002	0.0001	0.0002	0.0001	0.056	0.088	0.033
	859568M	Park Terrace	0.012	0.019	0.007	0.005	0.007	0.003	0.0001	0.0002	0.0001	0.062	0.098	0.036
	859550C	Broadway St.	0.033	0.053	0.020	0.013	0.020	0.008	0.0003	0.0005	0.0002	0.169	0.269	0.100
	859549H	Junius	0.004	0.006	0.002	0.002	0.002	0.001	0.0000	0.0001	0.0000	0.021	0.033	0.012
	859548B	Bowie St	0.002	0.004	0.001	0.001	0.002	0.001	0.0000	0.0000	0.0000	0.013	0.020	0.007

Table H-9 (continued)
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the Proposed Action

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
	859547U	Lawndale	0.043	0.068	0.025	0.017	0.026	0.010	0.0004	0.0006	0.0002	0.219	0.348	0.129
	859546M	Manchester St.	0.001	0.002	0.001	0.000	0.001	0.000	0.0000	0.0000	0.0000	0.006	0.010	0.004
Tower 30 to Tower 85	859533L	67th St.	0.004	0.006	0.002	0.002	0.002	0.001	0.0000	0.0000	0.0000	0.020	0.028	0.008
	859530R	66th St.	0.005	0.007	0.002	0.002	0.003	0.001	0.0000	0.0001	0.0000	0.025	0.035	0.010
	288035Y	Hughes St.	0.009	0.013	0.004	0.004	0.005	0.001	0.0001	0.0001	0.0000	0.048	0.067	0.019
Tower 85 to Tower 87	288034S	Harrisburg Blvd.	0.314	0.339	0.025	0.121	0.131	0.010	0.0028	0.0030	0.0002	1.601	1.729	0.128
	288033K	Sherman St.	0.041	0.044	0.003	0.016	0.017	0.001	0.0004	0.0004	0.0000	0.208	0.224	0.017
	288032D	Brady St.	0.011	0.012	0.001	0.004	0.004	0.000	0.0001	0.0001	0.0000	0.055	0.059	0.004
	288024L	Canal St.	0.117	0.126	0.009	0.045	0.049	0.004	0.0010	0.0011	0.0001	0.595	0.642	0.047
	288009J	Old Clinton Rd.	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.024	0.026	0.002
	288010D	Clinton Dr.	0.065	0.070	0.005	0.025	0.027	0.002	0.0006	0.0006	0.0000	0.331	0.357	0.026
	287996C	Market	0.043	0.047	0.003	0.017	0.018	0.001	0.0004	0.0004	0.0000	0.220	0.238	0.018
	287 994N	Lyons Ave.	0.012	0.013	0.001	0.005	0.005	0.000	0.0001	0.0001	0.0000	0.060	0.064	0.005
	287 982U	Wallisville Rd.	0.061	0.066	0.005	0.024	0.026	0.002	0.0006	0.0006	0.0000	0.313	0.338	0.025
Tower 87 to Dayton	758293C	Fields	0.007	0.008	0.001	0.003	0.003	0.000	0.0001	0.0001	0.0000	0.035	0.038	0.003
	745074B	Oates Road	0.040	0.044	0.004	0.016	0.017	0.002	0.0004	0.0004	0.0000	0.206	0.226	0.020
	762907S	Ralston Rd	0.013	0.015	0.001	0.005	0.006	0.000	0.0001	0.0001	0.0000	0.068	0.074	0.007
	762905D	Heather Row rd	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.025	0.028	0.002
	762904W	Ce King Pkwy	0.037	0.041	0.004	0.014	0.016	0.001	0.0003	0.0004	0.0000	0.191	0.210	0.018
	762901B	Van Hut Rd	0.016	0.018	0.002	0.006	0.007	0.001	0.0001	0.0002	0.0000	0.083	0.091	0.008
	762897N	Reservoir Rd	0.008	0.009	0.001	0.003	0.003	0.000	0.0001	0.0001	0.0000	0.040	0.044	0.004
	762895A	Aqueduct Rd	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.001	0.001	0.000
	762892E	Sheldon Rd.	0.013	0.014	0.001	0.005	0.006	0.000	0.0001	0.0001	0.0000	0.067	0.074	0.006
	762872T	First St or Miller Wilson Rd	0.012	0.014	0.001	0.005	0.005	0.000	0.0001	0.0001	0.0000	0.063	0.069	0.006
	762869K	Ramsey Rd	0.004	0.004	0.000	0.001	0.002	0.000	0.0000	0.0000	0.0000	0.019	0.020	0.002

