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Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Los Angeles Transportation Center, Los Angeles, California

prepared for:

Union Pacific Railroad Company

January 2007

prepared by:

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SUMMARY

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), Union Pacific Railroad Company (UPRR) has prepared a facility-wide emission inventory for the Los Angeles Transportation Center (LATC or Yard) in Los Angeles, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, area, and portable sources at LATC. The inventory has been prepared in accordance with CARB's *Rail Yard Emission Inventory Methodology* guidelines (July 2006) and UPRR's *Emission Inventory Protocol* (May 2006).

LATC is an intermodal container facility. Cargo containers are received, sorted, and distributed from the facility. Activities at LATC include receiving inbound trains, switching cars, loading and unloading intermodal trains, storing intermodal containers and chassis, building and departing outbound trains, and repairing freight cars and intermodal containers/chassis. Facilities within LATC include classification tracks, a gate complex for inbound and outbound intermodal truck traffic, intermodal loading and unloading tracks, and various buildings and facilities supporting railroad and contractor operations.

Emission sources include, but are not limited to, locomotives, light-heavy-duty Diesel-fueled trucks, heavy-heavy-duty Diesel-fueled trucks, cargo handling equipment, transport refrigeration units and refrigerated rail cars, and fuel storage tanks. Emissions were calculated on a source-specific and facility-wide basis for the 2005 baseline year.

An air dispersion modeling analysis was also conducted for LATC. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations near the Yard. Emission sources included in the modeling analysis were locomotives, heavy-heavy duty (HHD) Diesel-fueled trucks, Diesel-fueled cargo handling equipment (CHE), Diesel-fueled heavy equipment, and a gasoline storage tank. The air dispersion modeling was conducted using the AERMOD Gaussian plume dispersion model and wind speed, wind direction and temperature data from the Downtown Los Angeles – North Main monitoring station operated by the South

Coast Air Quality Management District (SCAQMD), Missing data was replaced by data from Los Angeles International Airport (LAX), and cloud cover data was also obtained from the LAX station operated by the National Weather Service. The meteorological data was processed using the AERMET program. The modeling analysis was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006).

Toxic Air Contaminant Emission Inventory and Dispersion Modeling Report for the Los Angeles Transportation Center Los Angeles, California

TABLE OF CONTENTS

Page

SUMMARY i

PART I. INTRODUCTION 1

PART II. FACILITY DESCRIPTION 2
- A. Facility Name and Address 2
- B. Facility Contact Information 2
- C. Main Purpose of the Facility 2
- D. Type of Operations Performed at the Facility 2
- E. Facility Operating Schedule 3
- F. General Land Use Surrounding the Facility 3

PART III. MAP AND FACILITY PLOT PLAN 4

PART IV. COVERED SOURCES 6

PART V. SITE-SPECIFIC EQUIPMENT INVENTORY 7
- A. Locomotives 7
- B. LHD Diesel-Fueled Trucks 8
- C. HHD Diesel-Fueled Trucks 8
- D. Cargo Handling Equipment 9
- E. Heavy Equipment 9
- F. Tanks 10
- G. TRUs and Reefer Cars 10
- H. Portable Equipment 11

PART VI. ACTIVITY DATA 12
- A. Locomotives 12
- B. LHD Diesel-Fueled Trucks 15
- C. HHD Diesel-Fueled Trucks 16
- D. Cargo Handling Equipment 17
- E. Heavy Equipment 18
- F. Tanks 18
- G. TRUs and Reefer Cars 19

TABLE OF CONTENTS (continued)

Page

PART VII. EMISSIONS....20
A. Calculation Methodology and Emission Factors....20
1. Locomotives....20
2. LHD Diesel-Fueled Truck....26
3. HHD Diesel-Fueled Trucks....26
4. Cargo Handling Equipment....27
5. Heavy Equipment....28
6. Tanks....29
7. TRUs and Reefer Cars....29
B. TAC Emissions by Source Type....30
C. Facility Total Emissions....34

PART VII. RISK SCREENING CALCULATIONS....35

PART IX. AIR DISPERSION MODELING....37
A. Modeling Selection and Preparation....37
1. Modeled Sources and Source Treatment....37
2. Model Selection....39
3. Modeling Inputs....40
4. Meteorological Data Selection....41
5. Model Domain and Receptor Grids....46
6. Dispersion Coefficients....52
7. Building Downwash....53
B. Modeling Results....53
C. Demographic Data....54

PART X. REFERENCES....55

LIST OF APPENDICES

Appendix A – Locomotive Data

Appendix B – Emission Factor Derivation and EMFAC-WD 2006 Output for On-Road Diesel-Fueled Trucks

Appendix C – Emission Factor Derivation, EMFAC-WD 2006 Output, and the CARB Technical Support Document for HHD Diesel-Fueled Trucks

Appendix D – Emission Factor Derivation and OFFROAD2006 Output for Cargo Handling Equipment

Appendix E – Emission Factor Derivation and OFFROAD2006 Output for Heavy Equipment

Appendix F – TANKS Output and SPECIATE Database Sections for the Gasoline Storage Tank

Appendix G – Emission Factor Derivation and OFFROAD2006 Output for TRUs and Reefer Cars

Appendix H – Detailed Emission Calculations

Appendix I – Detailed Risk Screening Calculations

Appendix J – Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources

Appendix K – Seasonal and Diurnal Activity Profiles

Appendix L – Selection of Population for the Urban Option Input in AERMOD Air Dispersion Modeling Analysis

Appendix M – Demographic Data

LIST OF FIGURES

Page

1. Location Map 4
2. LATC Rail Yard Layout....5
3. Source Locators....38
4. Coarse Modeling Grid....47
5. Fine Modeling Grid....48
6. Sensitive Receptors 52

LIST OF TABLES

Page

1. Locomotive Models (Road Power) Identified at LATC 8
2. Equipment Specifications for Cargo Handling Equipment 9
3. Equipment Specifications for Heavy Equipment 9
4. Storage Tank Specifications 10
5. Portable Equipment Specifications 11
6. Train Activity Summary 14
7. Summary of LHD Diesel Truck Activity Data 15
8. Summary of Gate Count Data 16
9. Summary of HHD Diesel Truck Activity Data 17
10. Activity Data for Cargo Handling Equipment 18
11. Activity Data for Heavy Equipment 18
12. Summary of Gasoline Storage Tank Activity Data 19
13. Activity Data for TRUs and Reefer Cars 19
14. Locomotive Diesel Particulate Matter Emission Factors 24
15. Locomotive Diesel Particulate Matter Emission Factors 25
16. Emission Factors for the LHD Diesel-Fueled Truck 26
17. Emission Factors for HHD Diesel-Fueled Trucks 27
18. Emission Factors for Cargo Handling Equipment 28
19. Emission Factors for Heavy Equipment 28
20. TAC Emission Factors for Gasoline Storage Tank 29
21. Emission Factors for TRUs and Reefer Cars 30
22. Locomotive Duty Cycles 30
23. DPM Emissions from Locomotives 31
24. DPM Emissions from the LHD Diesel-Fueled Truck 32
25. DPM Emissions from HHD Diesel-Fueled Trucks 32
26. DPM Emissions from Cargo Handling Equipment 32
27. DPM Emissions from Heavy Equipment 33
28. TAC Emissions from Gasoline Storage Tanks 33
29. DPM Emissions from TRUs and Reefer Cars 34
30. Facility-Wide Diesel Particulate Emissions 34
31. Summary of Weighted Risk by Source Category 35
32. Summary of De Minimis Sources 36
33. Source Treatment for Air Dispersion Modeling 38
34. Locomotive Modeling Inputs 43
35. Non-locomotive Modeling Inputs 44
36. Sensitive Receptor Locations 49

Toxic Air Contaminant Emission Inventory and Dispersion Modeling Report for the Los Angeles Transportation Center Los Angeles, California

PART I. INTRODUCTION

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), Union Pacific Railroad Company (UPRR) has prepared a facility-wide emission inventory for the Los Angeles Transportation Center (LATC or Yard) in Los Angeles, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, and portable sources at LATC. The inventory has been prepared in accordance with CARB's *Rail Yard Emission Inventory Methodology* guidelines (July 2006) and UPRR's *Emission Inventory Protocol* (May 2006).

An air dispersion modeling analysis was also conducted for LATC. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations near the Yard. Emission sources included in the modeling analysis were locomotives, heavy-heavy duty (HHD) Diesel-fueled trucks, Diesel-fueled cargo handling equipment (CHE), Diesel-fueled heavy equipment, and a gasoline storage tank. The air dispersion modeling was conducted using the AERMOD Gaussian plume dispersion model and wind speed, wind direction, and temperature data from the Downtown Los Angeles – North Main monitoring station[1] operated by the South Coast Air Quality Management District. Missing data was replaced by data from Los Angeles International Airport (LAX), and cloud cover data was also obtained from the LAX station operated by the National Weather Service. The meteorological data was processed using the AERMET program. The modeling analysis was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006).

[1] Located at 1630 North Main Street, Los Angeles, CA 90012

PART II. FACILITY DESCRIPTION

A. Facility Name and Address

Union Pacific Railroad Company
Los Angeles Transportation Center
750 Lamar St.
Los Angeles, CA 90031

B. Facility Contact Information

Brock Nelson
Director of Environmental Operations – West
Union Pacific Railroad Company
10031 Foothills Boulevard
Roseville, CA 95747
Phone: (916) 789-6370
Fax: (402) 233-3162
banelson@up.com

C. Main Purpose of the Facility

The LATC Yard is an intermodal container facility. Cargo containers are received, sorted, and distributed from the facility. Intermodal containers may arrive at the facility by truck to be loaded onto trains for transport to distant destinations, or arrive by train and unloaded onto chassis for transport by truck to local destinations. Cargo containers and chassis are also temporarily stored at LATC. Cranes and packers are washed at LATC. Wastewater generated during equipment washing is shipped, by tanker truck, to the Commerce Yard WWTP for treatment.

D. Type of Operations Performed at the Facility

Activities at LATC include receiving inbound trains, switching cars, loading and unloading intermodal trains, storing intermodal containers and chassis, building and departing outbound trains, and repairing freight cars and intermodal containers/chassis. Facilities within LATC include classification tracks, a gate complex for inbound and

outbound intermodal truck traffic, intermodal loading and unloading tracks, and various buildings and facilities supporting railroad and contractor operations.

E. Facility Operating Schedule

The facility operates 24 hours per day, 365 days per year.

F. General Land Use Surrounding the Facility

The land use surrounding the facility within 1,000 feet is mostly industrial-commercial, with residential areas at the northwest and northeast corners of the facility. Additional residential areas are located approximately 1,500 feet to the south of the facility. There are 26 elementary schools, 19 day care centers, 7 hospitals, and 1 nursing home within 1 mile of the facility. The location of specific receptors is further discussed in Part IX.

PART III. MAP AND FACILITY PLOT PLAN

Figure 1
Location Map

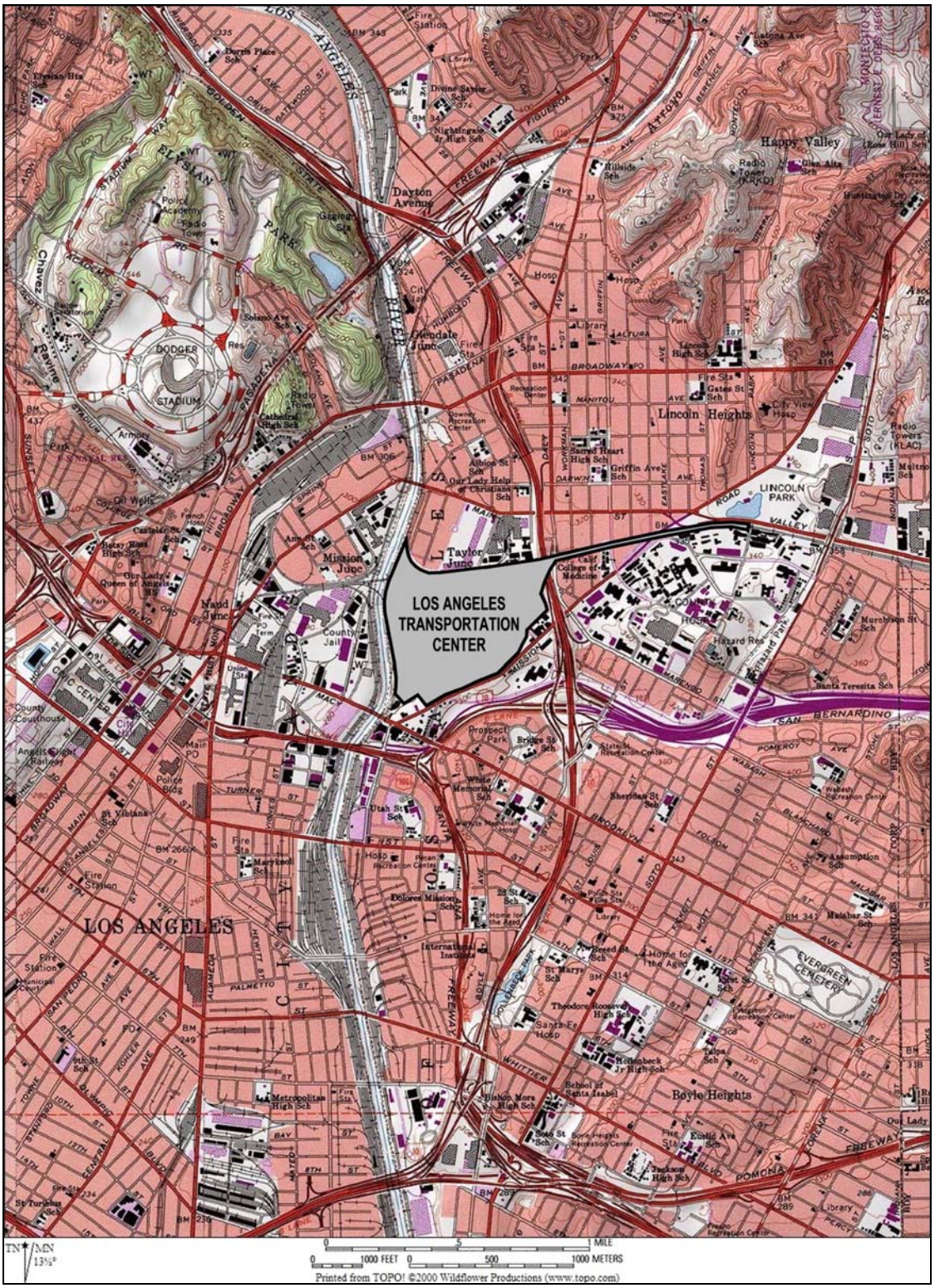
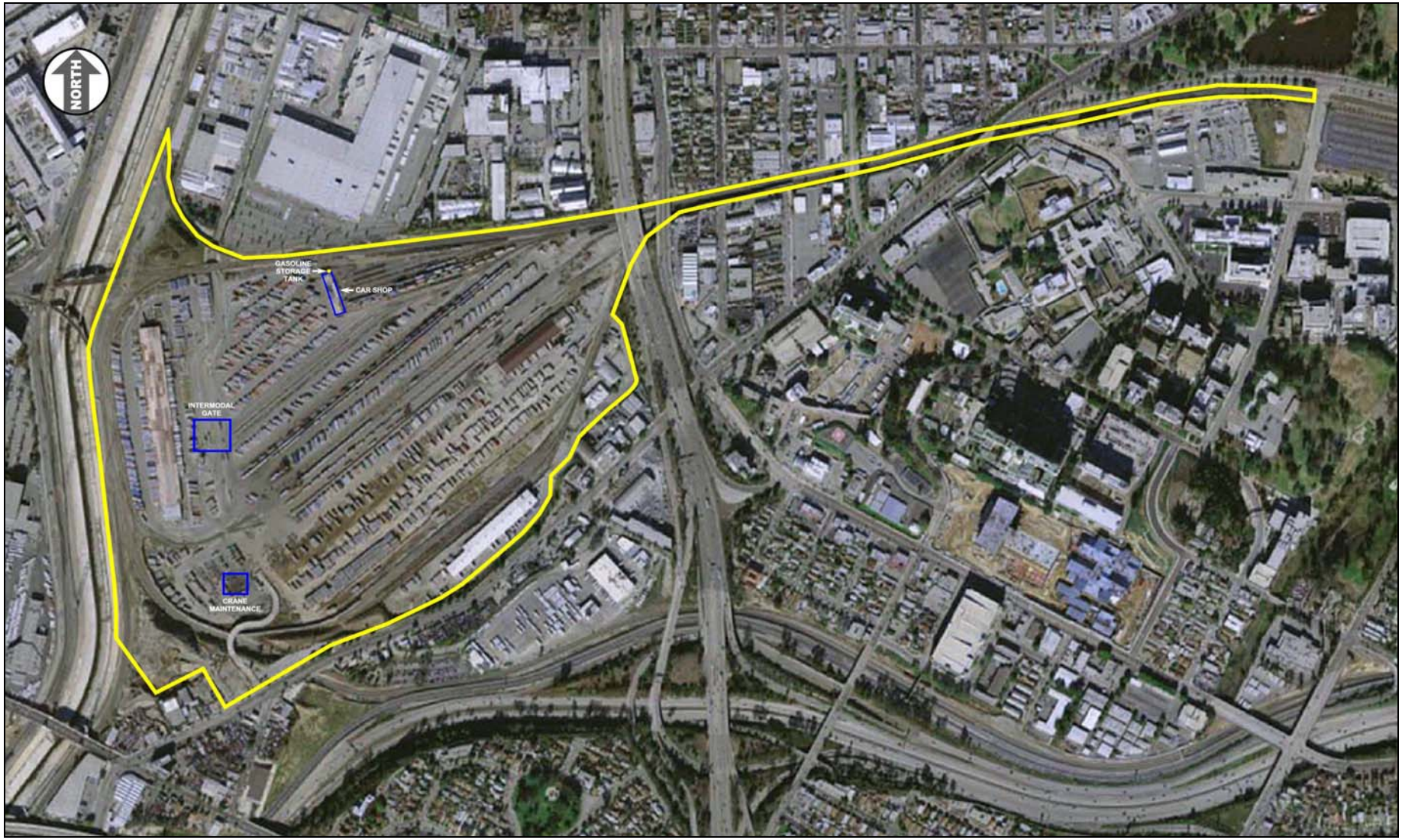


Figure 2
LATC Rail Yard Layout



PART IV. COVERED SOURCES

This emission inventory quantifies toxic air contaminant (TAC) emissions from the stationary, mobile, and portable sources located or operating at LATC. Sources include, but are not limited to, locomotives, light-heavy-duty Diesel-fueled trucks, heavy-heavy-duty (HHD) Diesel-fueled trucks, cargo handling equipment (CHE), transport refrigeration units (TRUs) and refrigerated railcars (reefer cars), and fuel storage tanks. A site-specific equipment inventory is included in Section V below.

Stationary point and area sources that are exempt from local air district rules have been identified but not included in the detailed emission inventory. As agreed upon in the emission inventory protocol approved by the CARB, de minimis sources, based on weighted risk, have been identified in the inventory but were not further discussed or included in the modeling analysis. De minimis sources are the individual sources that represent less than 3 percent of the facility-total weighted-average site health risk (determined separately for cancer risk and non-cancer chronic health hazard). Total exclusions for all de minimis sources did not exceed 10 percent of the facility-total weighted-average site cancer risk or chronic health hazard. De minimis sources are further discussed in Part VIII of this report.

PART V. SITE-SPECIFIC EQUIPMENT INVENTORY

As discussed in Part IV above, there are a number of mobile, stationary, and portable emissions sources operating at LATC. The mobile sources include locomotives, light-heavy duty (LHD) Diesel-fueled trucks, heavy-heavy duty (HHD) Diesel-fueled trucks, cargo handling equipment (CHE), and heavy equipment. The only stationary emission sources discussed in the report are storage tanks. Portable equipment operating at the Yard includes transport refrigeration units (TRUs) and refrigerated railcars (reefer cars), welders, air compressors, and light towers. Each source group is further discussed below.

A. Locomotives

Locomotive activities at the yard fall into several categories. "Road power" activities (locomotives used on inbound and outbound freight) include hauling through trains on the main line; pulling arriving trains through the yard and departing trains out of the yard; and movements of locomotives to and from maintenance facilities at other locations after arrival and prior to departure. Yard operations include the use of three sets of low horsepower locomotives to move sections of trains within the yard. During 2005, the working sets included two pairs of remote control locomotive (RCL) switchers and one pair of switchers operated by an on-board engineer.

Table 1 provides the number of locomotives in operation (arrivals, departures, and through traffic) at the yard during 2005 by locomotive model group and type of train. Through trains use the main line passing by the facility. Intermodal trains and occasionally other trains enter the yard on specified tracks. Power moves are trains with locomotives but no cars, whose objective is either to move locomotives to locations where they are needed or to take malfunctioning units to service facilities. In general, only one or two locomotives are in operation during power moves.

Table 1
Locomotive Models (Road Power) Identified at
Los Angeles Transportation Center

Locomotive Model Group	Train Type[1]		
	Through Trains	Arriving/Departing Trains	Power Moves
Switch[2]	7	12	11
GP3x	55	53	35
GP4x	1,264	960	373
GP50	65	55	34
GP60	2,771	942	375
SD7x	3,559	4,910	1,743
SD90	141	7	9
Dash7	4	2	2
Dash8	819	900	379
Dash9	2,904	1,561	641
C60A	96	18	4
Unknown	92	76	33
Total	**11,777**	**9,496**	**3,639**

Notes:
1. Includes all locomotives identified on an arriving, a departing, or a through train, including both working and non-working units.
2. Does not include switcher locomotives used for yard operations.

B. LHD Diesel-Fueled Trucks

There is one light-heavy duty (LHD) Diesel-fueled truck, a 2003 Dodge 2500 pickup, operating at LATC to support Yard activities.

C. HHD Diesel-Fueled Trucks

A variety of HHD Diesel-fueled trucks operate at LATC each day. The HHD trucks are used to pick up and deliver cargo containers. The trucks are owned and operated by many large trucking companies and independent operators (draymen). Therefore, a fleet distribution is not available. For emission calculations, the EMFAC-WD 2006 model default fleet distribution for HHD Diesel-fueled operating in Los Angeles County was used.

D. Cargo Handling Equipment

A variety of heavy equipment is used to load, unload, and move cargo containers in the Yard. Table 2 provides the equipment specifications for CHE operating at LATC.

Table 2
Equipment Specifications for Cargo Handling Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Engine Make/Model	Model Year	Rating (hp)	No. of Units
Forklift	Taylor THD200S	Perkins 1006-6T	2000	154	1
RTG[1]	Mi Jack 1000RC	Detroit DDEC	2004	300	2
RTG[1,2]	Mi Jack 1000R	Detroit 671TA	1984	300	3
Top Pick	Mi Jack MJ9090	Cummins NA335	1990	335	1
Top Pick	Taylor TEC 155H	Cummins 6BT	1998	150	1
Yard Hostler	Ottawa Commando30	Cummins 5.9 BT	2003	150	3
Yard Hostler	Ottawa Commando30	Cummins 5.9 BT	2004	150	10

Notes:
1. Rubber Tire Gantry Crane.
2. Two of these units are not being used.

E. Heavy Equipment

In addition to the CHE discussed above, Diesel-fueled heavy equipment is used at LATC. The heavy equipment is used for non-cargo-related activities at the Yard, such as locomotive maintenance, handling of parts and Company material, derailments, etc. Table 3 provides detailed information for the heavy equipment used at the Yard.

Table 3
Equipment Specifications for Heavy Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Engine Make/Model	Model Year	Rating (hp)	No. of Units
Crane	Grove RT650E	Cummins 5.9 BT	2003	275	1
Forklift	Lull	John Deere	2004	150	1
Forklift	Toyota	Unknown	1999	150	1

F. Tanks

There are a number of tanks at the facility that are used to store liquid petroleum products such as Diesel fuel, gasoline, lubricating oils, and used oil. Table 4 provides detailed information for all storage tanks located at the facility.

Table 4
Storage Tank Specifications
Los Angeles Transportation Center

Tank Location	Material Stored	Tank Capacity (gallons)
RIP Track[1]	Diesel	500
RIP Track	Gasoline	500
Crane Maintenance[1]	Diesel	1,000
Crane Maintenance[1]	Hydraulic Oil	762
Crane Maintenance[1]	SAE 15w-40 Motor Oil	136
Crane Maintenance[1]	Used Oil	394
Crane Maintenance[1]	SAE 15w-40 Motor Oil	367
Crane Maintenance[1]	Automatic Transmission Fluid	314

Notes:
1. These tanks are exempt from permitting requirements per SCAQMD Rule 219 (m).

As shown in Table 4, all storage tanks at the facility, except the gasoline tank at the RIP (Repair in Place) track, are exempt from South Coast Air Quality Management District (SCAQMD) permitting requirements per Rule 219(m). Since these storage tanks are exempt from local air district rules, the emissions from these tanks were not included in the inventory or in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

G. TRUs and Reefer Cars

Transport refrigeration units (TRUs) and refrigerated railcars (reefer cars) are used to transport perishable and frozen goods. TRUs and reefer cars are transferred in and out of the Yard and are temporarily stored at the Yard. The TRUs are owned by a variety of independent shipping companies and equipment-specific data are not available. Therefore, the default equipment rating and distribution contained in the OFFROAD2006

model were used for emission calculations. It was assumed that the number of TRUs and reefer cars in the Yard at any one time remained constant during the year, with individual units cycling in and out of the Yard.

H. Portable Equipment

A variety of welders and other portable equipment are used at the Yard. Table 5 provides the equipment specifications for the welders and miscellaneous portable equipment.