Table H-9 (continued)
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the Proposed Action

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
	762866P	Boheman Hall Rd or Adlong Johnson Rd	0.002	0.002	0.000	0.001	0.001	0.000	0.0000	0.0000	0.0000	0.009	0.010	0.001
	762865H	Crosby E Gate Rd	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.025	0.028	0.002
	762861F	Lord Rd	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.005	0.006	0.001
	762859E	Shady Lane	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
	762856J	County Rd 604	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
	762855C	County Rd 603	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.005	0.006	0.001
	762853N	Wolf Island	0.004	0.004	0.000	0.001	0.002	0.000	0.0000	0.0000	0.0000	0.018	0.020	0.002
	762852G	Sw. Dayton or Stilson Rd	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
Baytown Subdivision	762790L	US 90	0.327	0.371	0.044	0.126	0.143	0.017	0.0029	0.0033	0.0004	1.667	1.890	0.224
		Total	1.63	2.42	0.79	0.63	0.93	0.30	0.015	0.022	0.0071	8.30	12.32	4.01

[1]1996 ADT DATA

Table H-10
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the No-Build Alternative

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
Bayport Loop South of Bay Area Boulevard/ Port Road	755672S	N. Bound Front Rd	0.005	0.007	0.001	0.002	0.003	0.000	0.0000	0.0001	0.0000	0.028	0.033	0.005
	758824W	Port Road	0.027	0.033	0.005	0.011	0.013	0.002	0.0002	0.0003	0.0000	0.140	0.166	0.027
Bayport Loop North of Bay Area Boulevard/ Port Road	758835J	Bay Area Blvd	0.331	0.394	0.063	0.128	0.152	0.024	0.0030	0.0035	0.0006	1.687	2.008	0.321
	758839L	Bay Area Blvd	0.229	0.273	0.044	0.088	0.105	0.017	0.0021	0.0024	0.0004	1.168	1.390	0.222
Bayport Industrial Lead	758826K	Fairmont Pkwy	0.331	0.420	0.089	0.128	0.162	0.034	0.0030	0.0038	0.0008	1.687	2.143	0.456
Strang Subdivision (Strang Yard to Pasadena Junction)	758848K	Houston Rd	0.011	0.012	0.002	0.004	0.005	0.001	0.0001	0.0001	0.0000	0.054	0.063	0.009
	758849S	Underwood Rd[1]	0.114	0.133	0.019	0.044	0.051	0.007	0.0010	0.0012	0.0002	0.584	0.680	0.096
	758854N	Ivy St.	0.004	0.005	0.001	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.023	0.027	0.004
	758855V	Center St.	0.102	0.119	0.017	0.039	0.046	0.007	0.0009	0.0011	0.0002	0.521	0.607	0.086
	758856C	Shabbona/Robi St.	0.026	0.031	0.004	0.010	0.012	0.002	0.0002	0.0003	0.0000	0.133	0.156	0.022
	755675M	Sh 225 Wbfrontage	0.028	0.033	0.005	0.011	0.013	0.002	0.0003	0.0003	0.0000	0.145	0.169	0.024
	755362X	Tenneco Rd.	0.017	0.020	0.003	0.007	0.008	0.001	0.0002	0.0002	0.0000	0.088	0.103	0.015
	869756E	South St (Ethyl)	0.023	0.026	0.004	0.009	0.010	0.001	0.0002	0.0002	0.0000	0.116	0.135	0.019
	869754R	Jefferson St.	0.048	0.056	0.008	0.019	0.022	0.003	0.0004	0.0005	0.0001	0.247	0.287	0.041
	869753J	Davison	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.001	0.001	0.000
	869752C	Witter	0.009	0.011	0.002	0.004	0.004	0.001	0.0001	0.0001	0.0000	0.047	0.055	0.008
Strang Subdivision (Sinco Jn to Pasadena Jn)	869723S	N. Richey St.	0.004	0.004	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.020	0.022	0.002
Strang Subdivision (Tower 30 to Sinco Junction)	755363E	Light Co Rd	0.040	0.046	0.006	0.016	0.018	0.002	0.0004	0.0004	0.0001	0.205	0.237	0.031
	755364L	Dodge	0.043	0.050	0.007	0.017	0.019	0.003	0.0004	0.0004	0.0001	0.221	0.254	0.034
	755365T	Shaw	0.029	0.033	0.004	0.011	0.013	0.002	0.0003	0.0003	0.0000	0.146	0.168	0.022
	755366A	Lawndale St.	0.085	0.098	0.013	0.033	0.038	0.005	0.0008	0.0009	0.0001	0.436	0.502	0.067
	755369V	Allen Genoa Rd.	0.110	0.127	0.017	0.042	0.049	0.006	0.0010	0.0011	0.0002	0.560	0.646	0.086
	755374S	Lawndale[2]	0.093	0.107	0.014	0.036	0.041	0.005	0.0008	0.0010	0.0001	0.472	0.544	0.072