Table 5
Portable Equipment Specifications
Los Angeles Transportation Center

Equipment Location	Equipment Type	Number of Units	Fuel Type	Rated Capacity (hp)
RIP Track	Welder	1	Gasoline	9
RIP Track	Welder	1	Gasoline	9
RIP Track	Air Compressor	1	Gasoline	49
RIP Track	Air Compressor	1	Diesel	45
Administrative Building	Light Tower	1	Diesel	10.7
Crane Maintenance	Welder	1	Gasoline	16

Internal combustion engines with a rated capacity of 50 brake horsepower or less are exempt from permitting requirements by SCAQMD Rule 219(b)(1). As shown in Table 5, all of the portable equipment operated at LATC has a rated capacity of less than 50 hp, and therefore is exempt from permitting requirements. Since these units are exempt from local air district rules, the emissions from these units were not included in the inventory or in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

PART VI. ACTIVITY DATA

Emissions from mobile sources are based on the number and type of equipment, equipment size, load factor, and operation during the baseline year of 2005. Since fuel consumption data were not available, default load factors from the OFFROAD2006 model and operating data were used for emission calculations. For sources where operating data weren't available, an average operating mode (AOM) was developed based on employee interviews.

A. Locomotives

Locomotive emissions were based on the number, model distribution, and operating conditions (idling, throttle notch, and speeds of movements, etc). Table 6 summarizes the activity data for locomotives operating on trains at LATC, including the number of trains and number of working locomotives per consist, as well as their idle and working time, and speed on arrival or departure. In general, arriving trains enter the Yard and stop while the railcars are detached from the locomotive. After the railcars are detached, the locomotives are moved to other yards on "power moves" for refueling and service. Prior to departure, locomotive consists return to LATC on power moves (usually from Commerce) and move to the appropriate end of an outbound train. The train departs after completion of the Federal Railroad Administration (FRA) mandated safety inspections (e.g., air pressure and brakes) and the arrival of the train crew. In some cases, trains that are nominally "through" trains (arriving and departing under the same train symbol and date) add or drop cars or locomotives at the LATC Yard. These trains are counted separately, as the idling period is shorter prior to departure, and the consist is not disconnected.

There are three (rather than the typical two) entrance and exit routes for trains at LATC. The UP main line is on the north and west sides of the facility, and is typically considered "East" and "West." In addition, UP trains arrive and depart from the north at the northwest corner of the yard. Because of this configuration, actual paths followed by arriving and departing locomotives must be inferred from the trains' nominal directions,

and the points of origin or termination. In addition, power moves within the yard may follow multiple paths in order for the lead locomotive of the consist to be oriented in the proper direction. Appendix A-3 shows the various routes followed by trains in the yard. Because of the limited size of the main portion of the LATC yard, all inbound trains are brought in from the west side of the yard. For westbound trains, this involves bringing them across the north boundary of the yard, turning south, and entering the primary intermodal arrival area. The head of the trains proceeds out of the yard along Alhambra Avenue to Valley Boulevard, stopping just before San Pablo Street. The power move disconnects, and moves backward along the track along the south edge of the yard and north until it can move forward again on the main line heading south to Commerce. Arrivals from the north enter the yard at the same location as westbound trains, but arrivals from the south traverse the north edge of the yard onto the tracks leading to San Pablo. Power move routes into the yard depend on the direction of departure of the assigned train. Eastbound trains always depart from the east end of the tracks leading to San Pablo Street, while northbound trains always depart from the main intermodal track within the yard. Other than power moves to Commerce, there are no southbound departing trains from LATC.

The UPRR Commerce Yard provides service and maintenance for the road power on trains arriving and departing from LATC. Consists from arriving trains at LATC continue to Commerce for refueling and service under a train symbol that designates the arrival at Commerce as a power move. Following service, consists are taken back to LATC by UPRR locomotive hostlers without using a train symbol. For this reason, the total locomotive count for arriving and departing locomotives on trains at LATC shows a net imbalance of approximately 3,400 locomotives for 2005. This number is approximately 30 percent higher than the number of identified departing power moves from LATC. For purposes of emission calculations, it is assumed this imbalance represents power moves by hostlers from Commerce to LATC, with the same average consist size as other identified power moves. In the emission calculations, the number of locomotives in arriving power moves from the south has been increased by this 3400

difference.[2] This results in a net balance in the number of arriving and departing locomotives. Although power moves may have as many as 10 or more locomotives, typically only one or two locomotives are actually working. For emission calculations, power moves were assumed to have 1.5 working locomotives (except for power moves involving just one locomotive).[3] In addition to road power, three sets of yard locomotives operate in the yard to move sections of inbound trains, spot them in the appropriate areas for handling, and subsequently reconnect these sections and move them to the appropriate outbound train areas. The two sets of RCL locomotives operate 24 hours per day, and the third set of switchers operates between 11 PM and 7 AM daily.

Table 6
Train Activity Summary
Los Angeles Transportation Center

Train Type	Number of Trains	Locomotives per Consist	Movement Speed (mph)	Idle Time (hrs)
Through S to E	676	3.69	10	0.167
Through E to S	1,433	2.72	10	0.167
Through N to E	97	3.23	10	0.0
Through E to N	669	2.14	10	0.167
Through S to N	360	2.96	10	0.0
Through N to S	646	3.14	10	0.0
Arrivals from E	621	3.27	10	1.0
Arrivals from S	16	2.13	10	1.0
Arrivals from N	344	2.52	10	1.0
Departures to E	438	3.58	10	2.0
Departures to W	636	3.56	10	2.0
Departures to S	48	2.06	10	2.0
Arr & Dep S to E	138	3.25	10	0.167
Arr & Dep E to S	446	2.54	10	0.167
Arr & Dep N to E	29	2.83	10	0.0
Arr & Dep E to N	101	2.54	10	0.167
Arr & Dep S to N	7	1.86	10	0.0

[2] A similar imbalance was seen in the analysis of Commerce train activity, with a higher number of units arriving (due to power moves under train symbols from LATC) than departing (due to hostler power moves from Commerce to LATC). In that analysis, the number of locomotives in departing power moves was increased to achieve a net balance in locomotives arriving and departing.

[3] UP personnel report that although the train data records for power moves may show all locomotives "working," in actuality all locomotives except for one at the front and rear end (and more commonly only one at the front end) are shut down as they are not needed to pull a train that consists only of locomotives. Assuming 1.5 working locomotives per power move may slightly overestimate the actual average number of working locomotives per power move.

Table 6
Train Activity Summary
Los Angeles Transportation Center

Train Type	Number of Trains	Locomotives per Consist	Movement Speed (mph)	Idle Time (hrs)
Arr & Dep N to S	153	2.14	10	0.0
Power Through E to S	106	4.42	10	0.167
Power Through N to E	52	3.69	10	0.0
Power Through E to N	23	2.87	10	0.167
Power Through S to N	4	2.25	10	0.0
Power Through N to S	21	3.81	10	0.0
Power from E	9	3.78	10	0.0
Power from S	15	3.53	10	0.0
Power from N	3	5.00	10	0.0
Power to E	127	3.32	10	1.0
Power to W	27	3.74	10	1.0
Power to S	583	3.30	10	1.0

Notes:
1. Data reflect the number of operating locomotives; locomotives that are being transported, but are not under power, are not shown.
2. In addition to the activities described above, three sets of switcher locomotives are used in Yard operations. Two sets are RCL and operate 24 hours a day, the third set operates between 11AM and 7PM daily.

B. LHD Diesel-Fueled Trucks

Emissions from the LHD Diesel-fueled truck are based on the annual vehicle miles traveled (VMT) and the amount of time spent idling. Table 7 summarizes the activity data for the LHD Diesel-fueled truck operating at the Yard.

Table 7
Summary of LHD Diesel Truck Activity Data
Los Angeles Transportation Center

Vehicle Class	Make/Model	Model Year	Annual VMT[1]	Idling Time	
				(min/day)	(hr/yr)
LHD	Dodge 2500	2003	5,000	15	91

Notes:
1. Annual vehicle miles traveled (VMT) and idling time provided by Tony Madrigal of PARSEC.

C. HHD Diesel-Fueled Trucks

Emissions from HHD Diesel-fueled trucks are based on the number of truck trips, the length of each trip, and the amount of time spent idling. Gate count data were used to determine the number of HHD trucks operating at LATC during the 2005 calendar year. UPRR personnel count the number of cargo containers processed through both the "in" and "out" gates of the Yard. Since each HHD truck holds only one cargo container, the gate counts were used to determine the number of HHD truck trips for 2005. Trucks that enter or exit the facility without a chassis and/or a cargo container are referred to as "bobtails." Based on personal communication with the Intermodal Operations Manger at LATC, the monthly gate counts were increased by 25% to account for bobtails. The monthly gate count data for 2005, including the estimated number of bobtails, are summarized in Table 8.

Table 8
Summary of Gate Count Data
Los Angeles Transportation Center

Month	In-Gate Total[1]	Out-Gate Total[1]	Bobtails[2]	Total
January	6,205	4,967	2,793	13,965
February	6,448	4,555	2,751	13,754
March	7,448	5,700	3,287	16,435
April	6,291	5,206	2,874	14,371
May	6,746	5,691	3,109	15,546
June	7,815	5,110	3,231	16,156
July	7,194	4,764	2,990	14,948
August	7,584	5,645	3,307	16,536
September	6,939	5,200	3,035	15,174
October	7,926	5,908	3,459	17,293
November	8,803	5,856	3,665	18,324
December	6,297	5,119	2,854	14,270
Totals	**85,696**	**63,721**	**37,354**	**186,771**

Notes:
1. Provided by UPRR's Manager of Intermodal Operations for LATC
2. Bobtails are trucks without a chassis and/or container. It was assumed bobtail counts are equal to 25% of the container count.

Table 9 summarizes the remaining activity data, such as annual VMT and idling time, for HHD Diesel-fueled trucks. In addition to the traveling emissions, an average idling time

of 30 minutes per HHD truck trip was assumed to account for emissions during truck queuing, staging, loading and/or unloading. Based on interviews with UPRR personnel, the average queuing time at the gate at LATC is less than 10 minutes per truck. In addition to idling during queuing, it was assumed that each truck idles an average of 15 minutes per trip while the chassis is connected/disconnected from the truck cab. An additional 5 minutes of idle per trip was included to account for any other delays that may be encountered.

Table 9
Summary of HHD Diesel Truck Activity Data
Los Angeles Transportation Center

Number of HHD Truck Trips[1]	VMT per HHD Truck Trip (mi/trip)[2]	Annual VMT (mi/yr)	Idling Time	
			(min/trip)[2]	(hr/yr)
186,771	1.5	280,157	30	93,386

Notes:
1. Provided by UPRR. See Table 8.
2. Engineering estimate based on observation of truck activity and interviews with the Manager of Intermodal Operations.

D. Cargo Handling Equipment

Emissions from CHE operating at the Yard are based on the number and type of equipment, equipment model year, equipment size, and the annual hours of operation. Activity data for CHE are summarized in Table 10.

Table 10
Activity Data for Cargo Handling Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	Rating (hp)	No. of Units	Hours of Operation (hr/yr per unit)
Forklift	Taylor THD200S	2000	154	1	260
RTG	Mi Jack 1000RC	2004	300	2	2,920
RTG[1]	Mi Jack 1000R	1984	300	1	2,920
Top Pick	Mi Jack MJ9090	1990	335	1	60
Top Pick	Taylor TEC 155H	1998	150	1	1,040
Yard Hostler	Ottawa Commando30	2003	150	3	8,000
Yard Hostler	Ottawa Commando30	2004	150	10	8,000

Notes:
1. There are a total of three units at the facility, but two are not being used.
2. Data provided during interviews with equipment operators.

E. Heavy Equipment

Emissions from heavy equipment operating at the Yard are based on the number and type of equipment, equipment model year, equipment size, and the annual hours of operation. Activity data for heavy equipment are summarized in Table 11.

Table 11
Activity Data for Heavy Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	Rating (hp)	No. of Units	Hours of Operation (hr/yr per unit)
Crane	Grove RT650E	2003	275	1	2,190
Forklift	Lull	2004	150	1	8,000
Forklift	Toyota	1999	150	1	2,190

Notes:
1. Data provided during interviews with UPRR personnel.

F. Tanks

Emissions from the non-exempt storage tanks located at LATC are based on the size of the tank, material stored, and annual throughput. Activity data for the non-exempt tanks are shown in Table 12.

Table 12
Summary of Gasoline Storage Tank Activity Data
Los Angeles Transportation Center

Tank Location	Material Stored	Tank Capacity (gal)	Tank Dimensions (ft)	Annual Throughput (gal/yr)[1]
RIP Track	Gasoline	500	5 x 4	6,000

Notes:
1. Information provided by David Hawthorne of UPRR.

G. TRUs and Reefer Cars

Emissions from TRUs and reefer cars are based on average size of the units, the average number of units in the Yard, and the hours of operation for each unit. Activity data for TRUs and reefer cars are summarized in Table 13.

Table 13
Activity Data for TRUs and Reefer Cars
Los Angeles Transportation Center

Equipment Type	Average Rating (hp)[1]	Average No. of Units in Yard[2]	Hours of Operation	
			(hr/day)[3]	(hr/yr)[4]
Container	28.56	20	4	1,460
Railcar	34	4	4	1,460

Notes:
1. Based on the average horsepower distribution in the OFFROAD2006 model.
2. UPRR staff estimates and car data reports indicate that there are 8-10 TRUs and 0-2 reefer cars in the Yard at any given time. To be conservative, these estimates were increased by 100%.
3. From CARB's *Staff Report: Initial Statement of Reason for Proposed Rulemaking for Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate*, October 2003.
4. It was assumed that the number of units and the annual hours of operation remain constant, with individual units cycling in and out of the Yard.

PART VII. EMISSIONS

A. Calculation Methodology and Emission Factors

Emission calculations were based on the site-specific equipment inventory, equipment activity data, and the source-specific emission factors. The calculation methodology and emission factors for each specific source type are further discussed below. Emissions were calculated in accordance with CARB Guidelines (July 2006) and the UPRR *Emission Inventory Protocol* (May 2006).

1. Locomotives

Emissions were calculated for UPRR-owned and -operated locomotives, as well as "foreign" locomotives [4] operating in the rail yard and on through trains on the main line. Procedures for calculating emissions followed the methods described in Ireson et al. (2005).[5] A copy of Ireson et al is contained in Appendix A-6.

Emissions from locomotive activities were calculated based on the number of working locomotives, time spent in each notch setting, and locomotive model-group distributions, with model groups defined by manufacturer and engine type.[6] A separate calculation was performed for each type of locomotive activity, including line-haul or switcher locomotive operations, and consist movements. Speed, movement duration, and throttle notch values were obtained from UPRR personnel for the LATC Yard for different types of activities. Detailed counts of locomotive by model, tier, and train type are shown in Appendix A-1 and A-2. Maps detailing the principal locomotive routes at the Yard are contained in Appendix A-5.

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[4] Foreign locomotives are locomotives not owned by UPRR, including passenger trains and locomotives owned by other railroads that are brought onto the UPRR system via interchange.

[5] Ireson, R.G., M.J. Germer, L.A. Schmid (2005). "Development of Detailed Railyard Emissions to Capture Activity, Technology, and Operational Changes." Proceedings of the USEPA 14th Annual Emission Inventory Conference, *http://www.epa.gov/ttn/chief/conference/ei14/session8/ireson.pdf*, Las Vegas NV, April 14, 2006.

[6] Emission estimates are based on the total number of working locomotives. Therefore, the total number of locomotives used in the emission calculations, shown in Table 8, is slightly lower than the total number of locomotives counted as arriving, departing, or through trains (shown in Table 1). See Appendix A for detailed emission calculations.

Notch-specific emission factors were assembled from a number of sources. These included emission factors presented in CARB's *Roseville Rail Yard Study* (October, 2004), as well as EPA certification data and other testing by Southwest Research Institute of newer technology locomotives.

For line haul operations, yard-specific average consist composition (number of units, number of units working, model distribution, locomotive tier distribution, fraction equipped with auto start/stop technology[7]) was developed from UPRR data for different train types. Movement speed, duration, and notch estimates were developed for arriving, departing, through train, and in-yard movements. Idle duration was estimated based on UPRR operator estimates for units not equipped with auto start/stop. Units that were equipped with AESS/ZTR technology were assumed to idle for 30 minutes per extended idle event, with other locomotives idling for the remaining duration of the event. Numbers of arrivals and departures were developed from UPRR data. Emissions were calculated separately for through trains, for train arrivals and departures, and for power moves.

Three sets of "captive" locomotives (i.e., dedicated to moving sections of rail cars within the yard) operated within the facility boundaries. These sets were all pairs of low horsepower switcher locomotives. Based on information from UPRR personnel, these units were assumed to operate on the full EPA switcher duty cycle.

Data regarding the sulfur content of 2005 UPRR Diesel fuel deliveries within and outside of California were not available. To develop locomotive emission factors for different types of activities, estimates of fuel sulfur content were developed and base case emission factors from the primary information sources (e.g., EPA certification data, with an

[7] There are two primary types of auto start/stop technology – "Auto Engine Start Stop" (AESS), which is factory-installed on recent model high horsepower units, and the ZTR "SmartStart" system (ZTR), which is a retrofit option for other locomotives. Both are programmed to turn off the Diesel engine after 15 to30 minutes of idling, provided that various criteria (air pressure, battery charge, and others) are met. The engine automatically restarts if required by one of the monitored parameters. We assume that an AESS/ZTR-equipped locomotive will shut down after 30 minutes of idling in an extended idle event.

assumed nominal fuel sulfur content of 3,000 ppm) were adjusted based on the estimated sulfur content of in-use fuels. Fuel sulfur content reportedly affects the emission rates for Diesel particulate matter from locomotives. The sulfur content in Diesel fuel varies with the type of fuel produced (e.g., California on-road fuel, 49-state off-road fuel, 49-state on-road fuel), the refinery configuration at which it is produced, the sulfur content of the crude oil being refined, and the extent to which it may be mixed with fuel from other sources during transport. As a result, it is extremely difficult to determine with precision the sulfur content of the fuel being used by any given locomotive at a specific time, and assumptions were made to estimate sulfur content for different types of activities.

To estimate the fuel sulfur content for UPRR locomotives in California during 2005, the following assumptions were made:

- "Captive" locomotives and consists in use on local trains (e.g., commuter rail) used only Diesel fuel produced in California.
- Trains arriving and terminating at California rail yards (with the exception of local trains) used fuel produced outside of California, and arrive with remaining fuel in their tanks at 10 percent of capacity.
- On arrival, consists were refueled with California Diesel fuel, resulting in a 90:10 mixture of California and non-California fuel, and this mixture is representative of fuel on departing trains as well as trains undergoing load testing (if conducted at a specific yard).
- The average composition of fuel used in through trains by-passing a yard and in trains both arriving and departing from a yard on the same day is 50 percent California fuel and 50 percent non-California fuel.

In 2005, Chevron was Union Pacific Railroad's principal supplier of Diesel fuel in California. Chevron's California refineries produced only one grade ("low sulfur Diesel" or LSD) in 2005. Quarterly average sulfur content for these refineries ranged from 59 ppm to 400 ppm, with an average of 221 ppm (Hinckley, 2006). This value is assumed to be representative of California fuel used by UPRR. Non-California Diesel fuel for 2005 is assumed to have a sulfur content of 2,639 ppm. This is the estimated 49-state average

fuel sulfur content used by the U.S. Environmental Protection Agency in its 2004 regulatory impact analysis in support of regulation of nonroad Diesel engines (EPA, 2004).

To develop emission inventories for locomotive activity, an initial collection of locomotive model- and notch-specific emissions data was adjusted based on sulfur content. Although there is no official guidance available for calculating this effect, a draft CARB document provides equations to calculate the effect of sulfur content on PM emission rates at specific throttle settings, and for 2-stroke and 4-stroke engines (Wong, undated). These equations can be used to calculate adjustment factors for different fuels as described in Appendix A-7. The adjustment factors are linear in sulfur content, allowing emission rates for a specific mixture of California and non-California fuels to be calculated as a weighted average of the emission rates for each of the fuels. Adjustment factors were developed and used to prepare tables of emission factors for two different fuel sulfur levels: 221 ppm for locomotives operated on California fuel; and 2,639 ppm for locomotives operating on non-California fuel. These results are shown in Tables 14 and 15. Sample emission calculations are shown in Appendix A-3 and A-4.
The calculations of sulfur adjustments are shown in Appendix A-7.,

Table 14
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 221 PPM
Los Angeles Transportation Center

Model Group	Tier	Throttle Setting										Source[1]
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	129.2	140.6	173.3	272.7	315.6	409.1	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	174.1	187.5	230.2	369.1	423.5	555.1	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	211.9	228.6	289.7	488.5	584.2	749.9	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	282.3	275.2	339.6	587.7	663.5	847.2	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	266.3	264.8	323.5	571.6	680.2	859.8	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	224.1	311.5	446.4	641.6	1029.9	1205.1	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	146.8	215.0	276.8	331.8	434.7	538.0	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	215.7	335.9	388.6	766.8	932.1	1009.6	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	205.3	261.7	376.5	631.4	716.4	774.0	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	254.4	265.7	289.0	488.2	614.7	643.0	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	239.5	374.7	484.1	291.5	236.1	852.4	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	306.9	292.4	297.5	255.3	249.0	307.7	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	248.7	261.6	294.1	318.5	347.1	450.7	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	187.7	258.0	332.5	373.2	359.5	517.0	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	195.7	235.4	552.7	489.3	449.6	415.1	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	259.5	342.2	380.4	443.5	402.7	570.0	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	259.8	325.7	363.6	356.7	379.7	445.1	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	237.2	208.9	247.7	265.5	168.6	265.7	GE[4] (UP7555)

Notes:
1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments – Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

Table 15
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 2,639 PPM
Los Angeles Transportation Center

Model Group	Tier	Throttle Setting										Source[1]
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	136.9	156.6	197.4	303.4	341.2	442.9	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	184.5	208.8	262.2	410.8	457.9	601.1	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	224.5	254.6	330.0	543.7	631.6	812.1	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	299.0	306.5	386.9	653.9	717.3	917.4	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	282.1	294.9	368.5	636.1	735.4	931.0	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	237.4	346.9	508.5	714.0	1113.4	1304.9	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	155.5	239.4	315.4	369.2	469.9	582.6	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	228.5	374.1	442.7	853.3	1007.8	1093.2	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	217.5	291.5	428.9	702.6	774.5	838.1	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	269.4	295.9	329.2	543.3	664.6	696.2	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	253.7	417.3	551.5	324.4	255.3	923.1	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	352.7	323.1	327.1	293.7	325.3	405.4	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	285.9	289.1	323.3	366.4	453.5	593.8	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	215.7	285.1	365.6	429.3	469.7	681.2	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	224.9	260.1	607.7	562.9	587.4	546.9	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	298.2	378.1	418.3	510.2	526.2	751.1	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	298.5	359.9	399.8	410.4	496.1	586.4	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	272.6	230.8	272.3	305.4	220.3	350.1	GE[4] (UP7555)

Notes:
1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments – Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

2. LHD Diesel-Fueled Truck

Emission estimates for the LHD Diesel-fueled truck are based on the vehicle's model year, annual VMT within the Yard, and amount of time the vehicle spends idling. Vehicle-specific emission factors, calculated using the EMFAC-WD 2006 model, are shown in Table 16. Per CARB guidelines, the emissions from idling and traveling modes have been separated because different source treatments (point or volume sources) will be used in the air dispersion modeling analysis for these modes. Detailed emission factor derivation calculations and EMFAC-WD 2006 output are contained in Appendix B.

Table 16
Emission Factors for the LHD Diesel-Fueled Truck
Los Angeles Transportation Center

Operating Mode	Emission Factors				
	ROG	CO	NOx	DPM[3]	SOx
Traveling (g/mi)[1]	0.32	1.65	6.69	0.08	0.05
Idling (g/hr)[2]	3.173	26.30	75.051	0.753	0.357

Notes:
1. Emission factors calculated using the EMFAC-WD 2006 model with the BURDEN output option
2. Emission factors calculated using the EMFAC-WD 2006 model with the EMFAC output option.
3. Diesel PM_{10} (DPM) is a TAC.
4. See Part V for vehicle specifications.

3. HHD Diesel-Fueled Trucks

Emission estimates for the HHD Diesel-fueled trucks are based on the number of truck trips, the annual VMT within the Yard, and the amount of idling time. Per CARB guidelines, the emissions from idling and traveling modes have been separated because different source treatments (point or volume sources) will be used in the air dispersion modeling analysis for these modes. A fleet average emission factor for traveling exhaust emissions was calculated using the EMFAC-WD 2006 model with the BURDEN output option. Since the fleet distribution is not known, the EMFAC-WD 2006 default distribution for Los Angeles County was used. Idling emission factors were calculated using the EMFAC-WD 2006 model with the EMFAC output option. The emission

factors for the HHD Diesel-fueled trucks are shown in Table 17. Detailed emission factor derivation calculations and the EMFAC-WD 2006 output are contained in Appendix C.

Table 17
Emission Factors for HHD Diesel-Fueled Trucks
Los Angeles Transportation Center

Operating Mode	Fleet Average Emission Factors				
	ROG	CO	NOx	DPM[3]	SOx[4]
Traveling (g/mi)[1]	5.73	15.40	27.41	2.27	0.24
Idling (g/hr)[2]	16.16	52.99	100.38	2.85	0.55

Notes:
1. Emission factors were calculated using the EMFAC-WD 2006 model with the BURDEN output option. The default fleet distribution for Los Angeles County was used.
2. Emission factors were calculated using the EMFAC-WD 2006 model with the EMFAC output option. The default fleet distribution for Los Angeles County was used.
3. Diesel PM_{10} (DPM) is a TAC.
4. See Part V for vehicle specifications.

4. Cargo Handling Equipment

Emission estimates for the CHE are based on the number and type of equipment, the equipment model, and the hours of operation. Emission factors were calculated by CARB staff and are based on the OFFROAD2006 model. The emission factors for the CHE are shown in Table 18. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix D.

Table 18
Emission Factors for Cargo Handling Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	Emission Factors (g/bhp-hr)				
			VOC	CO	NOx	DPM	SOx
Forklift	Taylor THD200S	2000	0.5307	2.8296	6.8159	0.3536	0.0597
RTG	Mi Jack 1000RC	2004	0.0906	0.9456	4.1618	0.0972	0.0521
RTG	Mi Jack 1000R	1984	0.9965	5.4833	12.8557	0.7230	0.0521
Top Pick	Mi Jack MJ9090	1990	0.6811	3.3000	9.0164	0.4547	0.0597
Top Pick	Taylor TEC 155H	1998	0.5505	2.8920	6.9482	0.3734	0.0597
Yard Hostler	Ottawa Commando30	2003	0.2501	2.7810	5.1174	0.2136	0.0597
Yard Hostler	Ottawa Commando30	2004	0.1639	2.7540	4.5529	0.1648	0.0597

Notes:
1. Emission factors were calculated by CARB staff and are based on the OFFROAD2006.

5. Heavy Equipment

Emission estimates for heavy equipment are based on the number and type of equipment, equipment model, and the hours of operation. Emission factors were calculated using OFFROAD2006 model. The emission factors for heavy equipment are shown in Table 19. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix E.

Table 19
Emission Factors for Heavy Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	Emission Factors (g/bhp-hr)[1]				
			VOC[2]	CO	NOx	DPM	SOx
Crane	Grove RT650E	2003	0.2332	0.2332	0.2332	0.1053	0.0478
Forklift	Lull	2004	0.3500	0.3500	0.3500	0.1861	0.0548
Forklift	Toyota	1999	0.3500	0.3500	0.3500	0.5778	0.0548

Notes:
1. Emission factors from the OFFROAD2006 model.
2. Evaporative emissions for these sources are negligible.

6. Tanks

VOC emissions from the non-exempt storage tanks were calculated using EPA's TANKS program. CARB's speciation database was used to determine the fraction of each TAC in the total VOC emissions from gasoline storage tank located at the RIP track. All TACs listed in the most recent version of the Emission Inventory Criteria and Guidelines Report for the Air Toxics "Hot Spots" Program have been included. The TAC emission factors for gasoline storage are shown in Table 20. The TANKS output and the relevant sections of CARB's speciation database are included in Appendix F.

Table 20
TAC Emission Factors for Gasoline Storage Tank
Los Angeles Transportation Center

CAS	Chemical Name	Organic Fraction of VOC (by weight)
540841	2,2,4-trimethylpentane	0.0129
71432	Benzene	0.0036
110827	cyclohexane	0.0103
100414	ethylbenzene	0.0012
78784	isopentane	0.3734
98828	isopropylbenzene (cumene)	0.0001
108383	m-xylene	0.0034
110543	n-hexane	0.0154
95476	o-xylene	0.0013
106423	p-xylene	0.0011
108883	toluene	0.0170
Total		**0.44**

Notes:
1. The organic fraction information is from CARB's SPECIATE database. Data are from the "Headspace vapors 1996 SSD etoh 2.0% (MTBE phaseout)" option.
2. Emissions were calculated only for chemicals that were in both the SPECIATE database and the AB2588 list.

7. TRUs and Reefer Cars

Emission estimates for the Diesel-fueled TRUs and reefer cars were based on the average number of units in the yard and the hours of operation. Emission factors are from the OFFROAD2006 model. The emission factors are shown in Table 21. Detailed emission

factor derivation calculations and the OFFROAD2006 output are contained in Appendix G.

Table 21
Emission Factors for TRUs and Reefer Cars
Los Angeles Transportation Center

Equipment Type	Emissions (g/hp-hr-unit)[1]				
	HC[2]	CO	NOx	DPM	SOx[3]
TRU	2.85	6.78	6.43	0.71	0.07
Reefer Car	3.23	7.49	6.71	0.79	0.07

Notes:
1. Emission factors from OFFROAD2006 model.
2. Evaporative emissions from this source are negligible.
3. Emission factor based on a Diesel fuel sulfur content of 130 ppm.

B. TAC Emissions by Source Type

TAC emission calculations for each source type were based on the site-specific equipment inventory (shown in Part V of this report), equipment activity data (shown in Part VI of this report), and the source-specific emission factors shown in Part VII.A above.

Emissions from locomotive operations were based on the emission factors shown in Table 14 and 15, the number of events, the number of locomotives per consist, duration, and duty cycle of different types of activity. Table 22 shows the duty cycles assumed for different types of activities.

Table 22
Locomotive Duty Cycles
Los Angeles Transportation Center

Activity	Duty Cycle
Through Train Movement	N1 – 50%, N2- 50%
Movements within the Yard	N1 – 50%, N2- 50%
Yard Operations	EPA Switch Duty Cycle[1]

Notes:
1. EPA (1998) Regulatory Support Document

For locomotive models and tiers for which specific emission factors were not available, the emissions for the next lower tier were used, or the next higher tier if no lower tier data were available. Emission factors for the "average locomotive" for different types of activity were developed from the emission factors and the actual locomotive model and technology distributions for that activity. Separate distributions were developed for four types of activity: through trains (including through power moves); arrivals and departures; arriving and departing power moves; and yard operations. Table 23 shows the DPM emission estimates for the different types of activities.

Table 23
DPM Emissions from Locomotives
Los Angeles Transportation Center

Activity	DPM Emissions (tons/yr)
Through Trains and Power Moves	0.20
Arriving and Departing Trains	0.47
Arriving and Departing Power Moves	0.06
Yard Operations	2.46
Total	**3.19**

Notes:
1. See Table 1 for equipment specifications.
2. See Table 6 for activity data.
3. See Table 14 and 15 for emission factors.
4. Emissions from yard operations are based on two sets of switcher locomotives operating 24 hours per day and a third set of switchers operating between 7 AM and 11 PM daily, the EPA Switch Duty Cycle, and the emission factors shown in Tables 14 and 15.
5. See Appendices A-3 and A-4 for detailed emission calculations. The calculations of sulfur adjustments are shown in Appendix A-7.

DPM emissions from the LHD Diesel-fueled truck are shown in Table 24. DPM emissions from HHD Diesel-fueled trucks and CHE are shown in Tables 25 and 26, respectively. DPM emissions from heavy equipment are shown in Table 27. Table 28 summarizes the TAC emissions from the gasoline storage tank. DPM emissions from the Diesel-fueled TRUs and reefer cars are shown in Table 29. Detailed emission calculations for each source group are contained in Appendix H.

Table 24
DPM Emissions from the LHD Diesel-Fueled Truck
Los Angeles Transportation Center

Pollutant	Emissions (tpy)		
	Traveling Mode	Idling Mode	Total
DPM	0.0005	0.0001	0.001

Notes:
1. See Part V for equipment specifications.
2. See Table 7 for activity data.
3. See Table 16 for emission factors.

Table 25
DPM Emissions from HHD Diesel-Fueled Trucks
Los Angeles Transportation Center

Pollutant	Emissions (tpy)		
	Traveling Mode	Idling Mode	Total
DPM	0.70	0.29	0.99

Notes:
1. See Part V for equipment specifications.
2. See Table 9 for activity data.
3. See Table 17 for emission factors.

Table 26
DPM Emissions from Cargo Handling Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	DPM Emissions (tpy)
Forklift	Taylor THD200S	2000	0.005
RTG	Mi Jack 1000RC	2004	0.081
RTG	Mi Jack 1000R	1984	0.300
Top Pick	Mi Jack MJ9090	1990	0.038
Top Pick	Taylor TEC 155H	1998	0.006
Yard Hostler	Ottawa Commando30	2003	0.466
Yard Hostler	Ottawa Commando30	2004	1.199
Total			**2.10**

Notes:
1. See Table 2 for equipment specifications.
2. See Table 10 for activity data.
3. See Table 18 for emission factors.

Table 27
DPM Emissions from Heavy Equipment
Los Angeles Transportation Center

Equipment Type	Make/Model	Model Year	DPM Emissions (tpy)
Crane	Grove RT650E	2003	0.030
Forklift	Lull	2004	0.074
Forklift	Toyota	1999	0.063
Total			**0.17**

Notes:
1. See Table 3 for equipment specifications.
2. See Table 11 for activity data.
3. See Table 19 for emission factors.

Table 28
TAC Emissions from Gasoline Storage Tanks
Los Angeles Transportation Center

CAS	Chemical Name	Emissions (tpy)
540841	2,2,4-trimethylpentane	0.0011
71432	Benzene	0.0003
110827	Cyclohexane	0.0008
100414	Ethylbenzene	0.0001
78784	Isopentane	0.0304
98828	Isopropylbenzene (cumene)	0.0000
108383	m-Xylene	0.0003
110543	n-Hexane	0.0013
95476	o-Xylene	0.0001
106423	p-Xylene	0.0001
108883	Toluene	0.0014
Total		**0.036**

Notes:
1. See Table 4 for equipment specifications.
2. See Table 12 for activity data.
3. See Table 20 for emission factors.

Table 29 DPM Emissions from TRUs and Reefer Cars Los Angeles Transportation Center	
Equipment Type	DPM Emissions (tpy)
TRU	0.37
Railcar	0.09
Total	**0.46**

Notes:
1. See Part V for equipment specifications.
2. See Table 13 for activity data.
3. See Table 21 for emission factors.

C. Facility Total Emissions

Facility-wide DPM emissions are shown in Table 30. The gasoline storage tank is the only source of other TACs at LATC; therefore, Table 28 summarizes facility-wide emissions of other TACs.

Table 30 Facility-Wide Diesel Particulate Emissions Los Angeles Transportation Center	
Source	Emissions (tpy)
Locomotives[1]	3.19
LHD Diesel-Fueled Trucks[2]	0.001
HHD Diesel-Fueled Trucks[3]	0.99
Cargo Handling Equipment[4]	2.10
Heavy Equipment[5]	0.17
TRUs and Reefer Cars[6]	0.46
Total	**6.91**

Notes:
1. See Table 23.
2. See Table 24.
3. See Table 25.
4. See Table 26.
5. See Table 27.
6. See Table 29.

PART VIII: RISK SCREENING CALCULATIONS

As discussed in Part IV of this report, de minimis sources, based on weighted health risk, were identified in the inventory but were not included in the modeling analysis. De minimis sources are the individual source categories that represent less than 3 percent of the facility-total weighted average site health impacts (determined separately for cancer risk and non-cancer chronic health hazard). Total exclusions for all de minimis sources did not exceed 10 percent of the facility-total weighted average site health impacts.

The OEHHA unit risk factor for each pollutant was multiplied by the annual emissions of that pollutant to generate a risk index value for each source. Each source-specific risk index was divided by the facility total risk index to get the fractional contribution to the total risk for each source. The cancer risk, the non-cancer health hazard index, and the fractional contribution to the cancer risk and non-cancer chronic health hazard for each source are summarized in Table 31. Detailed cancer risk and non-cancer health hazard index calculations are in Appendix I.

Table 31
Summary of Weighted Risk by Source Category
Los Angeles Transportation Center

	Cancer Risk		Non-Cancer Chronic Health Hazard	
Source	Risk Index Value	Percent of Total Risk	Health Hazard Index Value	Percent of Total Hazard
Locomotives	9.57×10^{-4}	46.21	1.60×10^{1}	36.04
LHD Diesel-Fueled Trucks	1.61×10^{-7}	0.01	2.69×10^{-3}	0.01
HHD Diesel-Fueled Trucks	2.98×10^{-4}	14.41	4.97	11.24
Cargo Handling Equipment	6.28×10^{-4}	30.34	1.05×10^{1}	23.66
Heavy Equipment	5.00×10^{-5}	2.41	8.33×10^{-1}	1.88
Gasoline Storage Tank	8.50×10^{-9}	0.00	9.74	22.00
TRUs and Reefer Cars	1.37×10^{-4}	6.62	2.29	5.17
Total	**2.07×10^{-3}**	**100**	**4.43×10^{1}**	**100**

Sources that represent less than 3 percent each of the facility-total weighted average cancer risk and non-cancer chronic health hazard, as shown in Table 31, are de minimis. Table 32 lists the de minimis sources for LATC.

Table 32 Summary of De Minimis Sources Los Angeles Transportation Center	
De minimis Sources for Cancer Risk	De Minimis Sources for Non-Cancer Chronic Health Hazard
LHD Diesel-Fueled Trucks Heavy Equipment Gasoline Storage Tank	LHD Diesel-Fueled Trucks Heavy Equipment

Sources that are de minimis for both cancer risk and non-cancer chronic health hazard (i.e. LHD Diesel-fueled truck) will not be included in the dispersion modeling analysis. At the request of CARB, heavy equipment will be included in the dispersion modeling analysis notwithstanding their de minimis risk contribution.

PART IX: AIR DISPERSION MODELING

An air dispersion modeling analysis was conducted for LATC. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations near the Yard. Air dispersion modeling was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006). Each aspect of the modeling is further described below.

A. Model Selection and Preparation

1. Modeled Sources and Source Treatment

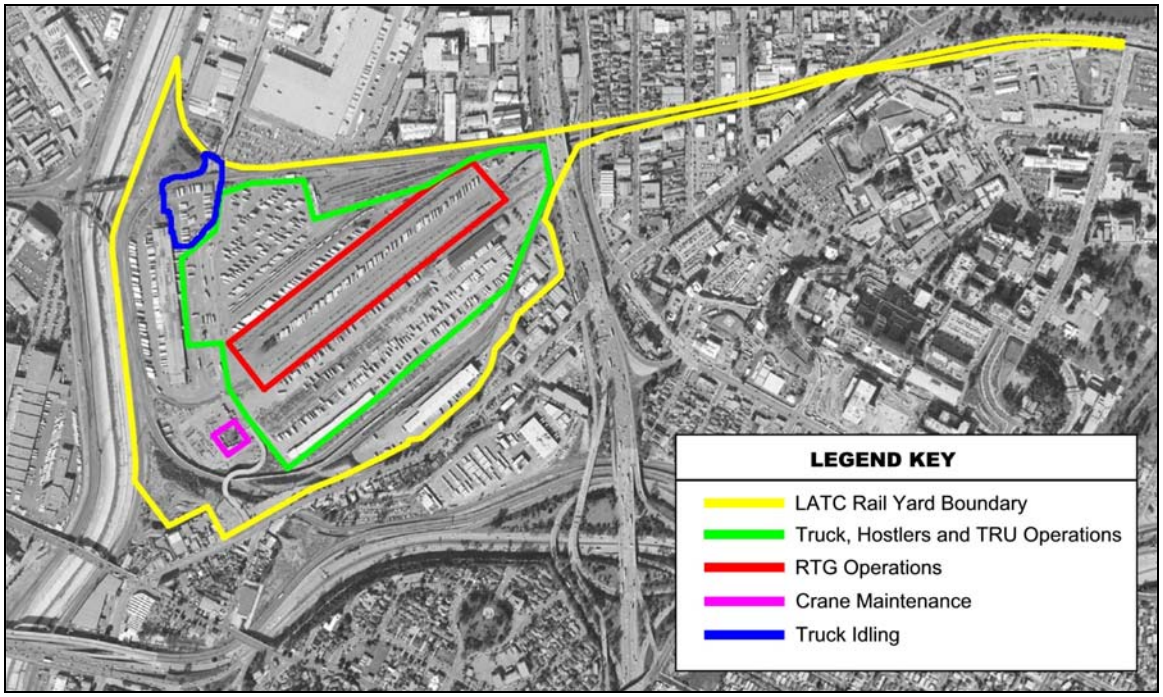
As discussed in Part VIII, only sources that represent more than 3 percent of the facility-total weighted average site health impacts (determined separately for cancer risk and non-cancer chronic health hazard) were included in the dispersion modeling analysis. At the request of CARB, heavy equipment was included as well, notwithstanding their de minimis risk contribution. Emissions from mobile sources, low-level cargo handling equipment, heavy equipment, and moving locomotives were simulated as a series of volume sources along their corresponding travel routes and work areas. Idling locomotives and elevated cargo handling equipment (cranes) were simulated as a series of point sources within the areas where these events occur. The elevation for each source was interpolated from a 50 m grid of USGS terrain elevations. Table 33 shows the sources that were included in the modeling analysis and treatment used for each source. Assumptions used to spatially allocate emissions from locomotive operations within the Yard are included in Appendix A-4. Assumptions used to spatially allocate emissions from non-locomotive sources are contained in Appendix J.

Table 33
Source Treatment for Air Dispersion Modeling
Los Angeles Transportation Center

Source	Source Treatment
Gasoline Storage Tank	Point
HHD Diesel-Fueled Trucks (idling)	Volume
HHD Diesel-Fueled Trucks (traveling)	Volume
Locomotives (idling)	Point
Locomotives (traveling)	Volume
Cargo Handling Equipment (low level)	Volume
Cargo Handling Equipment (RTGs)	Point
Heavy Equipment (idling)	Volume
Heavy Equipment (traveling)	Volume
TRUs and Reefer Cars	Volume

Notes:
1. See Figure 3 for source locations.

Figure 3
Source Locators



2. Model Selection

Selection of air dispersion models depends on many factors, including the type of emissions source (point, line, or volume) and type of terrain surrounding the emission source. The USEPA-approved guideline air dispersion model, AERMOD, was selected for this project. AERMOD is recommended by EPA as the preferred air dispersion model, and is the recommended model in CARB's *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006).

AERMOD is a steady-state,[8] multiple-source, Gaussian dispersion model designed for use with stack emission sources situated in terrain where ground elevations can exceed the stack heights of the emission sources (i.e., complex terrain).[9] AERMOD was provided with hourly wind speed, wind direction, and temperature data from the Downtown Los Angeles – North Main station operated by the SCAQMD. Missing data were replaced by data from Los Angeles International Airport (LAX), and cloud cover data were also obtained from the LAX station operated by the National Weather Service. AERMOD used these parameters to select the appropriate dispersion coefficients.

Standard AERMOD control parameters were used, including stack-tip downwash, non-screening mode, non-flat terrain, and sequential meteorological data check. Following USEPA guidance, stack-tip downwash adjusted the effective stack height downward following the methods of Briggs (1972) for stack exit velocity less than 1.5 times the wind speed at stack top.

[8] The term "steady-state" means that the model assumes no variability in meteorological parameters over a one-hour time period.
[9] Federal Register, November 9, 2005; Volume 70, Number 216, Pages 68218-68261.

Two AERMET preprocessors (Stages 1 and 2, and Stage 3) were used to prepare meteorological data for use in AERMOD. Albedo and Bowen Ratio[10] were estimated in multiple wind direction sectors surrounding the Yard, while surface roughness from similar sectors around the meteorological monitoring site was used in the model. This separation was based on the fact that atmospheric turbulence induced by surface roughness around the meteorological monitoring tower affects the resulting wind speed profile used by AERMOD to represent conditions at the Yard, while Albedo and Bowen Ratio around the Yard are more appropriate to characterize land use conditions surrounding the area being modeled.

As suggested by USEPA (2000), the surface characteristics were specified in sectors no smaller than a 30-degree arc. Specifying surface characteristics in narrower sectors becomes less meaningful because of expected wind direction variability during an hour, as well as the encroachment of characteristics from the adjacent sectors with a one-hour travel time. Use of weighted-average[11] characteristics by surface area within a 30-degree (or wider) sector made it possible to have a unique portion of the surface significantly influence the properties of the sector that it occupies. The length of the upwind fetch for defining the nature of the turbulent characteristics of the atmosphere in each sector surrounding the source location was 3 kilometers as recommended by Irwin (1978) and USEPA's *Guideline on Air Quality Models.*[12]

3. Modeling Inputs

Modeling was based on the annual average emissions for each source as discussed in Part VII B above. Temporal and seasonal activity scalars were applied to locomotive activities, cargo handling equipment activities, and HHD truck operations. The following profiles were used in the modeling. See Appendix K for additional details.

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[10] The albedo of a specified surface is the ratio of the radiative flux reflected from the surface to the radiative flux incident on the surface. Flux is the amount of energy per unit time incident upon or crossing a unit area of a defined flat plane. For example, snow and ice vary from 80% to 85% and bare ground from 10% to 20%. Bowen ratio is the ratio of heat energy used for sensible heating (conduction and convection) of the air above a specified surface to the heat energy used for latent heating (evaporation of water or sublimation of snow) at the surface. The Bowen ratio ranges from 0.1 for the ocean surface to more that 2.0 for deserts; negative values are also possible.

[11] Weighting was based on wind direction frequency, such as determined from a wind rose.

[12] USEPA (1986), and published as Appendix W to 40 CFR Part 51 (as revised).

- A seasonal/diurnal activity profile was calculated for locomotive idling based on the number of arrivals and departures in each hour of the day and the number of arriving and departing trains in each season. Each hourly factor was based on the number of arrivals and departures in that hour, the number of arrivals in the preceding two hours, and the number of departures in the following two hours. This approach captures the idling times for consists on arrival and departure. These factors were applied to consist idling for arriving and departing trains, and idling at the service track.
- A seasonal/diurnal activity profile was calculated for in-yard locomotive movements of road power using the same approach as for idling. In this case, however, only the number of arriving and departing trains in a single hour was used for that hour's factor.
- A diurnal profile was used for switching operations based on the operating shifts for the yard switchers. Seasonal adjustment factors were not used for yard switching.
- The seasonal distribution for arriving and departing trains was applied to both cargo handling equipment activity and HHD truck activity at the Yard.

The volume source release heights and vertical dispersion parameters (σ_z) were those used by CARB for the Truck Stop Scenario in Appendix VII of the Diesel Risk Reduction Plan for mobile vehicles and equipment other than locomotives. For locomotives, the release height and σ_z values used were those developed by CARB for daytime and nighttime locomotive movements in the Roseville Risk Assessment modeling. Stack parameters used to create the AERMOD input file for locomotive operations are shown in Table 34. Table 35 summarizes the modeling inputs used to create the AERMOD input file for each non-locomotive source at the Yard.

4. Meteorological Data Selection

The Yard does not monitor meteorological variables on site. Data from the downtown Los Angeles – North Main station**,** operated by SCAQMD, and from the Los Angeles

International Airport, operated by the National Weather Service, were used for this project.

To the extent that airflow patterns are spatially variable due to elevated terrain and land-sea effects near the coast, judgment was exercised to select the monitoring stations that are most representative of conditions at LATC. While the Los Angeles – North Main

Table 34
Locomotive Modeling Inputs
Los Angeles Transportation Center

Source	Point/Idling Source Parameters				Volume Source Parameters		
	Stack Ht (m)	Stack Dia. (m)	Exit Velocity (m/s)	Temp (° K)	σ_z (m)	σ_y[5] (m)	Release Ht (m)
Locomotives (idling and load tests)[1]							
Road power at all yards-SD7x[2]	4.6	0.625	3.1	364	-	-	-
Yard locomotives LC-SW	4.6	0.305	5.6	341	-	-	-
Locomotives (traveling)[3]					-	-	-
Day[4]	-	-	-	-	2.6	20-50	5.6
Night[4]	-	-	-	-	6.79	20-50	14.6

Notes:
1 Stack parameters for stationary locomotives taken from the CARB Roseville modeling
2 Idling road power stack parameters are those of the most prevalent locomotive model (SD-7x)
3 All locomotive movements for road power and yard locomotives while working are the day and night volume source parameters for moving locomotives from the CARB Roseville modeling.
4 Lateral dispersion coefficient (σ_y) for moving locomotive volume sources was set to values between 20 and 50 m, depending on the spacing of sources in different areas of the yard and proximity to yard boundaries.

Table 35
Non-Locomotive Modeling Inputs
Los Angeles Transportation Center

Source	Point/Idling Source Parameters				Volume Source Parameters		
	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Temp (° K)	σ_z (m)	σ_y[5] (m)	Release Height (m)
HHD Diesel-fueled Trucks	-	-	-	-	1.39	20-50	4.15
Cranes[1]	12.5	0.13	20	644.3	-	-	-
RTGs[1]	12.5	0.13	20	644.3	-	-	-
Top Picks[2]	-	-	-	-	1.39	20-50	4.15
Forklifts[2]	-	-	-	-	1.39	20-50	4.15
Yard Hostlers[2]	-	-	-	-	1.39	20-50	4.15
TRUs and Reefer Cars[2]	-	-	-	-	1.39	20-50	4.15

Notes:
1. Stack parameters from equipment manufacturers.
2. Low level sources treated as volume sources using the release height and vertical dispersion parameter (σ_z) from the CARB Diesel Risk Reduction Plan (Sept 13, 2000), Appendix VII, Table 2 (Truck stop scenario).
3. Low level source lateral dispersion parameter (σ_y) set to a value between 20 and 50 meters based on spacing between sources and proximity to the yard boundary.

station is relatively close to the yard, significant elevated terrain exists to the northwest of the yard through the northeast. As a result, surface wind patterns in the vicinity are unlikely to be uniform, particularly during periods of night time drainage flows as well as during periods of light winds from the southeast through southwest. In the absence of more detailed data and given the inability of steady-state Gaussian models such as AERMOD to treat non-uniform flow fields, some uncertainty will exist in the ability of the model to predict the locations of highest concentrations outside of the Yard. Because rail yards, especially emissions from locomotives, tend to be aligned linearly along the main track routes, the directions of prevailing surface winds were important to achieve representativeness of model predictions in the near field. For longer transport distances (e.g., 1 to 10 km), surface winds were still the primary consideration, with atmospheric stability also playing an important role. Due to the relatively low release heights and limited plume rise of rail yard sources, modeled concentrations are relatively insensitive to mixing heights, temperatures, and vertical temperature and wind profiles.