Table H-10 (continued)
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the No-Build Alternative

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
	755375Y	Central St.	0.031	0.036	0.005	0.012	0.014	0.002	0.0003	0.0003	0.0000	0.159	0.184	0.024
	755376F	Central St.	0.019	0.022	0.003	0.007	0.008	0.001	0.0002	0.0002	0.0000	0.097	0.112	0.015
	755382J	Manchester St	0.042	0.048	0.006	0.016	0.018	0.002	0.0004	0.0004	0.0001	0.212	0.244	0.032
	869708P	Frio St.	0.004	0.005	0.001	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.022	0.026	0.003
	859544Y	Fennell	0.006	0.007	0.001	0.002	0.003	0.000	0.0001	0.0001	0.0000	0.032	0.037	0.005
	859543S	San Antonio St.	0.002	0.002	0.000	0.001	0.001	0.000	0.0000	0.0000	0.0000	0.008	0.009	0.001
Tower 30 to Tower 85	859533L	67th St.	0.004	0.006	0.002	0.002	0.002	0.001	0.0000	0.0000	0.0000	0.020	0.028	0.008
	859530R	66th St.	0.005	0.007	0.002	0.002	0.003	0.001	0.0000	0.0001	0.0000	0.025	0.035	0.010
	288035Y	Hughes St.	0.009	0.013	0.004	0.004	0.005	0.001	0.0001	0.0001	0.0000	0.048	0.067	0.019
Tower 85 to Tower 87	288034S	Harrisburg Blvd.	0.314	0.339	0.025	0.121	0.131	0.010	0.0028	0.0030	0.0002	1.601	1.729	0.128
	288033K	Sherman St.	0.041	0.044	0.003	0.016	0.017	0.001	0.0004	0.0004	0.0000	0.208	0.224	0.017
	288032D	Brady St.	0.011	0.012	0.001	0.004	0.004	0.000	0.0001	0.0001	0.0000	0.055	0.059	0.004
	288024L	Canal St.	0.117	0.126	0.009	0.045	0.049	0.004	0.0010	0.0011	0.0001	0.595	0.642	0.047
	288009J	Old Clinton Rd.	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.024	0.026	0.002
	288010D	Clinton Dr.	0.065	0.070	0.005	0.025	0.027	0.002	0.0006	0.0006	0.0000	0.331	0.357	0.026
	287996C	Market	0.043	0.047	0.003	0.017	0.018	0.001	0.0004	0.0004	0.0000	0.220	0.238	0.018
	287994N	Lyons Ave.	0.012	0.013	0.001	0.005	0.005	0.000	0.0001	0.0001	0.0000	0.060	0.064	0.005
	287982U	Wallisville Rd.	0.061	0.066	0.005	0.024	0.026	0.002	0.0006	0.0006	0.0000	0.313	0.338	0.025
Tower 87 to Dayton	758293C	Fields	0.007	0.008	0.001	0.003	0.003	0.000	0.0001	0.0001	0.0000	0.035	0.038	0.003
	745074B	Oates Road	0.040	0.044	0.004	0.016	0.017	0.002	0.0004	0.0004	0.0000	0.206	0.226	0.020
	762907S	Ralston Rd	0.013	0.015	0.001	0.005	0.006	0.000	0.0001	0.0001	0.0000	0.068	0.074	0.007
	762905D	Heather Row Rd	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.025	0.028	0.002
	762904W	Ce King Pkwy	0.037	0.041	0.004	0.014	0.016	0.001	0.0003	0.0004	0.0000	0.191	0.210	0.018
	762901B	Van Hut Rd	0.016	0.018	0.002	0.006	0.007	0.001	0.0001	0.0002	0.0000	0.083	0.091	0.008
	762897N	Reservoir Rd	0.008	0.009	0.001	0.003	0.003	0.000	0.0001	0.0001	0.0000	0.040	0.044	0.004
	762895A	Aqueduct Rd	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.001	0.001	0.000
	762892E	Sheldon Rd.	0.013	0.014	0.001	0.005	0.006	0.000	0.0001	0.0001	0.0000	0.067	0.074	0.006