Based on the above requirements for representativeness, wind speed, wind direction, and temperature data from the Downtown Los Angeles – North Main monitoring station operated by the SCAQMD. Missing data was replaced by data from LAX, and cloud cover data was also obtained from the LAX station operated by the National Weather Service. These data were processed in AERMET, the meteorological preprocessor for AERMOD.

Four years, 2002 through 2005, of meteorological data from the Downtown Los Angeles – North Main monitoring station were processed with AERMET to assure that an adequate number of years of acceptable data completeness and quality would be available for AERMOD modeling. It is expected that year-to-year variability would not cause significant differences in the modeled health impacts, and hence, would justify needing only to subject the full set of receptors to one year of meteorological data. The meteorological data from 2002 was selected for rail yard dispersion modeling because it had higher completeness of wind speed and direction data compared to 2003-2005.

5. Model Domain and Receptor Grids

The modeling used both a coarse grid and fine grid in separate runs. The coarse grid had a domain size of 20 km by 20 km and 500 m x 500 m spacing between receptors in a square array. A fine grid of 50 m x 50 m surrounded the Yard within 300 m of the fence line, itself surrounded by a medium grid of 100 m x 100 m out to 600 m around the fence line, and surrounded further out by the coarse grid 500 m spacing.

All receptors were identified by UTM coordinates. United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEMs) information was used to identify terrain heights at each receptor. Figures 4 and 5 show the outline of the Yard along with the coarse and fine receptor grids.

Sensitive receptors, consisting of hospitals, schools, day-care centers, and elder care facilities, within a 1-mile radius of the Yard, were identified. Table 36 lists the address, elevations, and UTM coordinates for each sensitive receptor. Figure 6 shows the outline of the Yard and the location of each sensitive receptor identified in Table 36.

Figure 4
Coarse Modeling Grid

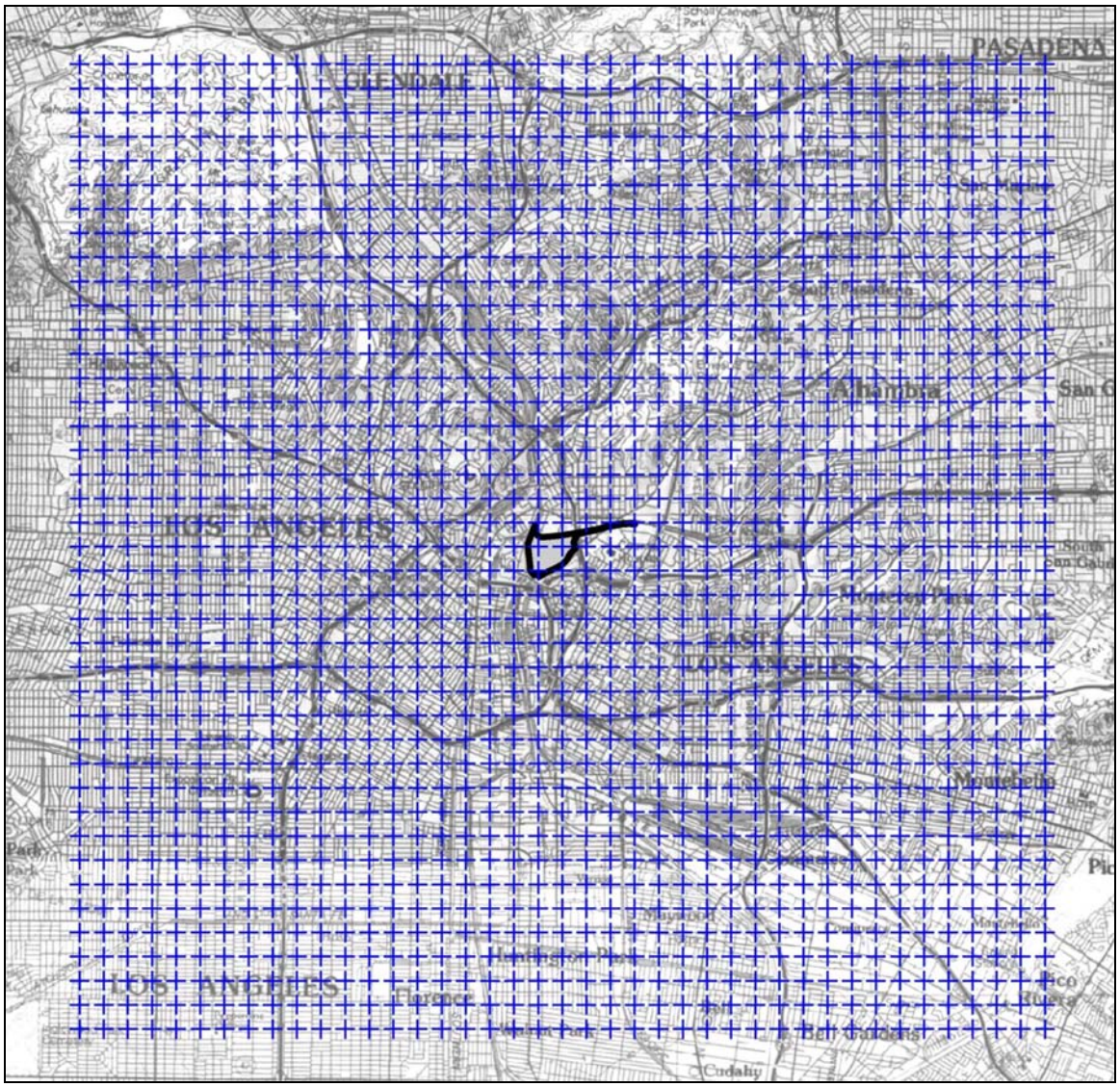


Figure 5
Fine Modeling Grid

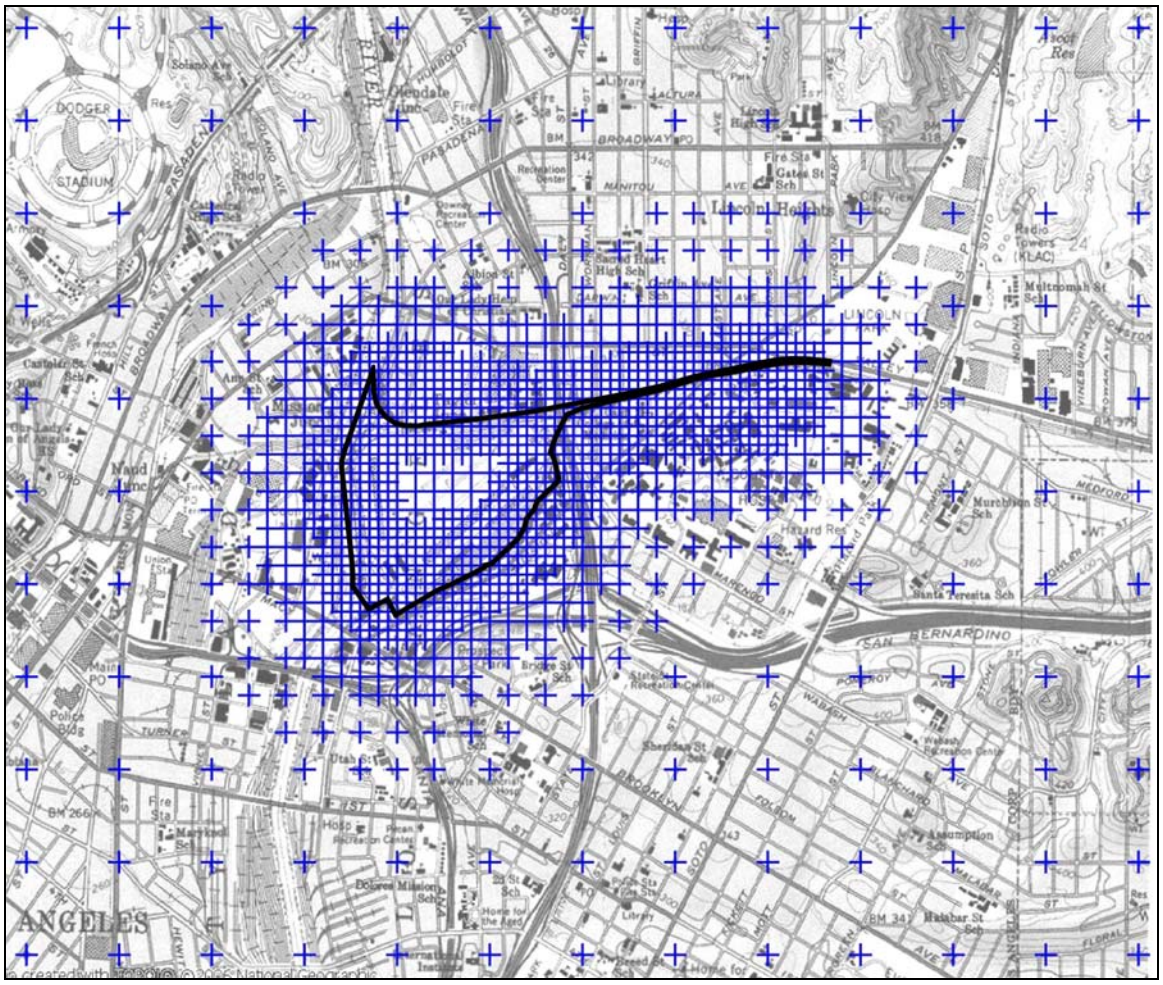


Table 36
Sensitive Receptor Locations
Los Angeles Transportation Center

Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
Albion Street Elementary School	322 South Avenue 18, Los Angeles, CA 90031	91	387405	3770407
Ann Street Elementary School	126 Bloom St, Los Angeles, CA 90012	89	386496	3769968
Breed Street Elementary	2226 E 3rd St, Los Angeles, CA 90033	90	387979	3767533
Bridge Street Elementary School	605 N Boyle Ave, Los Angeles, CA 90033	105	387666	3768712
Castelar Street Elementary	840 Yale St, Los Angeles, CA 90012	96	385672	3769986
Cathedral High School	1253 Bishops Rd, Los Angeles, CA 90012	103	386137	3770539
Evergreen Ave Elementary Schl	2730 Ganahl St, Los Angeles, CA 90033	121	389458	3768643
Gates Street Elementary	3333 Manitou Ave, Los Angeles, CA 90031	110	388717	3770809
Griffin Ave Elementary School	2025 Griffin Ave, Los Angeles, CA 90031	99	388138	3770325
KIPP Los Angeles College Prep	1855 N Main St, Los Angeles, CA 90031	91	387463	3770178
Lincoln High School	3501 N Broadway, Los Angeles, CA 90031	119	388922	3771012
Multnomah Street Elementary	2101 N Indiana Ave, Los Angeles, CA 90032	122	389800	3770285
Murchison Street Elem School	1501 Murchison St, Los Angeles, CA 90033	121	389558	3769436
Our Lady Help of Christians School	2024 Darwin Ave, Los Angeles, CA 90031	96	387682	3770272
Pueblo de Los Angeles High School	2506 Alta St, Los Angeles, CA 90031	128	388871	3771151
Sacred Heart Elementary School	2109 Sichel St, Los Angeles, CA 90031	98	387985	3770539
Sacred Heart High School	2111 Griffin Ave, Los Angeles, CA 90031	100	388097	3770541
San Antonio De Padua School	1500 Bridge St, Los Angeles, CA 90033	108	387368	3768734
Santa Teresita School	2646 Zonal Ave, Los Angeles, CA 90033	113	389405	3769150
Second St Elementary School	1942 E 2nd St, Los Angeles, CA 90033	90	387632	3767843
Sheridan St Elementary School	416 N Cornwell St, Los Angeles, CA 90033	109	388492	3768351
Solano Ave Elementary School	615 Solano Ave, Los Angeles, CA 90012	132	386338	3771258
St Mary Catholic Elementary	416 S St Louis St, Los Angeles, CA 90033	88	387776	3767423
Utah Street Elementary School	1605 New Jersey St, Los Angeles, CA 90033	81	387001	3768371
White Memorial Adventist Schl	4500 Multnomah St, Los Angeles, CA 90032	103	387490	3768502

Table 36
Sensitive Receptor Locations
Los Angeles Transportation Center

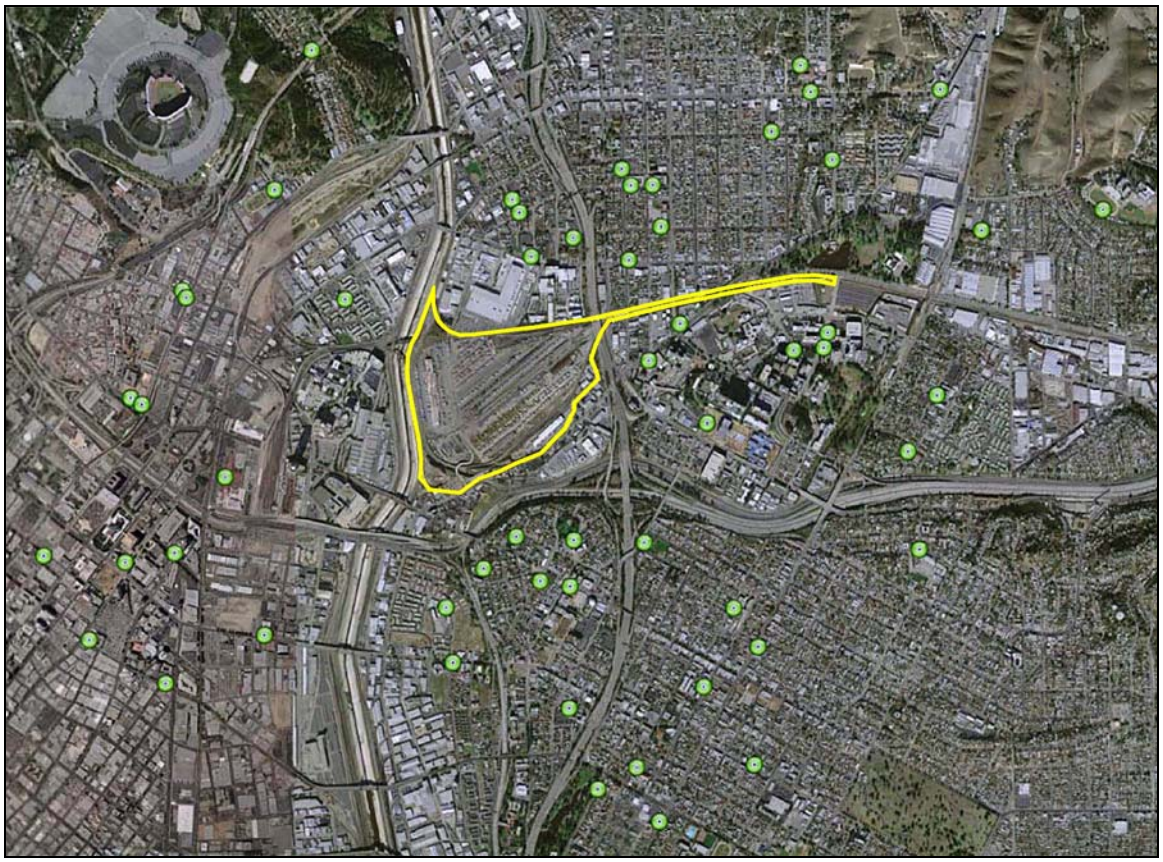
Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
Wilson High School	322 South Avenue 18, Los Angeles, CA 90031	149	390431	3770385
Albion Street Children's Center	348 South Avenue 18, Los Angeles, CA 90031	94	387368	3770473
Aliso Pico Preschool	1505 E 1st St, Los Angeles, CA 90033	80	387033	3768086
Centro De Alegria	420 N Soto St, Los Angeles, CA 90033	108	388616	3768149
Cesar Chavez Garden	555 W Cesar E Chavez Ave, Los Angeles, CA 90012	104	385378	3769471
Child Development Center	521 W Cesar E Chavez Ave, Los Angeles, CA 90012	100	385435	3769436
Childcare Alliance-Los Angeles	205 S Broadway # 808, Los Angeles, CA 90012	90	384917	3768664
Early Learning Center	233 N Breed St, Los Angeles, CA 90033	100	388332	3767945
Foundation For Early Childhood	716 N State St, Los Angeles, CA 90033	105	388033	3768695
Grace Iino Child Care Center	231 E 3rd St, Los Angeles, CA 90013	81	385148	3768225
H Pregerson Child Care Center	255 E Temple St, Los Angeles, CA 90012	85	385597	3768669
Joy Picus Child Development Center	111 E 1st St, Los Angeles, CA 90012	87	385261	3768645
LAC+USC Employees' Children's Center	1401 N Mission Rd, Los Angeles, CA 90033	100	388231	3769821
Los Angeles Child Care/Development	2701 N Main St, Los Angeles, CA 90031	97	387969	3770154
Los Angeles Universal Preschool	750 N Alameda St #200, Los Angeles, CA 90012	85	385863	3769060
Lumbini Child Development Center	505 E 3rd St, Los Angeles, CA 90013	80	385542	3767996
Nishi Hongwanji Child Development	815 E 1st St, Los Angeles, CA 90012	81	386057	3768240
Nuestro Futuro Inc	2615 E 1st St, Los Angeles, CA 90033	93	388589	3767540
Plaza De La Raza Head Start	2141 Workman St, Los Angeles, CA 90031	98	387938	3770624
Village Learning Center	4001 N. Mission Road, Los Angeles, CA 90032	127	389594	3771016
LA County Hospital + USC Medical Center	1200 N State St, Los Angeles, CA 90033	103	388365	3769306
LA County Women's Hospital	1240 N Mission Rd, Los Angeles, CA 90033	100	388067	3769633
Lincoln Hospital Medical Center	443 S Soto St, Los Angeles, CA 90033	95	388093	3767251
Pacific Alliance Medical Center	531 W College St, Los Angeles, CA 90012	96	385653	3770024
Sevanaad Health Care Center	1327 Pleasant Ave, Los Angeles, CA 90033	98	387197	3768570

Table 36
Sensitive Receptor Locations
Los Angeles Transportation Center

Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
USC Doheny Eye Institute	1450 San Pablo St, Los Angeles, CA 90033	110	388974	3769688
USC University Hospital	1500 San Pablo St, Los Angeles, CA 90033	108	388996	3769766
USC/Norris Cancer Hospital	1441 Eastlake Ave # 7418, Los Angeles, CA 90033	105	388818	3769677
White Memorial Medical Center	1720 E Cesar E Chavez Ave, Los Angeles, CA, 90033	107	387645	3768472
Keiro Nursing Home	2221 Lincoln Park Ave, Los Angeles, CA 90031	113	389041	3770662

Notes:
1. UTM Coordinates are in Zone 11, NAD 83.

Figure 6
Sensitive Receptors



6. Dispersion Coefficients

Dispersion coefficients are used in air dispersion models to reflect the land use over which the pollutants are transported. The area surrounding the Yard and the nearby BNSF rail yard was divided into sectors to characterize the surface roughness, albedo, and Bowen Ratio. These parameters were provided along with the meteorological data to the AERMET software. The resulting meteorological input file allows AERMOD to select appropriate dispersion coefficients during its simulation of air dispersion. AERMOD also provides an urban input option to use the overall size of the Standard Metropolitan Statistical Area that contains the emission source (i.e., the Yard) in accounting for the urban heat island effect on the nocturnal convective boundary layer height. If the option is not selected, AERMOD defaults to rural dispersion coefficients. If the urban option is selected, but no surface roughness is specified (i.e., not to be

confused with the surface roughness already specified for sectors around the meteorological monitoring station and input to AERMET), AERMOD assigns a default "urban" surface roughness of 1 meter. For LATC, AERMOD was run with the urban option. Based on CARB and USEPA guidance,[13] namely "*For urban areas adjacent to or near other urban areas, or part of urban corridors, the user should attempt to identify that part of the urban area that will contribute to the urban heat island plume affecting the source,*" the area encompassed by the surrounding Los Angeles Standard Metropolitan Statistical Area (SMSA) was considered to determine the urban heat island effect on the nocturnal convective boundary layer height. The population of this SMSA is approximately 13,000,000,[14] and the surface roughness that characterizes this metropolitan area was set to the URBANOPT default of 1 m. See Appendix L for additional discussion of this issue.

7. Building Downwash

Building downwash effects were considered for the Yard. Stack-tip downwash adjusted the effective stack height downward following the methods of Briggs (1972) when the stack exit velocity was less than 1.5 times the wind speed at stack top. The locomotives are the only structures in the Yard of sufficiently large size and close enough proximity to the modeled emission sources (i.e., their own stacks) to be entered into the Building Profile Input Program (BPIP) with one set of dimensions for a "standard" locomotive (24.2 m. long x 4.0 m. wide x 4.6 m. high).

B. Modeling Results

The AERMOD input and output files have been provided to CARB in an electronic format.

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[13] AERMOD Implementation Guide, September 27, 2005, http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide.pdf

[14] U.S. Census Bureau, Statistical Abstract of the United States: 2006 (http://www.census.gov/compendia/statab/population/pop.pdf) -- Table 26 (p. 30) gives 2004 Los Angeles-Long Beach-Santa Ana MSA population of 12,925,000.

C. Demographic Data

Demographic data files have been provided to CARB in an electronic format. See Appendix M for a description of the data.

PART X: REFERENCES

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APPENDIX A

LOCOMOTIVE DATA

APPENDIX A-1

LOCOMOTIVE MODEL, TIER, AND AUTO-START/STOP TECHNOLOGY FREQUENCY BY TRAIN TYPE

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	Thru EB Switch	Trains arr GP3x	N&W 676 GP4x	Side GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	3	12	361	10	1106	3	5	0	54	53	0	22
N	3	9	1	0	1	0	0	0	0	5	0	0
0	0	0	12	0	250	143	3	0	8	56	7	0
0	0	2	0	0	6	1	0	0	0	49	0	0
1	0	0	0	0	0	18	0	0	0	3	0	0
1	0	0	0	0	0	96	0	0	0	144	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	9	0	0	0	41	0	0

Tier	EB Switch	dep GP3x	676 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	3	12	361	10	1113	3	5	0	55	53	0	22
N	3	10	1	0	1	0	0	0	0	5	0	0
0	0	0	12	0	250	144	3	0	8	57	7	0
0	0	2	0	0	6	1	0	0	0	49	0	0
1	0	0	0	0	0	18	0	0	0	2	0	0
1	0	0	0	0	0	98	0	0	0	145	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	9	0	0	0	41	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	1433 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	4	481	22	794	12	6	3	265	213	2	45
N	0	3	0	0	0	0	0	0	0	19	0	0
0	0	0	12	0	199	664	0	0	48	65	1	0
0	1	0	0	0	5	3	0	0	0	9	0	0
1	0	0	0	0	0	131	0	0	0	0	0	0
1	0	0	0	0	0	553	0	0	0	18	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	99	0	0	0	216	0	0

Tier	WB Switch	dep GP3x	1433 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	4	481	22	794	12	6	3	265	213	2	45
N	0	3	0	0	0	0	0	0	0	19	0	0
0	0	0	12	0	199	664	0	0	48	65	1	0
0	1	0	0	0	5	3	0	0	0	9	0	0
1	0	0	0	0	0	131	0	0	0	0	0	0
1	0	0	0	0	0	553	0	0	0	18	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	99	0	0	0	216	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Thru	Trains	W	Side	Only							
	EB	arr	97									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	20	0	34	0	43	0	6	58	0	0
N	0	0	1	0	0	0	0	0	0	1	0	0
0	0	1	0	0	7	8	1	0	1	50	32	0
0	0	1	0	0	1	0	0	0	0	4	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
1	0	0	0	0	0	6	0	0	0	33	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

	EB	dep	97									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	20	0	34	0	43	0	6	58	0	0
N	0	0	1	0	0	0	0	0	0	1	0	0
0	0	1	0	0	7	8	1	0	1	50	32	0
0	0	1	0	0	1	0	0	0	0	4	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
1	0	0	0	0	0	6	0	0	0	33	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	669 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	77	7	55	6	45	0	99	115	1	11
N	0	3	0	0	1	0	0	0	0	7	0	0
0	0	0	6	0	12	296	1	0	15	101	47	0
0	0	0	0	0	1	0	0	0	0	37	0	0
1	0	0	0	0	0	51	0	0	0	1	0	0
1	0	0	0	0	0	248	0	0	0	125	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	18	0	0	0	45	0	0

Tier	WB Switch	dep GP3x	669 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	77	7	55	6	45	0	99	115	1	11
N	0	3	0	0	1	0	0	0	0	7	0	0
0	0	0	6	0	12	296	1	0	15	101	47	0
0	0	0	0	0	1	0	0	0	0	37	0	0
1	0	0	0	0	0	51	0	0	0	1	0	0
1	0	0	0	0	0	248	0	0	0	125	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	18	0	0	0	45	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Thru	Trains	N	Side	Only							
	EB	arr	360									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	62	3	44	2	5	1	90	59	0	1
N	0	0	0	0	1	0	0	0	0	9	0	0
0	0	0	3	1	7	188	0	0	9	88	1	0
0	0	0	0	0	0	3	0	0	0	53	0	0
1	0	0	0	0	0	38	0	0	0	6	0	0
1	0	0	0	0	0	168	0	0	0	168	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	20	0	0	0	32	0	0

	EB	dep	360									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	62	3	44	2	5	1	90	59	0	1
N	0	0	0	0	1	0	0	0	0	9	0	0
0	0	0	3	1	7	188	0	0	9	88	1	0
0	0	0	0	0	0	3	0	0	0	53	0	0
1	0	0	0	0	0	38	0	0	0	6	0	0
1	0	0	0	0	0	168	0	0	0	168	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	20	0	0	0	32	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	646 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	113	13	121	3	23	0	134	135	0	6
N	0	3	0	0	0	0	0	0	0	14	0	0
0	0	0	4	0	35	302	1	0	20	182	3	0
0	0	0	0	0	2	3	0	0	0	122	0	0
1	0	0	0	0	0	46	0	0	0	8	0	0
1	0	0	0	0	0	257	0	0	0	371	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	30	0	0	0	73	0	0

Tier	WB Switch	dep GP3x	646 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	2	113	13	121	3	23	0	134	135	0	6
N	0	3	0	0	0	0	0	0	0	14	0	0
0	0	0	4	0	35	302	1	0	20	182	3	0
0	0	0	0	0	2	3	0	0	0	122	0	0
1	0	0	0	0	0	46	0	0	0	8	0	0
1	0	0	0	0	0	257	0	0	0	371	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	30	0	0	0	73	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Arriving	Trains	from	E								
	WB	arr	621									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	3	82	10	84	24	1	0	213	264	0	13
N	0	0	0	0	1	0	0	0	0	16	0	0
0	0	0	2	0	13	542	0	0	31	37	3	0
0	0	0	0	0	2	1	0	0	0	0	0	0
1	0	0	0	0	0	108	0	0	0	0	0	0
1	0	0	0	0	0	471	0	0	0	8	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	35	0	0	0	68	0	0

	Arriving	Trains	from	S								
	EB	arr	16									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	21	1	4	0	0	0	1	0	0	3
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	3	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Arriving	Trains	from	N								
	EB	arr	344									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	21	1	23	1	1	0	41	39	0	1
N	0	0	0	0	1	0	0	0	0	6	0	0
0	0	0	0	0	7	261	0	0	9	25	4	0
0	0	0	0	0	0	1	0	0	0	4	0	0
1	0	0	0	0	0	55	0	0	0	0	0	0
1	0	0	0	0	0	235	0	0	0	12	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	49	0	0	0	70	0	0

	Departing	Trains	to	E								
	EB	dep	438									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	3	76	9	68	19	0	0	164	193	0	13
N	1	2	0	0	1	0	0	0	0	17	0	0
0	0	0	4	0	11	455	0	0	17	40	3	0
0	0	0	0	0	0	3	0	0	0	0	0	0
1	0	0	0	0	0	73	0	0	0	0	0	0
1	0	0	0	0	0	362	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	14	0	0	0	20	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Departing	Trains	to	N								
	WB	dep	636									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	3	153	10	130	2	0	0	158	114	0	6
N	0	0	2	0	3	0	0	0	0	13	0	0
0	0	0	3	0	21	615	1	0	33	61	5	0
0	0	0	0	0	1	2	0	0	0	2	0	0
1	0	0	0	0	0	119	0	0	0	0	0	0
1	0	0	0	0	0	528	0	0	0	7	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	96	0	0	0	175	0	0

	Departing	Trains	to	S								
	WB	dep	48									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	1	35	1	22	0	0	0	5	4	0	3
N	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	10	0	0	2	1	0	0
0	0	1	0	0	1	0	0	0	0	2	0	0
1	0	0	0	0	0	3	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	2	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Arr-Dep	Trains	E	to	S							
	EB	arr	138									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	3	81	0	265	0	0	0	1	0	0	2
N	0	4	0	0	1	0	0	0	0	1	0	0
0	0	0	0	0	74	2	0	0	1	2	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	4	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	2	0	0

	EB	dep	138									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	3	90	0	264	0	1	0	1	0	0	2
N	0	4	0	0	1	0	0	0	0	1	0	0
0	0	0	0	0	76	4	0	0	1	3	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	4	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	2	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	446 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	140	9	77	6	0	2	118	106	0	22
N	0	0	0	0	0	0	0	0	0	4	0	0
0	0	0	5	1	17	262	0	0	22	27	0	0
0	0	0	0	0	2	1	0	0	0	1	0	0
1	0	0	0	0	0	41	0	0	0	0	0	0
1	0	0	0	0	0	180	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	26	0	0	0	62	0	0

Tier	WB Switch	dep GP3x	446 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	140	9	77	6	0	2	118	105	0	21
N	0	0	0	0	0	0	0	0	0	4	0	0
0	0	0	5	1	17	262	0	0	22	27	0	0
0	0	0	0	0	2	1	0	0	0	1	0	0
1	0	0	0	0	0	41	0	0	0	0	0	0
1	0	0	0	0	0	177	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	26	0	0	0	61	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Arr-Dep	Trains	S	to	N							
	EB	arr	29									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	10	1	3	0	0	0	8	2	0	1
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	17	0	0	2	5	0	0
0	0	0	0	0	1	0	0	0	0	3	0	0
1	0	0	0	0	0	7	0	0	0	0	0	0
1	0	0	0	0	0	16	0	0	0	2	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

	EB	dep	29									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	12	1	5	0	0	0	8	2	0	1
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	17	0	0	2	8	0	0
0	0	0	0	0	0	0	0	0	0	3	0	0
1	0	0	0	0	0	7	0	0	0	0	0	0
1	0	0	0	0	0	16	0	0	0	6	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	1	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	101 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	22	3	7	0	0	0	26	11	0	0
N	0	0	0	0	0	0	0	0	0	2	0	0
0	0	0	2	0	0	65	0	0	5	5	1	0
0	0	0	0	0	0	0	0	0	0	3	0	0
1	0	0	0	0	0	12	0	0	0	2	0	0
1	0	0	0	0	0	57	0	0	0	9	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	2	0	0	0	22	0	0

Tier	WB Switch	dep GP3x	101 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	24	3	9	0	0	0	25	10	0	0
N	0	1	0	0	0	0	0	0	0	2	0	0
0	0	0	1	0	0	63	0	0	4	5	1	0
0	0	0	0	0	0	0	0	0	0	3	0	0
1	0	0	0	0	0	11	0	0	0	2	0	0
1	0	0	0	0	0	52	0	0	0	7	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	2	0	0	0	22	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Arr-Dep	Trains	N	to	E							
	EB	arr	7									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	2	0	0	0	0	0	0	1	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	2	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

	EB	dep	7									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	3	0	1	0	0	0	0	1	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	3	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	3	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	153 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	6	15	228	0	23	0	0	0	2	2	0	7
N	0	6	0	0	0	0	0	0	0	0	0	0
0	2	0	3	0	18	3	0	0	0	2	2	0
0	1	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	0	0	0

Tier	WB Switch	dep GP3x	153 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	6	16	229	0	22	0	0	0	1	2	0	8
N	0	6	2	0	0	0	0	0	0	0	0	0
0	2	0	3	0	17	3	0	0	0	2	2	0
0	1	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	0	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	Pwr WB Switch	Move arr GP3x	Thru 106 GP4x	N&W GP50	Side GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	69	5	27	2	3	1	48	35	0	5
N	0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	4	0	4	91	1	0	11	15	0	0
0	0	0	0	0	1	2	0	0	0	3	0	0
1	0	0	0	0	0	15	0	0	0	0	0	0
1	0	0	0	0	0	78	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	14	0	0	0	25	0	0

Tier	WB Switch	dep GP3x	106 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	69	5	27	2	3	1	48	35	0	5
N	0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	4	0	4	91	1	0	11	15	0	0
0	0	0	0	0	1	2	0	0	0	3	0	0
1	0	0	0	0	0	15	0	0	0	0	0	0
1	0	0	0	0	0	78	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	14	0	0	0	25	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	Pwr EB Switch	Move arr GP3x	Thru 52 GP4x	W GP50	Side GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	5	44	2	45	0	2	0	7	12	0	6
N	1	3	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	12	20	0	0	0	3	0	0
0	1	0	0	0	0	0	0	0	0	3	0	0
1	0	0	0	0	0	5	0	0	0	0	0	0
1	0	0	0	0	0	11	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

Tier	EB Switch	dep GP3x	52 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	5	44	2	45	0	2	0	7	12	0	6
N	1	3	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	12	20	0	0	0	3	0	0
0	1	0	0	0	0	0	0	0	0	3	0	0
1	0	0	0	0	0	5	0	0	0	0	0	0
1	0	0	0	0	0	11	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	23 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	12	2	6	0	0	0	2	5	0	1
N	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	16	0	0	1	3	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	1	0	0
1	0	0	0	0	0	8	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

Tier	WB Switch	dep GP3x	23 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	12	2	4	0	0	0	2	5	0	1
N	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	16	0	0	1	3	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	1	0	0
1	0	0	0	0	0	8	0	0	0	5	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	Pwr EB Switch	Move arr GP3x	Thru 4 GP4x	N GP50	Side GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	1	0	3	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

Tier	EB Switch	dep GP3x	4 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	1	0	3	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

Tier	WB Switch	arr GP3x	21 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	1	24	1	24	0	0	0	5	0	0	0
N	0	1	0	0	0	0	0	0	0	2	0	0
0	0	0	0	0	3	2	0	0	0	2	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	6	0	0	0	4	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

Tier	WB Switch	dep GP3x	21 GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	0	24	1	24	0	0	0	5	0	0	0
N	0	1	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	3	2	0	0	0	2	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	5	0	0	0	4	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	2	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Power	Moves	Arr	from	E							
	WB	arr	9									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	7	0	8	0	0	0	3	1	0	1
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	3	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	3	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	1	0	0

	Power	Moves	Arr	from	S							
	EB	arr	15									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	16	0	12	0	0	0	3	2	0	0
N	0	0	3	0	0	0	0	0	0	0	0	0
0	0	1	0	0	3	3	0	0	1	0	0	0
0	0	2	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	3	0	0	0	2	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Power	Moves	Arr	from	N							
	EB	arr	3									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	0	1	1	0	0	0	0	7	0	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	2	0	0	1	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

	Power	Moves	Dep	to	E							
	EB	dep	127									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	1	4	39	1	36	3	0	0	35	42	0	1
N	1	4	0	0	2	0	0	0	0	2	0	0
0	0	0	3	0	7	98	0	0	7	6	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	16	0	0	0	0	0	0
1	0	0	0	0	0	73	0	0	0	3	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	14	0	0	0	23	0	0

Appendix A-1
Locomotive Model and Tier Frequency by Train Type

	Power	Moves	Dep	to	N							
	WB	dep	27									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	1	25	0	47	0	0	0	2	3	0	1
N	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	10	0	0	0	1	2	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	3	0	0	0	0	0	0
1	0	0	0	0	0	3	0	0	0	3	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0

	Power	Moves	Dep	to	S							
	WB	dep	583									
Tier	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
N	0	4	83	13	69	20	2	0	179	223	0	14
N	3	0	0	0	1	0	0	0	0	12	0	0
0	1	0	2	0	11	521	0	0	30	36	4	0
0	0	1	0	0	1	0	0	0	0	2	0	0
1	0	0	0	0	0	100	0	0	0	0	0	0
1	0	0	0	0	0	454	0	0	0	10	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	50	0	0	0	79	0	0

APPENDIX A-2

LOCOMOTIVE MODEL DISTRIBUTION BY TRAIN TYPE GROUPS

Appendix A-2
Locomotive Model Distribution by Train Type Groups

Through Trains and Through Power Moves

Tier	AESS/ZTR	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A
N	N	0.000	0.002	0.106	0.005	0.189	0.002	0.011	0.000	0.059	0.057	0.000
N	Y	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000
0	N	0.000	0.000	0.004	0.000	0.044	0.145	0.001	0.000	0.009	0.047	0.008
0	Y	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.024	0.000
1	N	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.000	0.000	0.002	0.000
1	Y	0.000	0.000	0.000	0.000	0.000	0.120	0.000	0.000	0.000	0.074	0.000
2	N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Y	0.000	0.000	0.000	0.000	0.000	0.016	0.000	0.000	0.000	0.037	0.000
Total		0.001	0.005	0.110	0.006	0.235	0.310	0.012	0.000	0.069	0.245	0.008

Arriving and Departing Trains

Tier	AESS/ZTR	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A
N	N	0.001	0.004	0.121	0.005	0.096	0.005	0.000	0.000	0.079	0.076	0.000
N	Y	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.006	0.000
0	N	0.000	0.000	0.002	0.000	0.025	0.229	0.000	0.000	0.013	0.022	0.002
0	Y	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.002	0.000
1	N	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000	0.000
1	Y	0.000	0.000	0.000	0.000	0.000	0.187	0.000	0.000	0.000	0.006	0.000
2	N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Y	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.045	0.000
Total		0.002	0.007	0.124	0.005	0.123	0.487	0.000	0.000	0.092	0.158	0.002

Appendix A-2
Locomotive Model Distribution by Train Type Groups

Power Moves

Tier	AESS/ZTR	Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A
N	N	0.000	0.004	0.068	0.006	0.068	0.009	0.001	0.000	0.090	0.107	0.000
N	Y	0.002	0.002	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.006	0.000
0	N	0.000	0.000	0.002	0.000	0.014	0.248	0.000	0.000	0.016	0.018	0.002
0	Y	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
1	N	0.000	0.000	0.000	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000
1	Y	0.000	0.000	0.000	0.000	0.000	0.212	0.000	0.000	0.000	0.008	0.000
2	N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Y	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.000	0.000	0.041	0.000
Total		0.002	0.007	0.071	0.006	0.083	0.542	0.001	0.000	0.106	0.179	0.002

Notes:

1. There are two primary types of auto start/stop technology – “Auto Engine Start Stop” (AESS), which is factory-installed on recent model high horsepower units; and the ZTR “SmartStart” system (ZTR), which is a retrofit option for other locomotives. Both are programmed to turn off the Diesel engine after 15 to30 minutes of idling, provided that various criteria (air pressure, battery charge, and others) are met. The engine automatically restarts if required by one of the monitored parameters. We assume that an AESS/ZTR-equipped locomotive will shut down after 30 minutes of idling in an extended idle event.

APPENDIX A-3

SAMPLE CALCULATIONS

Appendix A-3
Sample Calculations

Activity Types	Activity Code	Number of Events/Year	Locomotives per Consist	Emission Factor Group	Locomotives per Consist Working	Fraction of Calif Fuel
Thru from S to E Arriving	1	676	3.692	1	3.692	0.500
Thru from S to E Departing	2	676	3.712	1	3.712	0.500
Thru from E to S Arriving	3	1433	2.717	1	2.717	0.500
Thru from E to S Departing	4	1433	2.717	1	2.717	0.500
Thru from N to E Arriving	5	97	3.227	1	3.227	0.500
Thru from N to E Departing	6	97	3.227	1	3.227	0.500
Thru from E to N Arriving	7	669	2.141	1	2.141	0.500
Thru from E to N Departing	8	669	2.141	1	2.141	0.500
Thru from S to N Arriving	9	360	2.956	1	2.956	0.500
Thru from S to N Departing	10	360	2.956	1	2.956	0.500
Thru from N to S Arriving	11	646	3.136	1	3.136	0.500
Thru from N to S Departing	12	646	3.136	1	3.136	0.500
Arrivals from E	13	621	3.272	2	3.272	0.000
Arrivals from S	14	16	2.125	2	2.125	0.000
Arrivals from N	15	344	2.520	2	2.520	0.000
Departures to E	16	438	3.580	2	3.580	0.900
Departures to W	17	636	3.558	2	3.558	0.900
Departures to S	18	48	2.062	2	2.062	0.900
Arr & Dep from S to E Arriving	19	138	3.246	2	3.246	0.500
Arr & Dep from S to E Departing	20	138	3.355	2	3.355	0.500
Arr & Dep from E to S Arriving	21	446	2.540	2	2.540	0.500
Arr & Dep from E to S Departing	22	446	2.527	2	2.527	0.500
Arr & Dep from N to E Arriving	23	29	2.828	2	2.828	0.500
Arr & Dep from N to E Departing	24	29	3.241	2	3.241	0.500
Arr & Dep from E to N Arriving	25	101	2.535	2	2.535	0.500
Arr & Dep from E to N Departing	26	101	2.446	2	2.446	0.500
Arr & Dep from S to N Arriving	27	7	1.857	2	1.857	0.500
Arr & Dep from S to N Departing	28	7	2.571	2	2.571	0.500
Arr & Dep from N to S Arriving	29	153	2.137	2	2.137	0.500

Appendix A-3
Sample Calculations

Activity Types	Activity Code	Number of Events/Year	Locomotives per Consist	Emission Factor Group	Locomotives per Consist Working	Fraction of Calif Fuel
Arr & Dep from N to S Departing	30	153	2.150	2	2.150	0.500
Power thru from E to S Arriving	31	106	4.415	1	1.500	0.500
Power thru from E to S Departing	32	106	4.415	1	1.500	0.500
Power thru from N to E Arriving	33	52	3.692	1	1.500	0.500
Power thru from N to E Departing	34	52	3.692	1	1.500	0.500
Power thru from E to N Arriving	35	23	2.870	1	1.500	0.500
Power thru from E to N Departing	36	23	2.783	1	1.500	0.500
Power thru from S to N Arriving	37	4	2.250	1	1.500	0.500
Power thru from S to N Departing	38	4	2.250	1	1.500	0.500
Power thru from N to S Arriving	39	21	3.810	1	1.500	0.500
Power thru from N to S Departing	40	21	3.667	1	1.500	0.500
Power from E	41	9	3.778	3	1.500	0.900
Power from S	42	967	3.533	3	1.500	0.900
Power from N	43	3	5.000	3	1.500	0.900
Power to E	44	127	3.315	3	1.500	0.000
Power to N	45	27	3.741	3	1.500	0.000
Power to S	46	583	3.302	3	1.500	0.000
Yard operations - 4 switcher shifts	47	365	4.000	4	4.000	1.000
Yard operations - 6 switcher shift	48	365	6.000	4	6.000	1.000

Appendix A-3
Sample Calculations

Emission Factors Weighted by Model/Tier/ZTR Fractions - DPM g/hr per Locomotive

Consist Groups	Group ID	Idle-NonZTR	Idle-All	DB	N1	N2	N3	N4	N5	N6	N7	N8
California Fuel (221 ppm S)												
Thru Trains and Power Moves Thru	1	25.90	32.94	64.45	48.47	107.32	228.78	278.51	363.26	540.85	623.79	743.55
Arriving and Departing Trains	2	23.00	30.60	55.13	46.13	97.27	221.02	277.87	353.56	563.95	659.20	761.85
Arriving and Departing Power	3	20.69	29.22	52.73	46.85	93.58	218.76	279.88	354.69	563.01	652.19	749.57
Yard Switchers	4	31.00	31.00	56.00	23.00	76.00	129.19	140.61	173.27	272.65	315.58	409.05
47-State Fuel (2639 ppm S)												
Thru Trains and Power Moves Thru	1	25.90	32.94	64.45	48.47	107.32	248.99	309.40	408.89	606.69	702.31	841.33
Arriving and Departing Trains	2	23.00	30.60	55.13	46.13	97.27	239.26	308.88	399.31	630.99	733.55	852.75
Arriving and Departing Power	3	20.69	29.22	52.73	46.85	93.58	237.50	311.04	400.21	630.40	728.63	843.73
Yard Switchers	4	31.00	31.00	56.00	23.00	76.00	136.86	156.61	197.40	303.41	341.18	442.94

Note: Idle-NonZTR is the average per-locomotive idle emission rate for the fraction of locomotives not equipped with ZTR/Auto start-stop technology

Locomotive Model Distributions
Thru Trains and Power Moves Thru

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	**No**	0.0004	0.0025	0.1058	0.0054	0.1893	0.0023	0.0111	0.0004	0.0595	0.0573	0.0003
Pre Tier 0	**Yes**	0.0003	0.0020	0.0002	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0051	0.0000
Tier 0	**No**	0.0000	0.0002	0.0035	0.0001	0.0443	0.1449	0.0006	0.0000	0.0095	0.0473	0.0076
Tier 0	**Yes**	0.0002	0.0003	0.0000	0.0000	0.0013	0.0010	0.0000	0.0000	0.0000	0.0236	0.0000
Tier 1	**No**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0259	0.0000	0.0000	0.0000	0.0016	0.0000
Tier 1	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.1200	0.0000	0.0000	0.0000	0.0735	0.0000
Tier 2	**No**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0159	0.0000	0.0000	0.0000	0.0367	0.0000

Appendix A-3
Sample Calculations

Emission Factors Weighted by Model/Tier/ZTR Fractions - DPM g/hr per Locomotive

Arriving and Departing Trains

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0012	0.0043	0.1212	0.0051	0.0960	0.0051	0.0003	0.0004	0.0788	0.0758	0.0000
Pre Tier 0	Yes	0.0001	0.0021	0.0004	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	0.0058	0.0000
Tier 0	No	0.0004	0.0000	0.0025	0.0002	0.0249	0.2292	0.0001	0.0000	0.0134	0.0223	0.0019
Tier 0	Yes	0.0002	0.0001	0.0000	0.0000	0.0010	0.0008	0.0000	0.0000	0.0000	0.0024	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0428	0.0000	0.0000	0.0000	0.0004	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.1866	0.0000	0.0000	0.0000	0.0061	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0226	0.0000	0.0000	0.0000	0.0452	0.0000

Arriving and Departing Power

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0004	0.0040	0.0675	0.0059	0.0679	0.0091	0.0008	0.0000	0.0904	0.1070	0.0000
Pre Tier 0	Yes	0.0016	0.0016	0.0012	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0055	0.0000
Tier 0	No	0.0004	0.0004	0.0024	0.0000	0.0138	0.2476	0.0000	0.0000	0.0158	0.0178	0.0016
Tier 0	Yes	0.0000	0.0012	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0008	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0478	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.2121	0.0000	0.0000	0.0000	0.0075	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0257	0.0000	0.0000	0.0000	0.0407	0.0000

Yard Switchers

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix A-3
Sample Calculations

Emission Factors Weighted by Model/Tier/ZTR Fractions - DPM g/hr per Locomotive

Tier 2	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix A-3
Sample Calculations

Track Segment	Segment Number	Length (mi)
West side main line	1	0.3735
NW corner main line	2	0.1551
W end of northside main line	3	0.2498
E end track at San Pablo	4	0.2294
NW corner to W side yard entrance	5	0.4680
W side yard entrance to W end of IM track	6	0.1863
W end of IM track	7	0.1529
NW corner to N limit of yard	8	0.2557
Track from N limit to northside main line	9	0.1680
W side yard entrance to balloon track	10	0.0832
Balloon track section 1	11	0.1000
Balloon track section 2	12	0.1212
Balloon track section 3	13	0.3139
Balloon track section 4 to E end of main yard	14	0.2895
Yard operations area - main yard	15	0.7123
Yard operations area - E end to San Pablo	16	0.7645
E end of northside mainline	17	0.2498
W and center of track to San Pablo	18	0.5352
E end of IM track	19	0.3567

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
Thru from S to E	1 and 2	1	10	1	0	0	1
"	1 and 2	2	10	1	0	0.166666667	1
"	1 and 2	3	10	1	0	0	1
"	1 and 2	17	10	1	0	0	1
"	1 and 2	18	10	1	0	0	1
"	1 and 2	4	10	1	0	0	1
Thru from E to S	3 and 4	4	10	1	0	0	1
"	3 and 4	18	10	1	0	0	1
"	3 and 4	17	10	1	0	0	1
"	3 and 4	3	10	1	0	0.166666667	1
"	3 and 4	2	10	1	0	0	1
"	3 and 4	1	10	1	0	0	1
Thru from N to E	5 and 6	1	10	1	0	0	1
"	5 and 6	8	10	1	0	0	1
Thru from E to N	7 and 8	8	10	1	0	0	1
"	7 and 8	1	10	1	0	0	1
Thru from S to N	9 and 10	9	10	1	0	0	1
"	9 and 10	3	10	1	0	0	1
"	9 and 10	17	10	1	0	0	1
"	9 and 10	18	10	1	0	0	1
"	9 and 10	4	10	1	0	0	1
Thru from N to S	11 and 12	4	10	1	0	0	1
"	11 and 12	18	10	1	0	0	1
"	11 and 12	17	10	1	0	0	1
"	11 and 12	3	10	1	0	0.166666667	1
"	11 and 12	9	10	1	0	0	1
Arrivals from E	13	4	10	1	0	0	1
"	13	18	10	1	0	0	1
"	13	17	10	1	0	0	1
"	13	3	10	1	0	0	1

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
"	13	2	10	1	0	0	1
"	13	5	10	1	0	0	1
"	13	6	10	1	0	0	1
"	13	7	10	1	0	0	1
"	13	19	10	1	0	0	1
"	13	18	10	1	0	0	1
"	13	4	10	1	0.5	0.5	1
Arrivals from S	14	1	10	1	0	0	1
"	14	2	10	1	0	0	1
"	14	3	10	1	0	0	1
"	14	17	10	1	0	0	1
"	14	18	10	1	0	0	1
"	14	4	10	1	0.5	0.5	1
Arrivals from N	15	8	10	1	0	0	1
"	15	5	10	1	0	0	1
"	15	6	10	1	0	0	1
"	15	7	10	1	0	0	1
"	15	19	10	1	0	0	1
"	15	18	10	1	0	0	1
"	15	4	10	1	0.5	0.5	1
Departures to E	16	4	10	1	1.5	0.5	0
Departures to W	17	7	10	1	1.5	0.5	0
"	17	6	10	1	0	0	1
"	17	5	10	1	0	0	1
"	17	8	10	1	0	0	1
Departures to S	18	4	10	1	1.5	0.5	0
"	18	18	10	1	0	0	1
"	18	17	10	1	0	0	1
"	18	3	10	1	0	0	1
"	18	2	10	1	0	0	1