Table H-10 (continued)
Estimated Emissions Due to Highway/Rail At-Grade Crossing Delay for the No-Build Alternative

Segments	FRA Crossing ID Number	Street Name	VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)			NO_x Emissions from Delayed Idling Vehicles (tons NO_x/year)			PM Emissions from Delayed Idling Vehicles (tons PM/year)			CO Emissions from Delayed Idling Vehicles (tons CO/year)		
			Pre	Post	△	Pre	Post	△	Pre	Post	△	Pre	Post	△
	762872T	First St or Miller Wilson Rd	0.012	0.014	0.001	0.005	0.005	0.000	0.0001	0.0001	0.0000	0.063	0.069	0.006
	762869K	Ramsey Rd	0.004	0.004	0.000	0.001	0.002	0.000	0.0000	0.0000	0.0000	0.019	0.020	0.002
	762866P	Boheman Hall Rd or Adlong Johnson Rd	0.002	0.002	0.000	0.001	0.001	0.000	0.0000	0.0000	0.0000	0.009	0.010	0.001
	762865H	Crosby E Gate Rd	0.005	0.005	0.000	0.002	0.002	0.000	0.0000	0.0000	0.0000	0.025	0.028	0.002
	762861F	Lord Rd	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.005	0.006	0.001
	762859E	Shady Lane	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
	762856J	County Rd 604	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
	762855C	County Rd 603	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.005	0.006	0.001
	762853N	Wolf Island	0.004	0.004	0.000	0.001	0.002	0.000	0.0000	0.0000	0.0000	0.018	0.020	0.002
	762852G	SW. Dayton or Stilson Rd	0.001	0.001	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.003	0.004	0.000
Baytown Subdivision	762790L	US 90	0.327	0.371	0.044	0.126	0.143	0.017	0.0029	0.0033	0.0004	1.667	1.890	0.224
		Total	3.00	3.46	0.46	1.16	1.34	0.18	0.027	0.031	0.004	15.3	17.7	2.4

[1] 1996 ADT DATA

[2] 1992 ADT DATA

Table H-11
Summary of Estimated Changes in Emissions at Highway/Rail At-Grade Crossings

		Proposed Action	**No-Build Alternative**
VOCs Emissions from Delayed Idling Vehicles (tons VOCs/year)	Pre	1.63	3.00
	Post	2.42	3.46
	Δ	0.79	0.46
NO_X Emissions from Delayed Idling Vehicles (tons NO_X/year)	Pre	0.63	1.16
	Post	0.93	1.34
	Δ	0.30	0.18
PM Emissions from Delayed Idling Vehicles (tons PM/year)	Pre	0.015	0.027
	Post	0.022	0.031
	Δ	0.007	0.004
CO Emissions from Delayed Idling Vehicles (tons CO/year)	Pre	8.3	15.3
	Post	12.3	17.7
	Δ	4.0	2.4