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
"	18	1	10	1	0	0	1
Arr & Dep from S to E	19	1	10	1	0	0	1
"	19	2	10	1	0	0.166666667	1
"	19	3	10	1	0	0	1
"	19	17	10	1	0	0	1
"	19	18	10	1	0	0	1
"	19	4	10	1	0	0	1
"	19	15	10	1	0	0.5	0
Arr & Dep from E to S	21	4	10	1	0	0	1
"	21	18	10	1	0	0	1
"	21	17	10	1	0	0	1
"	21	3	10	1	0	0.166666667	1
"	21	2	10	1	0	0	1
"	21	1	10	1	0	0	1
"	21	15	10	1	0	0.5	0
Arr & Dep from N to E	23	1	10	1	0	0	1
"	23	8	10	1	0	0	1
"	23	15	10	1	0	0.5	0
Arr & Dep from E to N	25	8	10	1	0	0	1
"	25	1	10	1	0	0	1
"	25	15	10	1	0	0.5	0
Arr & Dep from S to N	27	9	10	1	0	0	1
"	27	3	10	1	0	0	1
"	27	17	10	1	0	0	1
"	27	18	10	1	0	0	1
"	27	4	10	1	0	0	1
"	27	15	10	1	0	0.5	0
Arr & Dep from N to S	29	4	10	1	0	0	1
"	29	18	10	1	0	0	1
"	29	17	10	1	0	0	1

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
"	29	3	10	1	0	0.166666667	1
"	29	9	10	1	0	0	1
"	29	15	10	1	0	0.5	0
Power thru from E to S	31	4	10	1	0	0	1
"	31	18	10	1	0	0	1
"	31	17	10	1	0	0	1
"	31	3	10	1	0	0.166666667	1
"	31	2	10	1	0	0	1
"	31	1	10	1	0	0	1
Power thru from N to E	33	1	10	1	0	0	1
"	33	8	10	1	0	0	1
Power thru from E to N	35	8	10	1	0	0	1
"	35	1	10	1	0	0	1
Power thru from S to N	37	9	10	1	0	0	1
"	37	3	10	1	0	0	1
"	37	17	10	1	0	0	1
"	37	18	10	1	0	0	1
"	37	4	10	1	0	0	1
Power thru from N to S	39	4	10	1	0	0	1
"	39	18	10	1	0	0	1
"	39	17	10	1	0	0	1
"	39	3	10	1	0	0.166666667	1
"	39	9	10	1	0	0	1
Power from E	41	4	10	1	0	0	0.399002113
"	41	18	10	1	0	0	0.399002113
"	41	17	10	1	0	0	0.399002113
"	41	3	10	1	0	0	0.399002113
"	41	2	10	1	0	0	0.399002113
"	41	5	10	1	0	0	0.399002113
"	41	10	10	1	0	0	0.399002113

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
"	41	11	10	1	0	0	0.399002113
"	41	12	10	1	0	0	0.399002113
"	41	13	10	1	0	0	0.399002113
"	41	14	10	1	0	0	0.399002113
"	41	18	10	1	0	0	0.399002113
"	41	4	10	1	0	0	0.399002113
"	41	4	10	1	0	0	0.600997887
"	41	18	10	1	0	0	0.600997887
"	41	14	10	1	0	0	0.600997887
"	41	13	10	1	0	0	0.600997887
"	41	12	10	1	0	0	0.600997887
"	41	11	10	1	0	0	0.600997887
"	41	10	10	1	0	0	0.600997887
"	41	5	10	1	0	0	0.600997887
"	41	6	10	1	0	0	0.600997887
Power from S	42	1	10	1	0	0	0.399002113
"	42	2	10	1	0	0	0.399002113
"	42	3	10	1	0	0	0.399002113
"	42	17	10	1	0	0	0.399002113
"	42	18	10	1	0	0	0.399002113
"	42	4	10	1	0	0	0.399002113
"	42	1	10	1	0	0	0.600997887
"	42	5	10	1	0	0	0.600997887
"	42	6	10	1	0	0	0.600997887
Power from N	43	8	10	1	0	0	1
"	43	5	10	1	0	0	1
"	43	10	10	1	0	0	1
"	43	11	10	1	0	0	1
"	43	12	10	1	0	0	1
"	43	13	10	1	0	0	1

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
"	43	14	10	1	0	0	1
"	43	18	10	1	0	0	1
"	43	4	10	1	0	0	1
Power to E	44	4	10	1	0.5	0.5	0
Power to N	45	7	10	1	0.5	0.5	0
"	45	6	10	1	0	0	1
"	45	5	10	1	0	0	1
"	45	8	10	1	0	0	1
Power to S	46	4	10	1	0.5	0.5	1
"	46	18	10	1	0	0	1
"	46	14	10	1	0	0	1
"	46	13	10	1	0	0	1
"	46	12	10	1	0	0	1
"	46	11	10	1	0	0	1
"	46	10	10	1	0	0	1
"	46	5	10	1	0	0	1
"	46	1	10	1	0	0	1

Notes
(1) Segment numbers listed as negative values are in-yard power moves from arriving trains to service or from service to departing trains
(2) Non-ZTR Idling is the duration of an idle event when units without ZTR continue to idle after +ZTR-equipped units have shut down
(3) Idling All is the duration of idling during which all locomotives continue to idle
(4) Fraction of Segment Moving is the fraction of the length of the segment over which the movement occurs. (On departure, power moves from service are assumed to connect to trains 20% of the way into a track segment)

Appendix A-3
Sample Calculations

Yard Operations	Activity Code	Segment Number	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Working Time (hrs)
Day and Night Shift - Main Yard	47	15	2	0	0	11.2
Day and Night Shift - E end to San Pablo	47	16	2	0	0	4
Graveyard Shift - Main Yard	48	15	2	0	0	5.6
Graveyard Shift - E end to San Pablo	48	16	2	0	0	2

Duty Cycles (Percent of Time by Notch)	Duty Cycle Number	Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8
Train and Consist Movements	1	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yard Operations	2	59.8%	0.0%	12.4%	12.3%	5.8%	3.6%	3.6%	1.5%	0.2%	0.8%

Appendix A-3
Sample Calculations

Example 1 -- WB Arriving Intermodal Train

Parameter	Value
Activity Code	13
Number of Events	621
Locomotives per Consist on Train	3.272
Emission Factor Group	2
Fraction of California Fuel	0.00

Route Followed	Segment Number	Length (miles)	Speed (mph)	Power Move	Non-ZTR Idle (hrs)	ZTR Idle (hrs)	Locomotive Hours Moving	Locomotive Hours NonZTR Idle	Locomotive Hours ZTR Idle
E end track at San Pablo	4	0.229	10	N	0	0	46.61	0.00	0.00
W and center of track to San Pablo	18	0.535	10	N	0	0	108.75	0.00	0.00
E end of northside mainline	17	0.250	10	N	0	0	50.76	0.00	0.00
W end of northside main line	3	0.250	10	N	0	0	50.76	0.00	0.00
NW corner main line	2	0.155	10	N	0	0	31.51	0.00	0.00
NW corner to W side yard entrance	5	0.468	10	N	0	0	95.09	0.00	0.00
W side yard entrance to W end of IM track	6	0.186	10	N	0	0	37.85	0.00	0.00
W end of IM track	7	0.153	10	N	0	0	31.07	0.00	0.00
E end of IM track	19	0.357	10	N	0	0	72.48	0.00	0.00
W and center of track to San Pablo	18	0.535	10	N	0	0	108.75	0.00	0.00
E end track at San Pablo	4	0.229	10	N	0.5	0.5	46.61	1015.96	1015.96
Total							*680.24*	*1015.96*	*1015.96*

Appendix A-3
Sample Calculations

Emission Factors - Arriving and Departing Trains	**Group ID**	**Idle-NonZTR**	**Idle-All**	**DB**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**
California Fuel (221 ppm S)	2	23.00	30.60	55.13	46.13	97.27	221.02	277.87	353.56	563.95	659.20	761.85
47-State Fuel (2639 ppm S)	2	23.00	30.60	55.13	46.13	97.27	239.26	308.88	399.31	630.99	733.55	852.75
Fuel Fraction Adjusted Rates		*23.00*	*30.60*	*55.13*	*46.13*	*97.27*	*239.26*	*308.88*	*399.31*	*630.99*	*733.55*	*852.75*
Duty Cycle Moving	1	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Weighted g/hr emissions	1	0.00	0.00	0.00	23.07	48.64	0.00	0.00	0.00	0.00	0.00	0.00

	Moving	**Idle-NonZTR**	**Idle-All**
Emission Rate (g/hr)	71.70	23.00	30.60
Locomotive Hours	680.24	1015.96	1015.96
Total Emissions (g/yr)	**48773**	**23367**	**31088**

APPENDIX A-4

METHODOLOGY FOR ESTIMATING LOCOMOTIVE EMISSIONS AND GENERATING AERMOD EMISSION INPUTS

Appendix A-4

Methodology for Estimating Locomotive Emissions and Generating AERMOD Emission Inputs

Overview

This appendix describes the general procedures followed for developing locomotive emission inventories for the Union Pacific Railroad (UPRR) rail yards under the Memorandum of Understanding with the California Air Resources Board. It also describes the procedure by which the emission inputs for both locomotive and non-locomotive sources used in AERMOD dispersion modeling.

EMISSION CALCULATIONS

This section describes the details of the development of activity inputs, emission factors, and emission estimates for locomotive operations. Separate procedures are followed for estimating activity associated with locomotives on trains, locomotive consist movements within a yard, service and shop activity (if occurring at a specific yard), and yard switching operations within a yard. Emission factors are developed for each of the types of locomotive activity based on the model and technology distribution of locomotives involved in each activity. Emission estimates are then developed for the activities and specific areas of a yard in which each activity occurs. The data used to calculate these emissions are included in the Appendix A-3 Excel workbook, which includes a "Sample Calculations" worksheet showing the linkages between the various activities, emission factors, and operating characteristics data.

Train Activity

Train activity data for emissions calculations includes a number of separate components:

- The number of trains arriving, departing, or passing through a yard, broken down by type of train
- The average composition of working locomotives in each consist[1], including the fraction of locomotives of different models, emissions technology tier, and automatic idling control equipment[2]
- The identification of routes followed for different types of train activities

[1] The term "consist" refers to the group of locomotives (typically between one and four) that provide power for a specific train.

[2] Two types of automatic idling control equipment are in use, known as ZTR SmartStart (typically retrofit equipment on low horsepower units) and AESS (typically factory installed on newer high horsepower units). Both are programmed to automatically shut of the engines of parked idling locomotives after a specified period of time, and to restart the unit if any of a number of operating parameters (battery state, air pressure, coolant temperature, etc.) reach specified thresholds.

- Identification of the speeds and throttle settings for different types of train activities in different locations.

The primary source of information for estimating train activity is a database identifying the arrival and departure of locomotives at a specific yard. This database identifies locomotives by their ID numbers and models, the status on the train (working or not working), and the specific train to which they are connected. From these data, the total numbers of trains of different types are identified based on train symbols, train dates, train origination and termination indicators, and dates and times of arrival and departure. For each type of train and activity, the average number of locomotives per consist is calculated along with the distribution of locomotive models, emission technology tiers, and automatic idling control equipment. A separate database of UPRR locomotives is consulted based on locomotive ID to determine the tier and date of any retrofits of automatic idling controls to complete the development of these model distributions. The activity data so derived are shown on the "Activities" worksheet in the Appendix A-3 Excel workbook, and the model and technology distributions are shown on the "Consist Emissions" worksheet.

The types of trains to be identified can vary from yard to yard. For all yards, through trains (which bypass the yard itself on mainline tracks adjacent to the yard) are identified. Depending on the yard, trains entering or departing from the yard can be of several types, including:

- Intermodal trains
- Automobile trains
- "Manifest" or freight trains
- Local trains
- Power moves

Power moves are trains consisting only of locomotives which are either arriving at the yard to be serviced or used for departing trains, or departing from the yard to be serviced at another location or used for trains departing from another location. The routes followed by each type of train on arrival and departure are identified in consultation with UPRR yard personnel, along with estimates of average speeds and duty cycles (fraction of time spent at different throttle settings) for different areas.

Specific track subsections are identified by UTM coordinates digitized from georeferenced aerial photographs. The segments identified and their lengths are shown on the "Track Segments" worksheet of Appendix A-3. For each train type, direction, and route, a listing of track segments, segment lengths, and duty cycles is developed. Duty cycles are shown on the "Consist Emissions" worksheet of Appendix A-3, and the segment speeds, duty cycles, idling durations are shown on the "Movements and Yard Operations" worksheet. This listing, along with the number of locomotives per consist and number of trains of each type, allows calculation of the number of locomotive hours in each duty cycle to be calculated for each section of track. For arriving and departing trains, estimates of the duration of idling were developed in consultation with UPRR personnel. These idling periods were divided into two parts – the assumed amount of

time that all locomotives in a consist would idle on arrival or departure, and the amount of time that only locomotives not equipped with automatic idle controls would idle. Idling periods were assigned to a segment of the arrival or departure track one fifth of the length of the track at the appropriate end.

Service and Shop Activity

If there is a service track and/or shop at a yard, locomotives (including both road power from trains as well as yard switchers) undergo a variety of activities at these locations. If present at a yard, details of the service and shop activity, model distributions, and emission factors are shown on the "Service and Shop" worksheet of Appendix A-3. Specific locomotive activities involve idling while awaiting or undergoing routine service (cleaning, refueling, oiling, sanding, and other minor maintenance), movement and idling between service and maintenance areas, and stationary load testing associated with specific types of maintenance events. A database of service events at individual yards identifies the number of service events during the year, the locomotive ID and model, and the nature of servicing performed. Routine servicing involves periods of idling prior to and during service, and additional idling prior to movement of consists to departing trains in the yard. Estimates of the duration of idling associated with servicing are developed in consultation with UPRR personnel. As was done for trains, these idling periods were separated into two parts, the average total duration of idling by all locomotives, and the average duration of additional idling by locomotives not equipped with automatic idling controls.

The database also specifically identifies load test events and the type of maintenance with which the load testing is associated. These types include planned maintenance at different intervals (e.g., quarterly, semiannual) as well as unscheduled maintenance which may involve both diagnostic load testing prior to maintenance and post-maintenance load testing. The duration of load test events in each throttle setting depend on the equipment available and types of maintenance performed at the yard. Estimates of these durations, as well as the identification of load testing activity by type of load test and the time and duration of any additional idling and movements are developed in consultation with UPRR personnel.

A total number of events (servicing and load testing by location and type) are developed from these data, as are locomotive model and technology distributions for all locomotives serviced and for those specific locomotives undergoing load testing (if applicable). From these event counts and durations, the total number of hours of locomotive idling and higher throttle setting operation in different portions of the service areas are calculated for each of the two model distributions.

Yard Switcher Activity

In each yard, there are routine jobs assigned to individual switchers or sets of switchers. These activities are generally not tracked from hour to hour, but they occur routinely within yard boundaries during specified work shifts. Similarly, the specific yard switcher locomotive IDs assigned to these jobs are not routinely tracked, but these yard jobs are

generally assigned to a specific model of low horsepower locomotive. From the assigned yard switcher jobs and shifts, and in consultation with UPRR personnel, an estimate of the hours per day of switcher operation in a yard are developed, along with the specific times of day when these activities occur (time of day assignments were made only if operation was less than 24 hour per day). Duty cycles for switching operation are also developed in consultation with local UPRR personnel. Depending on the type of activity and type of trains being handled in a yard, duty cycle estimates may vary. In the absence of more detailed information, the USEPA switcher duty cycle is assumed to be representative of each switcher's operation[3]. The total number of locomotive hours of operation for each model are calculated and assigned to the areas in which the units work. In some cases, yard jobs are assigned to specific areas within the yard and specific models of locomotives. In these cases, the switcher activities are assigned specifically to these areas of the yard.

Emission Factor Development

The locomotive model and technology group distributions derived in the development of activity data are grouped by type or types of activity with consideration for the level and nature of the activity. For example, a single distribution is used for through trains of all types, including power moves, while consist model distributions for different types of trains within a yard may be treated as separate distributions if they are handled in different areas of a yard. As shown in Part VII of this report model-group-specific emission factors by throttle setting were developed based on emission test data and sulfur content adjustment factors. From these emission factors and the locomotive model and technology distributions for different types of trains and activities, weighted average emission factors are calculated for the "average" locomotive for that train type or activity on a gram per hour basis. For each train type or activity, two separate idle emission rates are calculated. The first is the straight weighted average emission rate for all locomotives, while the second is the weighted average only for the fraction of locomotives without automatic idle controls. Mathematically,

$$\overline{Q}(l) = \sum_{i=1}^{11}\sum_{j=1}^{4}\sum_{k=1}^{2} F(i,j,k)\cdot Q(i,j,l)$$

for l corresponding to idle through N8, and

$$\overline{Q}(l^*) = \sum_{i=1}^{11}\sum_{j=1}^{4} F(i,j,1)\cdot Q(i,j,l^*)$$

for idling emission rate during periods when only locomotives without automatic idle controls are idling

where

[3] USEPA (1998). Locomotive Emission Standards -- Regulatory Support Document. (Available at *www.epa.gov/otaq/regs/nonroad/locomotv/frm/locorsd.pdf*).

$\overline{\overline{Q}}(l)$ = weighted average emission factor for throttle setting l

$Q(i,j,l)$ = the base g/hr emission factor of a particular model group/technology class and throttle setting

$F(i,j,k)$ = the fraction of locomotives of a particular model group/technology class

i = model group index (Switcher, GP-3x, etc.)

j = technology tier index (pre-Tier 0, Tier 0, Tier 1, Tier 2)

k = automatic idle control status index (with or without)

l = throttle setting (idle, N1, . . ., N8)

l^* = index for idle throttle of locomotives without automatic idle controls.

Thus, for each defined locomotive model distribution, gram per hour emission factors are generated for each throttle setting.

Emission Calculations – Locomotive Movements

From the train activity analysis, the following data are available for each segment of track: track length of segment $L(i)$; speed $V(i)$; movement duty cycle $\boldsymbol{D}(i)$ (a vector of fractions of time spent in each throttle setting); number of trains of each type $N(j)$; and number of working locomotives per consist for each train type $C(j)$. For each type of train j, there is a set of throttle-specific emission factors $Q_j(l)$ for the "average" locomotive used on that train type. If a particular type of train or consist movement can follow multiple paths within the yard, the activity is allocated to sequences of track segments representing each such path. Total annual emissions $q_{tot}(i)$ for each segment are then calculated as

$$q_{tot}(i) = \frac{L(i)}{V(i)} \cdot \sum_j N(j) \cdot C(j) \sum_l D(i,l) \cdot Q_j(l) .$$

Emission Calculations – Locomotive Idling

Locomotive idling is calculated in a similar manner for road power and locomotives in service. For each train type and for service events, activity data provide a number of annual events $N(i)$, duration of idling by locomotives with ($T_{all}(i)$) and without ($T_{nZTR}(i)$)automatic idle control, and gram per hour emission rates for the "average" locomotive $Q_{all}(i)$, and the "average" locomotive excluding those with automatic idle controls $Q_{nZTR}(i)$. Total annual emissions are calculated as

$$q_{idle} = \sum_i N(i) \cdot C(i) \cdot (T_{all}(i) \cdot Q_{all}(i) + T_{nZTR}(i) \cdot Q_{nZTR}(i)) .$$

If a particular type of activity occurs at multiple locations within the yard (e.g., on multiple arrival or departure tracks), then the idling time is allocated to different segments of track as appropriate so that segment-specific emissions are obtained.

Emission Calculations – Load Testing

Load testing emissions are calculated separately for each throttle setting (idle, N1 and N8) using the weighted average emission factors for the load-tested units, the number of load tests of different types, and the duration of testing in each throttle setting for each type of test.

Emission Calculations – Yard Switcher Operations

Activity data provide the number and model group information for yard switchers, and the number of operating hours per day. Model-group specific emission factors are multiplied by the duty cycle to generate weighted average gram per hour emissions for idling and for combined emissions from operation in notch 1 through notch 8. Emissions are calculated directly from the number of units, hours per day working, and duty cycle weighted emission factors for both idle and non-idle throttle settings during work shifts.

AERMOD EMISSION INPUT PREPARATION

Emissions from both locomotives and from other emission sources in a yard are allocated to multiple individual point or volume sources in AERMOD inputs. In addition to each type of activity's emission rates, the locations of emissions, the release parameters, and other inputs (e.g., building downwash parameters, temporal variation in emissions, etc.) are required by AERMOD. Emission inputs are prepared sequentially for different types of activities and the areas within which they occur. The source elevation for each point or volume source is interpolated from a high resolution terrain file.

Locomotive Movements

For each type of locomotive movement, emissions calculated for each track segment are uniformly allocated to a series of evenly spaced volume sources along that track segment. The maximum spacing between sources is specified and the number of sources to be used for each segment is calculated from the segment length. The raw emission rate value in the AERMOD inputs (g/sec) is based directly on the annual emission total for the segment divided by the number of sources on that segment. For locomotive movements, separate day and night release parameters are needed. Therefore, each source is duplicated (but with a different source ID and parameters) in the AERMOD inputs, with temporal profile inputs (EMISFACT HROFDY) that use day time parameters from 0600-1800 and night time parameters for 1800-0600.

Locomotive Idling and Load Testing

Locomotive idling and load testing emissions are allocated to track segments in the same manner as locomotive movements, but as point, rather than volume sources. Each source location may have up to three separate sources identified, with different stack parameters used for idle, notch 1 and notch 8. Building downwash inputs are assigned from a pre-

prepared set of records for a typical locomotives dimensions and the orientation of the track segment on which the emissions occur.

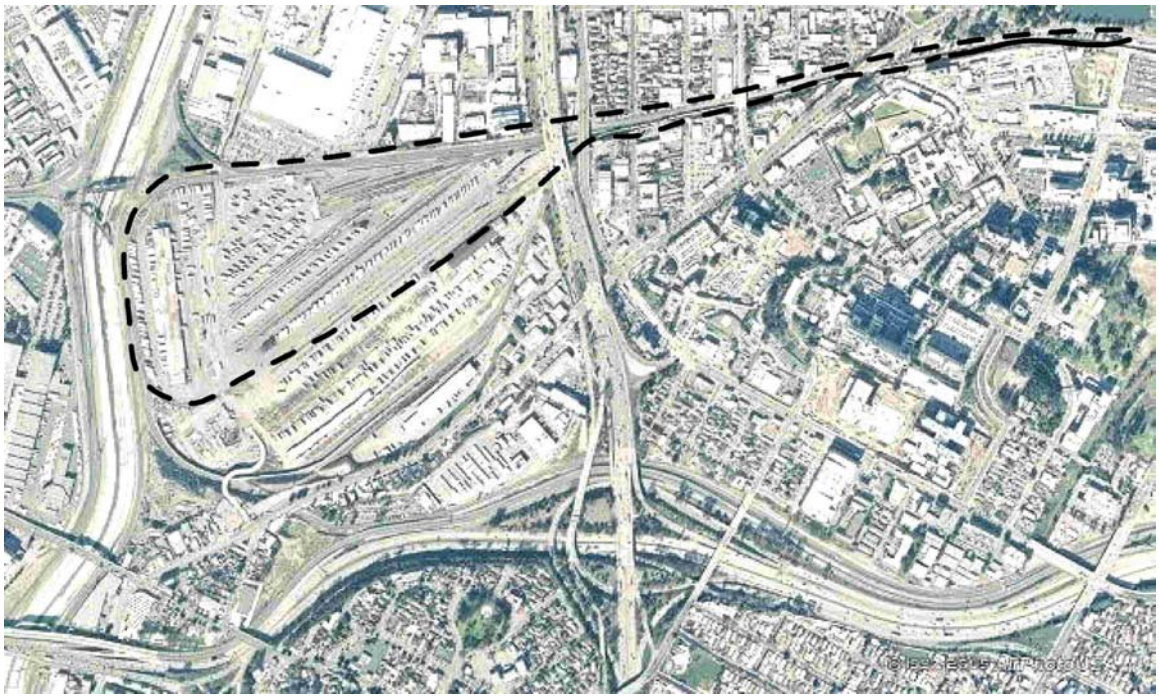
Yard Switcher Operations

Yard switcher operations are allocated to areas within the yard based on the estimated time spent working in each area. As for locomotive movements, yard switcher emissions for a specific area are allocated uniformly to a number of volume sources on defined segments. Day and night operations are handled similarly to train and consist movements, with EMISFACT HROFDY records used to switch day and night volume source release parameters. Depending on their magnitude and distance from yard boundaries, the "working idling" emissions for yard switching may be added to the non-idle emissions from volume sources, or treated as a series of point sources, using stack parameters for the specific model group being used. If treated as point sources, building downwash inputs are prepared as for other locomotive idling and load testing.

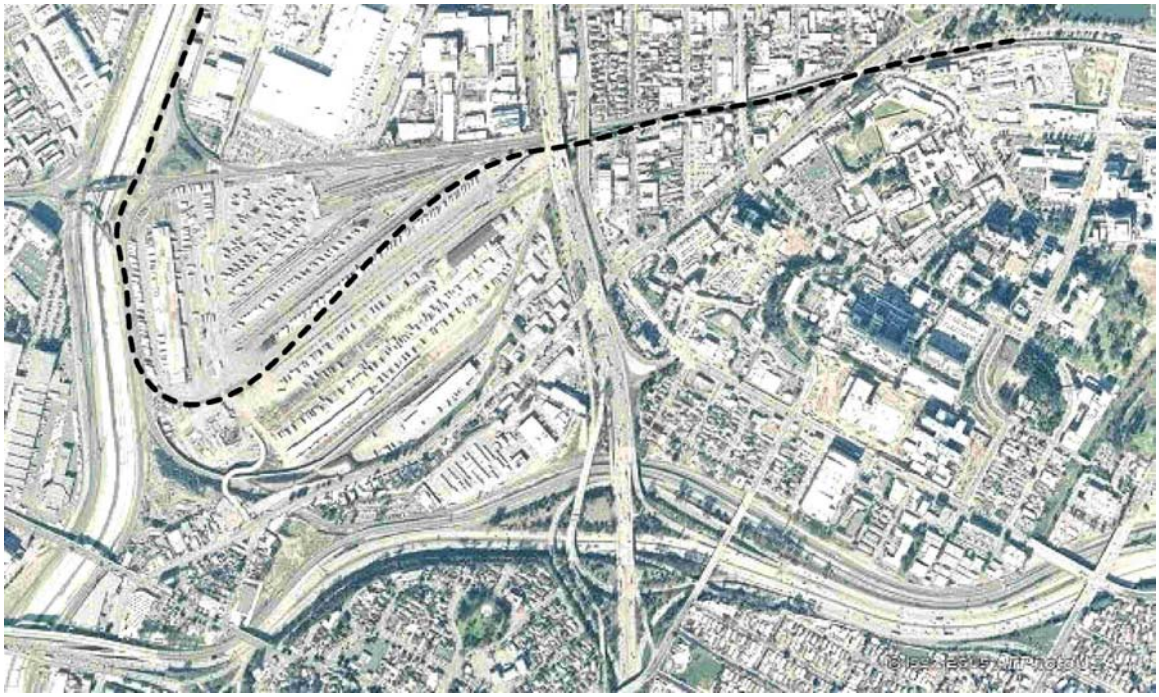
APPENDIX A-5

PRINCIPLE LOCOMOTIVE ROUTES

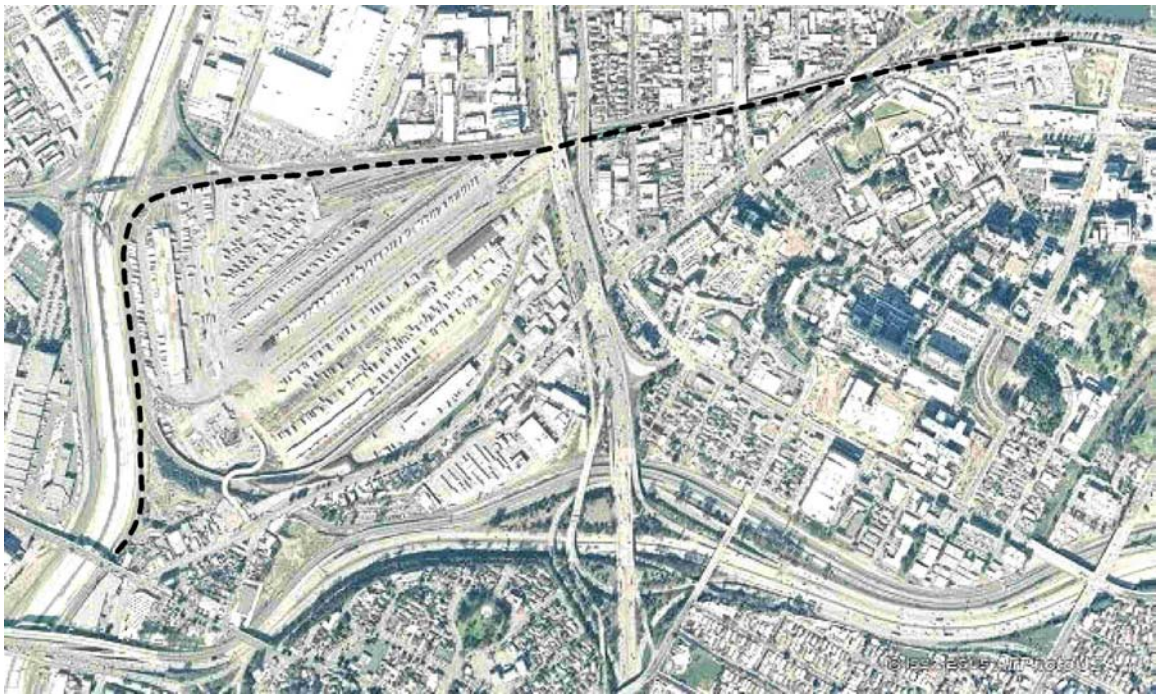
Appendix A-3
Principal Locomotive Routes at LATC



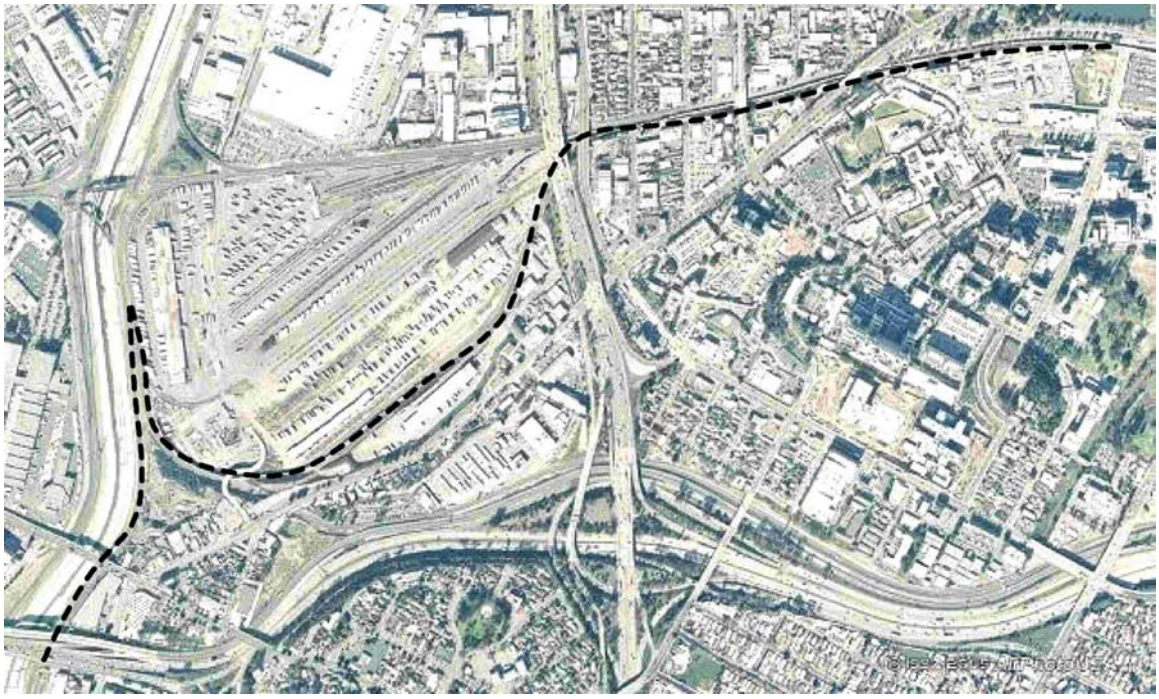
WB Arrivals (dashed)
EB Departures – Trains and Power Moves (solid)



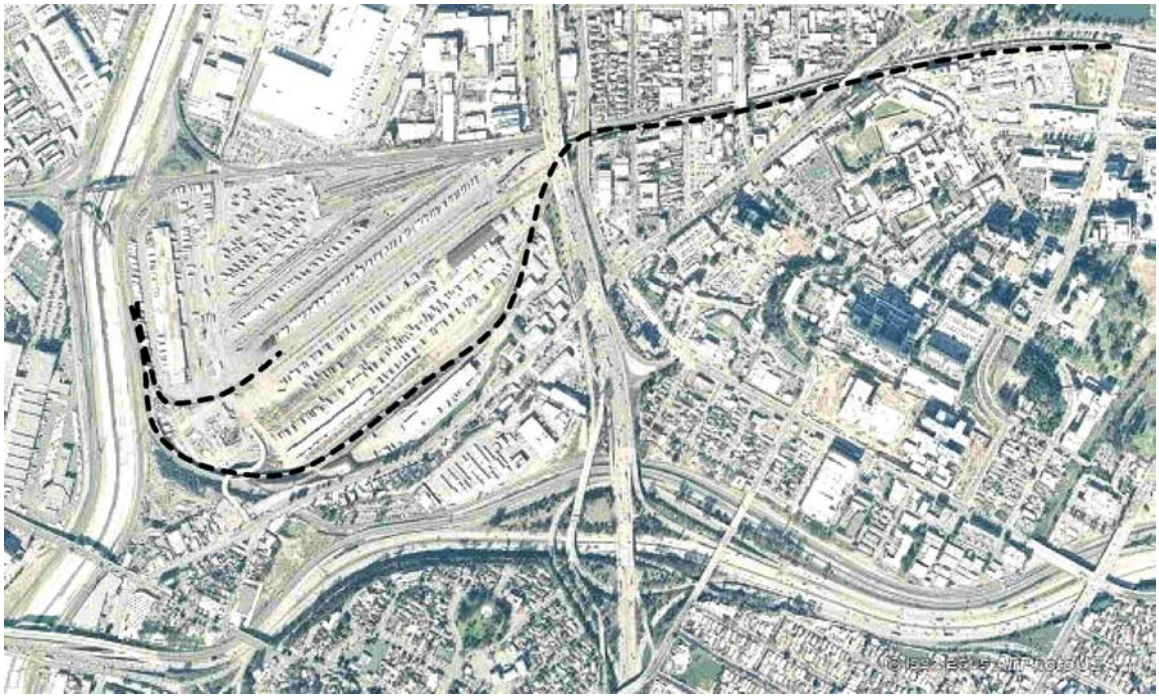
SB Arrivals



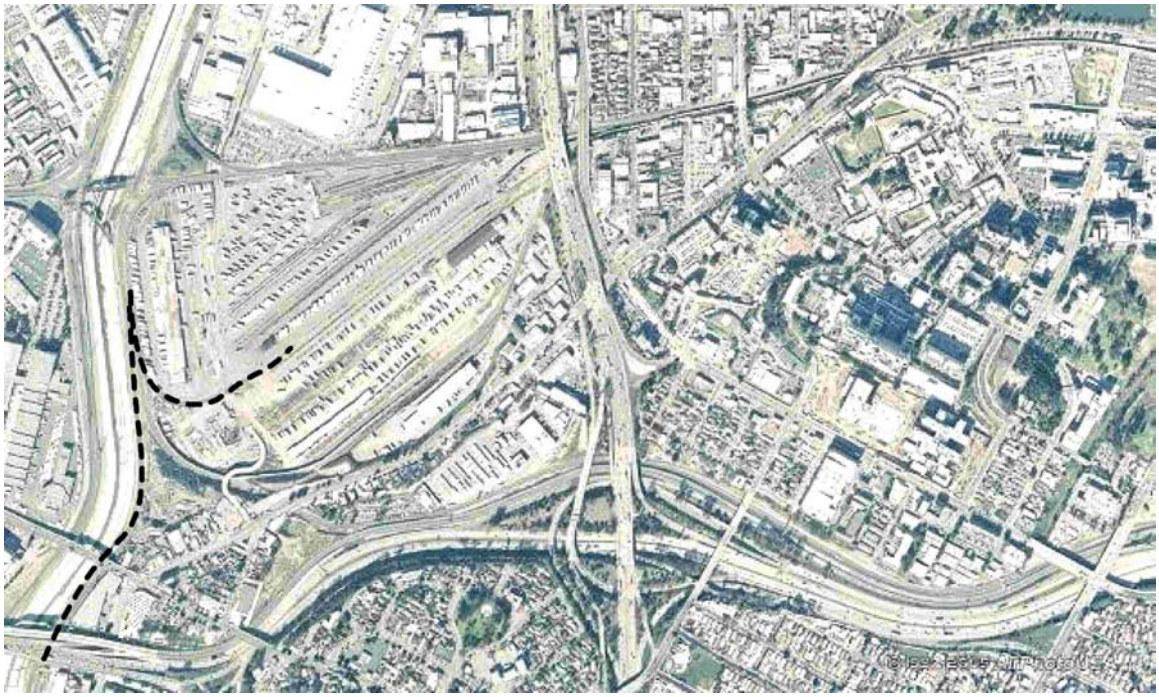
NB Arrivals
Through Trains from South to East and from East to South
Power Moves Arriving from South for EB Departure



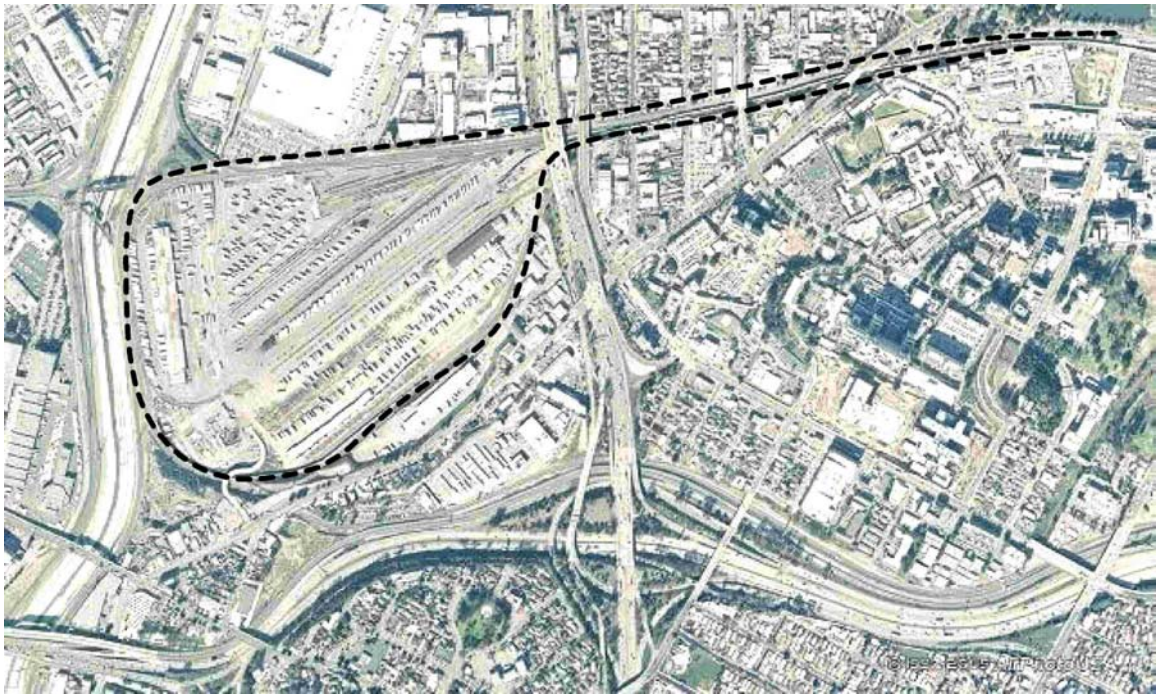
Power Moves to South



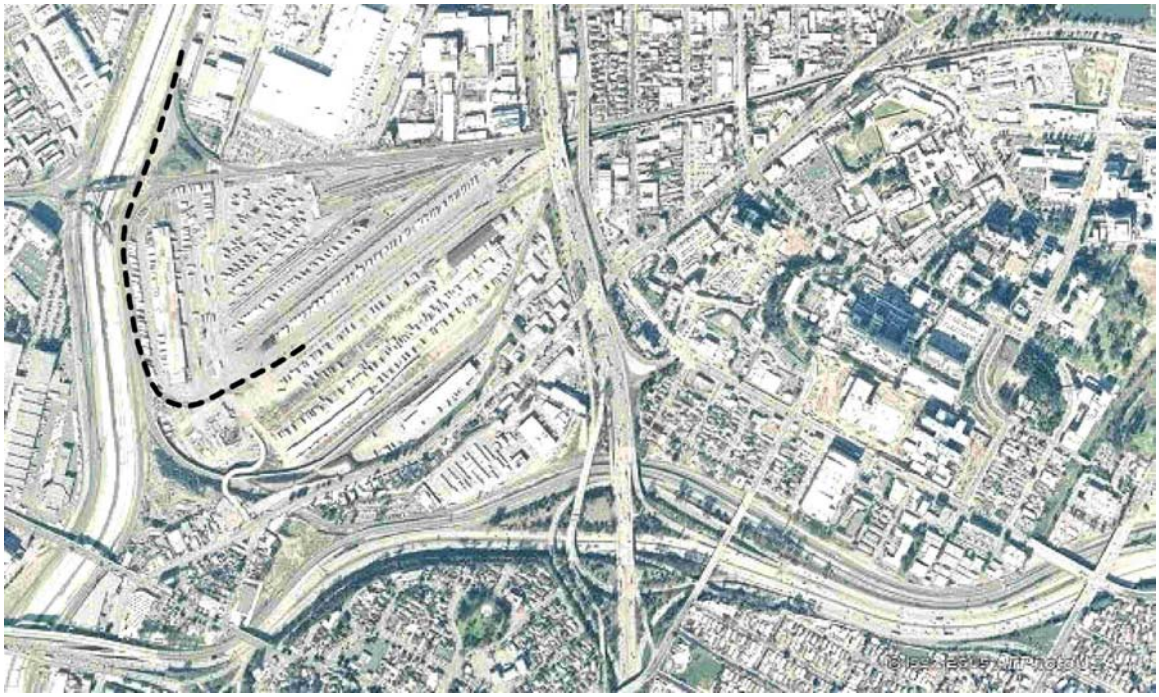
Power Moves Arriving from East for NB Departure



Power Moves Arriving from South for NB Departure



Power Moves Arriving from East for EB Departure



NB Departures

APPENDIX A-6

IRESON ET AL

Development of Detailed Railyard Emissions to Capture Activity, Technology and Operational Changes

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ABSTRACT

Railyard operations involve a variety of complex activities, including inbound and outbound train movements, classification (i.e., separating cars from inbound trains for redirection to multiple destinations, and building new trains), and servicing locomotives. Standard locomotive duty cycles provide long-term average activity patterns for locomotive operations, but they are not appropriate for the specialized activities that occur within railyards or at locations such as ports, and emission densities in such areas can be high relative to those of line haul activities. There are significant emission rate differences between locomotive models, and differences in the types of service for which specific models are used. Data for throttle-specific emissions, activity levels, and locomotive models and operating practices can be used to provide more accurate emissions estimates for such operations. Such data are needed to quantify actual emissions changes in these high activity areas. A calculation scheme has been developed to generate detailed emission inventories based on the types of data that are collected for managing rail operations. This scheme allows improved accuracy in emissions estimation, and also provides a more reliable basis for bottom-up tracking of emissions changes over time. Factors that can be addressed include: changes in the distribution of locomotive models and control technology levels (e.g., increasing fractions of Tier 0, 1, and 2 locomotives) for both line haul and local operations; actual in-yard idling duration and reductions associated with auto-start-stop technologies; fuel quality effects; and detailed operating practices for switching and train-building operations. By providing detailed disaggregation of activity and emissions data, the method also makes it possible to quantify and evaluate the effects of specific emission reduction alternatives.

INTRODUCTION

Freight movement by rail is a key component of the U.S. transportation infrastructure. The combination of rail's low rolling resistance and the fuel-efficient turbocharged diesel engines used in modern locomotives make rail the most efficient mode of transport from both an emissions and economic perspective. Railyards located strategically through the nation's rail network are used to assemble and direct goods movement to their destinations. Railyards may handle dozens of trains per day, each powered by a "consist" of several locomotives. While in railyards, these locomotives are serviced and regrouped into new consists as needed for specific departing trains. In addition to train arrivals and departures and locomotive servicing, so-called "classification" yards separate rail cars in inbound trains into segments with different destinations, and build new trains with a common destination. This work is accomplished by switcher locomotives (typically of lower horsepower than the locomotives used for "line-haul" operations). Some railyards also have major locomotive repair facilities whose activities include load testing of locomotives prior to or after maintenance. Collectively, the locomotive operations associated with these activities can result in relatively high localized emission densities.

The Union Pacific Railroad (UPRR) is the largest railroad in North America, operating throughout the western two-thirds of the United States. It operates a number of railyards throughout its system, including the J. R. Davis Yard in Roseville, California. The Davis Yard is UPRR's largest classification yard in the western U.S. It is approximately one-quarter mile wide and four miles long, and is visited by over 40,000 locomotives per year. The California Air Resources Board (CARB) recently completed a detailed dispersion modeling study to estimate concentrations of diesel particulate matter in the vicinity of the railyard.[1] UPRR cooperated closely with CARB in this study, including the identification, retrieval and analysis of data needed to assemble a detailed emission inventory for railyard operations. This effort produced the most detailed emission inventory for railyard operations to-date, including empirically developed train counts, locomotive model distributions, locomotive service and maintenance activities, and dedicated on-site switching operations. The results of this effort have been further adapted to allow UPRR to track the effect of locomotive fleet modernization, freight volume, and operational changes on emissions, and to identify opportunities for further emission reductions at the Davis Yard.

RAILYARD ACTIVITY ESTIMATION

At state and national levels, locomotive emissions have been estimated using locomotive fleet population data and average locomotive emission factors, expressed in g/bhp-hr, in conjunction with fuel efficiency estimates and fuel consumption. For freight locomotives, the emission factors are typically derived using both a switching duty cycle and a line haul duty cycle, each of which gives the fraction of operating time locomotives spend at different throttle settings, referred to as notch positions.[2] These throttle settings (see Table 1) include idle, notches 1 through 8, and dynamic braking (in which the locomotive traction motors are used to generate power which is dissipated through resistor grids). While this approach can provide reasonable estimates for larger regions, neither the overall locomotive fleet composition nor the standard duty cycles accurately reflect the specific activities that occur within an individual railyard. The g/bhp-hr emission factors vary substantially between throttle settings and between locomotive models. Other confounding factors include: speed limits within yards (which preclude the high throttle settings used for line-haul activity outside of yards); locomotive load (consists commonly move within yards with only one locomotive pulling and no trailing cars); and time spent either shut down or idling. Classification activities are carried out with duty cycles that are unique to yard operations and may vary from yard to yard. To develop more accurate emissions estimates, it is necessary to explicitly identify railyard activities at the level of individual locomotives.

Table 1. Locomotive Duty Cycles.

	Throttle Position (Percent Time in Notch)									
Duty Cycle	**D.B.**	**Idle**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**
EPA Line-Haul	12.5	38.0	6.5	6.5	5.2	4.4	3.8	3.9	3.0	16.2
EPA Switch	0.0	59.8	12.4	12.3	5.8	3.6	3.6	1.5	0.2	0.8
Trim Operations	0.0	44.2	5.0	25.0	2.3	21.5	1.5	0.6	0.0	0.0
Hump Pull-Back	0.0	60.4	12.5	12.4	5.9	3.6	3.6	1.5	0.0	0.0
Hump Push	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Consist Movement	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
Load Tests:										
10-Minute	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0
15-Minute	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7
30-Minute	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	33.3

To accomplish this, UPRR reviewed the types of databases available for its operations to identify where explicit emission-related activity information could be generated for the Davis Yard. UPRR

operates approximately 7000 locomotives over a network spanning 23 states. Large amounts of data are generated and retained by UPRR for management purposes. These include tracking the location and status of capital assets (e.g., locomotives and rail cars), tracking performance of specific activities, and managing operations. These databases can be queried for data records specific to the Davis Yard, but their content does not directly relate to emissions. Where possible, data providing a complete record of emissions-related events (e.g., locomotive arrivals and departures) were identified and retrieved. Where 100 percent data for an activity could not be obtained (e.g., locomotive model number for each arriving locomotive), distributions were developed based on available data. In some cases, data are not available for specific types of emission events (e.g., the duration of idling for individual trains prior to departure). In these cases, UPRR yard personnel were consulted to derive estimates of averages or typical operating practices.

Railyard Operations – Inbound and Outbound Trains

The majority of locomotive activity in a railyard arises from inbound and outbound freight traffic. Following arrival, consists are decoupled from their trains in receiving areas and are either taken directly to outbound trains, or more commonly, are sent through servicing which can include washing, sanding, oiling, and minor maintenance prior to connecting to outbound trains. Some fraction of trains arriving at a yard simply pass through, possibly stopping briefly for a crew change. UPRR maintains a database that, when properly queried, can produce detailed information regarding both arriving and departing trains. Table 2 lists some of the key parameters that are available in this database. In this study, 12 months of data were obtained for all trains passing through the Davis Yard. The extracted data (over 60,000 records) included at least one record for every arriving and departing train, and each record contained specific information about a single locomotive, as well as other data for the train as a whole. The data were processed using a commercial relational database program and special purpose FORTRAN code to identify individual train arrivals and departures and train and consist characteristics.

Table 2. Selected Train Database Parameters.

	Used to Identify				
Parameter	Identification of Train Events	Location in Railyard	Consist Composition	Temporal Profile	Train Characteristics
Train Symbol	X	X			
Train Section	X				
Train Date	X				
Arrival or Departure	X	X			
Originating or Terminating	X	X			
Direction		X			
Crew Change?		X			
Arrival & Departure Times				X	
# of Locomotives			X		
# of Working Locomotives			X		
Trailing Tons					X
Locomotive ID #			X		
Locomotive Model			X		

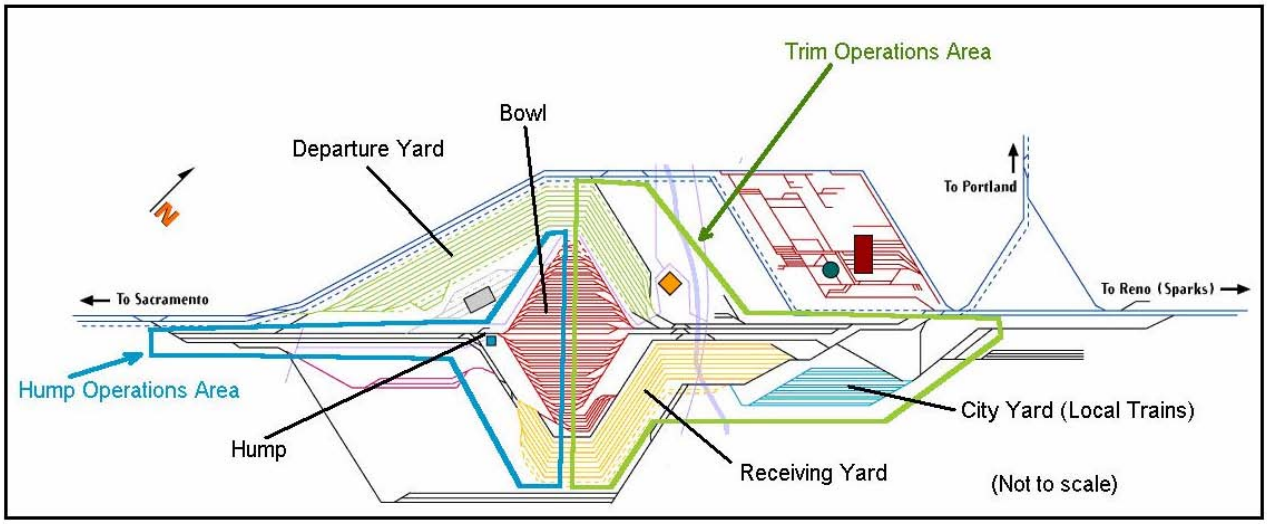
The parameters listed in Table 2 were used to calculate the number of trains by time of day arriving or departing from each area of the yard, as well as average composition of their consists (number of locomotives and distribution of locomotive models). The combination of train symbol, train segment, and train date provided a unique identifier for a single arrival or departure, and the individual locomotive models were tabulated to generate model distributions. Where necessary, working horsepower and total horsepower were used to estimate the number of working locomotives in the consist.

Emission calculations associated with inbound and outbound trains included both periods of movement within the yard boundaries and locomotive idling while consists we connected to their trains. Based on train direction and the location of its arrival or departure, moving emissions were based on calculations of time at different throttle settings based on distance traveled and estimated speed profiles, considering speed limits on different tracks. Yard operators provided estimates for the average duration of such idling for both inbound and outbound trains.

Railyard Operations – Classification

On arrival, inbound trains are "broken" into sections of rail cars destined for different outgoing trains. Figure 1 shows a schematic diagram of the Davis Yard including a large central "bowl" consisting of a large number of parallel tracks connected by automated switching controls to a single track to the west. Trains are pulled back to the west and then pushed to the "hump," a slightly elevated portion of track just west of the bowl. As cars pass over the hump, they are disconnected and roll by gravity into the appropriate track in the bowl. Dedicated special purpose locomotives, known as "hump sets," are used in this operation. Unlike most locomotives, these units have continuously variable throttles, rather than discrete throttle notch settings, to allow precise control of speed approaching the hump. Switching locomotives, known as "trim sets" are responsible for retrieving the train segments or trains being "built" in the bowl and moving them to the appropriate outbound track. The Davis Yard operates a fixed number of hump sets and trim sets at any given time, with backup sets standing by for shift changes and possible breakdowns.

Figure 1. Schematic of the J. R. Davis Yard.



Emission calculations for hump and trim operations were based on the number of working hump and trim sets at any given time, plus assumed idling times of standby units. For the hump sets, yard operators provided estimates of average pull-back and pushing times, and the duty cycles associated with these operations. For pull-back, based on distance and speed limits, the EPA switcher duty cycle,

excluding notch 7 and 8 was used. Pushing is conducted at the equivalent of notch 2. For the trim sets, speed limits within the Yard preclude any high throttle setting operation, but there is a greater time spent in mid-throttle settings than reflected in the EPA switcher cycle. A revised duty cycle was developed for these units based on the EPA switcher duty cycle, with high throttle fractions (notches 7 and 8) excluded, but with increased notch 1 and notch 4 operating time. These duty cycles are also shown in Table 1.

Railyard Operations – Consist Movement, Service, Repair and Testing

After disconnecting from inbound trains, consists move to one of several servicing locations for refueling and other maintenance, following designated routes in the yard. Typically, one locomotive in each consist will pull the others, with throttle settings at notch 1 or 2. Based on distance and speed limits, movement times were estimated for each route, and emissions calculated using the number of locomotives following each route.

While being serviced, locomotives may be either idling or shut down. Locomotives must be idling while oil and other routine checks are performed. In addition, since locomotive engines are water-cooled and do not use antifreeze, they are commonly left idling during cold weather conditions. New idling reduction technologies known as SmartStart and AESS provide computer-controlled engine shut down and restart as necessary, considering temperature, air pressure, battery charge, and other parameters. Yard personnel provided estimates of the average potential duration of idling associated with different servicing events. Databases for service and maintenance activities maintained by UPRR provide details on the number and types of service events at different locations in the yard. As for train activity, these data were processed with a commercial relational database program and special purpose FORTRAN code to characterize and tabulate service events. These results were used in conjunction with data for the number of inbound and outbound consists to estimate total idling emissions for different service event types and locations. Following service, consists are dispatched to outbound trains. The same procedures were followed for estimating idle time, number of locomotives moving to each outbound area of the yard, and the duration of each movement for emission calculations.

In addition to routine service, the databases include service codes indicating periodic inspections of various types, as well as major maintenance activities requiring load testing of stationary locomotives. Several types of load tests are conducted, including planned maintenance pre- and post-tests, quarterly maintenance tests, and unscheduled maintenance diagnostic and post-repair tests. Depending on the test type and locomotive model, these tests include some period of idling, notch 1 operation, and notch 8 operation. Data are not collected on the exact duration of individual tests, so estimates of average duration for each throttle setting were provided by shop personnel, as shown in Table 1. The number of tests of each type for each locomotive model group were tabulated based on the service codes in the database for each service event.

Trends in Activity and Technology

The initial study was based on data from December 1999 through November 2000. Since that time, UPRR's locomotive fleet modernization program as well as changes in freight volumes have occurred. A subsequent data retrieval for the period from May 2003 through April 2004 was made, and emission calculations updated. A number of significant changes occurred over this 40-month period. The distribution of locomotive models in line-haul operation showed a substantial shift from older, lower horsepower units to new high horsepower units. The average number of locomotives per consist remained the same at about 3, but the higher horsepower allowed an increase in train capacity (trailing tons per train). The decrease in older units also resulted in a decrease in the frequency of major maintenance load testing. In addition to updating activity inputs (number of locomotives by model) for

emission calculations, calculations were modified to reflect the penetration of new and retrofit technologies in the locomotive fleet, including SmartStart and AESS idling controls and Tier 0 and Tier 1 locomotives. UPRR data identifying the specific technologies installed on individual locomotives were matched with locomotive ID numbers in the train and servicing data retrievals to obtain a specific count of the number of locomotives of each model for which emissions reductions were achieved by these technologies. Historical temperature data for the Roseville area were used to estimate the fraction of time computer controls would require idling when the locomotive would otherwise be shut down.

EMISSION FACTORS

Data Sources

The study of the J. R. Davis Yard focused on diesel exhaust particulate matter emissions. At present, there is no unified database of emission test results for in-use locomotives. Appendix B of the USEPA's Regulatory Support Document for setting new emission standards for locomotives[2] contains a compilation of notch-specific emission factors. These data were supplemented by test data reported by Southwest Research Institute[3,4], as well as test data provided by locomotive manufacturers to assemble emission factors for each of 11 locomotive model groups.

There are dozens of specific locomotive model designations, and emissions tests are not available for all of them. However many models are expected to have nearly identical emission characteristics. Depending on their intended use, locomotives of different models may have different configurations (e.g., number of axles), but share a common diesel engine. For this project, 11 locomotive model groups were defined based on their engine models (manufacturer, horsepower, number of cylinders, and turbo- or super-charging of intake air). Table 3 lists these model groups and some of the typical locomotive models assigned to each group.

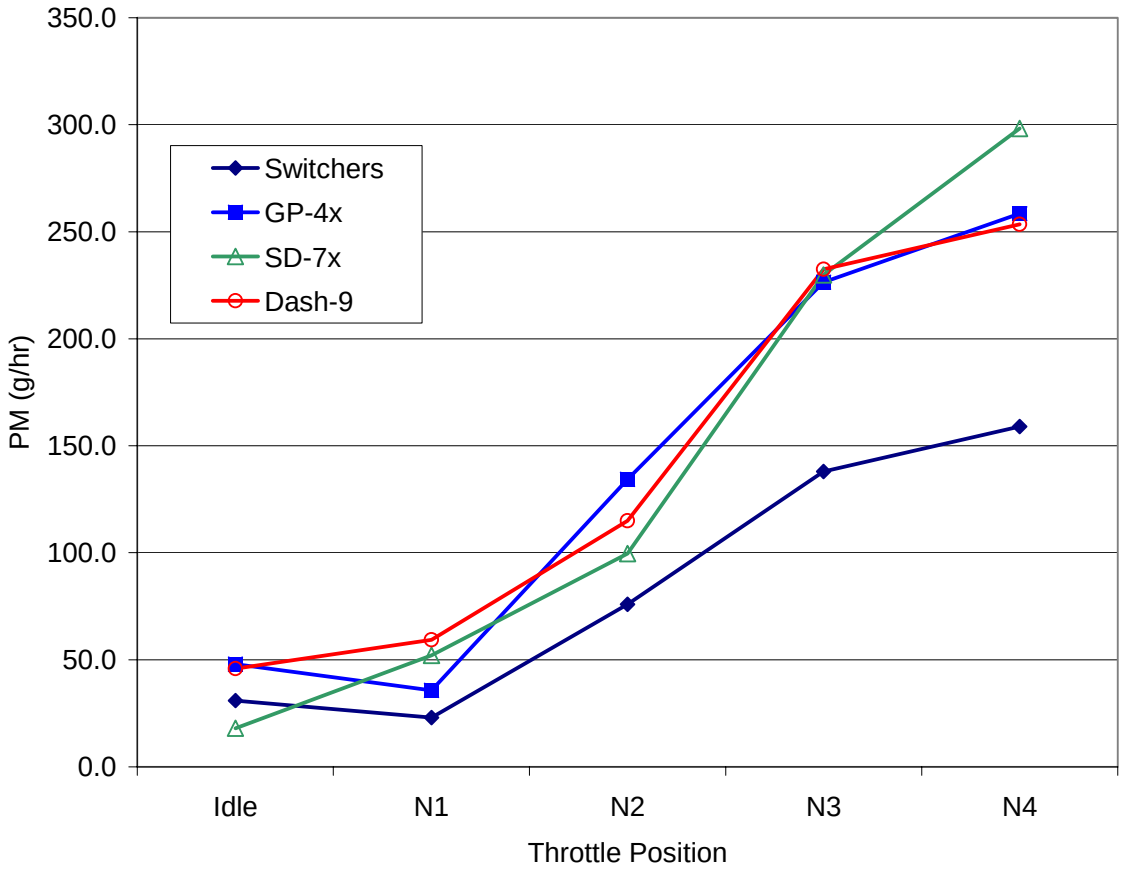
Table 3. Locomotive Model Groups

Model Group	Engine Family	Representative Models
Switchers	EMD 12-645E	GP-15, SW1500
GP-3x	EMD 16-645E	GP-30, GP-38
GP-4x	EMD 16-645E3B	GP-40, SD-40-2, SD-45-2
GP-50	EMD 16-645F3B	GP-50, SD-50M
GP-60	EMD 16-710G3A	GP-60, SD-60M
SD-7x	EMD 16-710G3B	SD-70MAC, SD-75
SD-90	EMD 16V265H	SD-90AC, SD-90-43AC
Dash-7	GE7FDL (12 cyl)	B23-7, B30-7, C36-7
Dash-8	GE7FDL (12 or 16 cyl)	B39-8, B40-8, C41-8
Dash-9	GE7FDL (16 cyl)	C44-9, C44AC
C60-A	GE7HDL	C60AC

Emission Factors and Fuel Effects

Figure 2 shows particulate matter (PM) emission factors for several of the more common locomotive model groups at the low to intermediate throttle settings typical of yard operations. As shown in the figure, emission rates generally increase with throttle setting. However, the older 3000 hp GP-4x series shows emissions comparable to (and in some cases, higher than) the newer 4000 to 4500 hp SD-7x and Dash-9 models. Due to the relatively large fraction of time locomotives spend at low throttle settings while in railyards, the relative differences in emission rates between models at these settings can significantly affect emissions estimates if locomotive model distributions change over time.

Figure 2. Locomotive PM Emission Factors (g/hr).



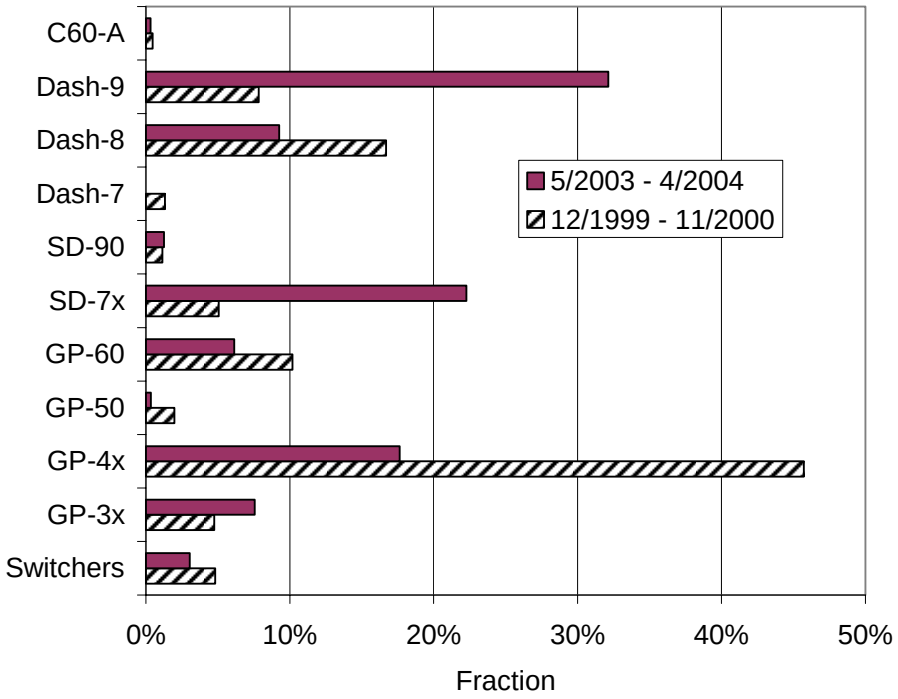
The emission factors used were based on tests using fuel typical of national off-road diesel. Initial emission estimates were derived by multiplying model-specific g/hr emission rates by the total hours of operation and locomotive model fraction for each activity within the yard. At the Davis Yard, over half of the diesel fuel dispensed to locomotives meets California on-road diesel fuel specifications (so-called "CARB diesel"). To account for the effect of fuel quality on emissions, estimates of the fraction of locally dispensed fuel burned by locomotives in different yard activities were developed. These ranged from 100 percent for hump and trim sets to zero percent for inbound line-haul units prior to refueling. These fractions were multiplied by the fraction of CARB diesel dispensed at the yard and an estimate of 14 percent reduction in PM emissions for locomotives burning CARB diesel to develop fuel effects adjustments for individual activities.

EMISSION TRENDS

Using the procedures described in the preceding sections, emissions estimates were developed for the December 1999 to November 2000 period, and the May 2003 to April 2004 period. During this period, significant changes in the UPRR locomotive fleet occurred, with the addition of new locomotives and the retirement of older units. Figure 3 shows the locomotive model distributions for all servicing events at the Davis Yard during these two periods. Service events include both the line-haul and local units arriving and departing on trains (which make up the bulk of these events), as well as the hump and trim sets. A significant increase in the relative fraction of high horsepower SD-7x and Dash-9 units is seen, and a corresponding decrease in the fraction of older GP-4x, GP-50, GP-60, Dash-7 and Dash-8 models. In addition to the fleet modernization, tabulations of specific emission control technologies on units serviced at the Davis Yard showed substantial penetration of new and retrofit

technologies. Approximately 31 percent of locomotives serviced at the yard were equipped with computer-controlled shut-down and restart technology, resulting in reduced idling times. Also, approximately 27 percent of servicings were for Tier 0 locomotives, and approximately 25 percent were Tier 1 units. Although the Tier 0 and Tier 1 technologies are not expected to substantially reduce PM emissions, their nitrogen oxides emissions are lower. A few prototype Tier 2 units were observed in 2003 – 2004 data, and their reduced PM emissions will show benefits in the future.

Figure 3. Changes in Locomotive Model Distributions.



The freight volume passing through the yard also changed between these periods. Table 4 lists the percent change in the number of arriving and departing trains, locomotives, and trailing tons (a measure of freight volume). The number of trains and locomotives showed little change, however the trailing tons increased by approximately 15 percent, implying that the average train weight (and correspondingly, the required consist horsepower) increased. This is a result of the increased availability of high horsepower units in the UPRR fleet. A higher fraction of trains bypass the yard, either not stopping, or stopping only for crew changes.

Table 4. Percent Change in Yard Activity Levels from 12/1999 – 11/2000 to 5/2003 – 4/2004.

	Trains	**Locomotives**	**Trailing Tons**
Arrivals	-5.2%	-3.5%	--
Departures	-7.0%	-7.3%	--
Throughs (Bypassing the yard)	8.0%	6.8%	--
Total Arrivals and Departures	-0.3%	-0.9%	15.1%

The newer locomotive fleet also affected the level of load testing activity required. Table 5 lists the percent change in the number of load tests of different types, and the corresponding change in total locomotive testing time at idle, notch 1, and notch 8. The extended 30-minute post-maintenance tests were substantially reduced, and total hours of testing were reduced for the various throttle settings between 12 and 43 percent.

Table 5. Percent Change in Load Test Activity from 12/1999 – 11/2000 to 5/2003 – 4/2004.

10-Minute Tests	-18.9%
15-Minute Tests	14.6%
30-Minute Tests	-43.2%
Total Tests	-12.3%
Idling Hours	-20.6%
Notch 1 Hours	-43.2%
Notch 8 Hours	-12.0%

The combined net result of these changes is shown in Table 6. Between November 2000 and April 2003, total estimated PM emissions in the yard decreased by approximately 15 percent. Reductions in idling and movement emissions of about 20 percent were calculated, due to the combination of a newer, lower emitting locomotive fleet and the computer-controlled shutdown technologies (both retrofits and standard equipment on newer units). Hump and trim emissions were reduced by about 6 percent, and load testing emissions by about 14 percent.

Table 6. Emissions Changes from 12/1999 – 11/2000 to 5/2003 – 4/2004.

	Estimated Emissions (tons per year)		**Percent Change**
	12/1999 – 11/2000	**5/2003 – 4/2004**	
Idling and Movement of Trains	5.2	4.2	-20.3%
Idling and Movement of Consists	8.5	6.8	-20.2%
Testing	1.5	1.3	-14.1%
Hump and Trim	7.0	6.6	-5.7%
Total	22.3	18.9	-15.3%

CONCLUSIONS

Because of the unique features of each individual railyard, top-down methods (e.g., based only on tons of freight handled or number of arriving locomotives) cannot provide reliable estimates of railyard emissions. Yard-specific data are needed. In-yard activity patterns (and emissions) will vary between yards depending on factors such as: the type of yard (e.g., hump or flat switching classification yards, or intermodal facilities); the presence and capabilities of service tracks or locomotive repair shops; the types of freight handled; the location of the yard in the rail network; and yard configuration. The development of procedures for retrieving and analyzing activity data and locomotive characteristics for a specific railyard is a substantial improvement of alternatives based on top-down estimation. By obtaining disaggregate data for the range of specific activities occurring within railyards, it is possible to reliably estimate historical trends in emissions, as well as to evaluate the potential effects of operational changes and new technologies. Railyard operations cannot be treated in isolation, since these yards are only one component of complex national level systems. Nevertheless, the ability to assess the details of yard operations and their emissions provides an improved basis for environmental management decisions at both local and larger scales.

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KEY WORDS

Emission inventories
Locomotives
Railyards
Diesel

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APPENDIX A-7

SULFUR ADJUSTMENT CALCULATIONS

Appendix A-7

Development of Adjustment Factors for Locomotive DPM Emissions Based on Sulfur Content

Wong (undated) provides equations for estimating g/bhp-hr emission rates for 4-Stroke (GE) and 2-Stroke (EMD) locomotives. Rather than using these statistically derived estimates for absolute emissions when model- and notch-specific emission factors are available, we used these equations to develop *relative* emission rate changes for different sulfur levels. The basic form of the equation is

$$q = a \cdot S + b$$

Where,

q is the predicted g/bhp-hr emission rate of a locomotive at a specific throttle setting and sulfur content;

a and b are coefficients specific to a locomotive type (2- or 4-stroke) and throttle notch; and

S is the fuel sulfur content in ppm.

Thus, to calculate the emission adjustment factor for a specific fuel sulfur content, it is necessary to calculate the nominal emission rate q_0 for the baseline fuel sulfur content S_0, and the emission rate q_i for the fuel of interest with sulfur content S_i. This adjustment factor k_i is simply

$$k_i = 1 - \frac{(q_0 - q_i)}{q_0},$$

Where, q_0 and q_i are calculated using the equation above. Tables 1 and 2 give the values of the a and b coefficients for 4-stroke and 2-stroke locomotives. For throttle settings below notch 3, sulfur content is not expected to affect emission rates. The baseline emission rates from which actual emissions are estimated were derived from emission tests of different locomotive models. Although full documentation of fuels is not available for all of these tests, they are assumed to be representative of actual emissions of the different models running on 3,000 ppm sulfur EPA non-road Diesel fuel. For the purposes of modeling 2005 emissions, these factors are needed to adjust the baseline emission factors to emission factors representative of two fuels – 221 ppm and 2639 ppm. Table 3 shows the resulting correction factors for these two fuels by notch and engine type. To generate locomotive model-, throttle-, tier-, and fuel-specific emission factors, the base case (nominal 3,000 ppm S) emission factors in Table 4 were multiplied by the corresponding correction factors for throttle settings between notch 3 and notch 8.

Table 1 Sulfur Correction Coefficients for 4-Stroke Engines		
Throttle Setting	***a***	***b***
Notch 8	0.00001308	0.0967
Notch 7	0.00001102	0.0845
Notch 6	0.00000654	0.1037
Notch 5	0.00000548	0.1320
Notch 4	0.00000663	0.1513
Notch 3	0.00000979	0.1565

Table 2 Sulfur Correction Coefficients for 2-Stroke Engines		
Throttle Setting	***a***	***b***
Notch 8	0.0000123	0.3563
Notch 7	0.0000096	0.2840
Notch 6	0.0000134	0.2843
Notch 5	0.0000150	0.2572
Notch 4	0.0000125	0.2629
Notch 3	0.0000065	0.2635

Table 3 DPM Emission Adjustment Factors for Different Fuel Sulfur Levels				
Throttle Setting	**4-Stroke (GE)**		**2-Stroke (EMD)**	
	2,639 ppm S	**221 ppm S**	**2,639 ppm S**	**221 ppm S**
Notch 8	0.9653	0.7326	0.9887	0.9131
Notch 7	0.9662	0.7395	0.9889	0.9147
Notch 6	0.9809	0.8526	0.9851	0.8852
Notch 5	0.9867	0.8974	0.9821	0.8621
Notch 4	0.9860	0.8924	0.9850	0.8844
Notch 3	0.9810	0.8536	0.9917	0.9362

Table 4
Base Case Locomotive Diesel Particulate Matter Emission Factors (g/hr)
(3,000 PPM Sulfur Assumed)

Model Group	Tier	Throttle Setting										Source
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	138.0	159.0	201.0	308.0	345.0	448.0	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	186.0	212.0	267.0	417.0	463.0	608.0	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	226.4	258.5	336.0	551.9	638.6	821.3	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	301.5	311.2	394.0	663.8	725.3	927.8	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	284.5	299.4	375.3	645.7	743.6	941.6	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	239.4	352.2	517.8	724.8	1125.9	1319.8	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	156.8	243.1	321.1	374.8	475.2	589.2	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	230.4	379.8	450.8	866.2	1019.1	1105.7	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	219.3	295.9	436.7	713.2	783.2	847.7	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	271.7	300.4	335.2	551.5	672.0	704.2	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	255.9	423.7	561.6	329.3	258.2	933.6	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	359.5	327.7	331.5	299.4	336.7	420.0	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	291.4	293.2	327.7	373.5	469.4	615.2	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	219.9	289.1	370.6	437.7	486.1	705.7	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	229.2	263.8	615.9	573.9	608.0	566.6	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	304.0	383.5	423.9	520.2	544.6	778.1	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	304.3	365.0	405.2	418.4	513.5	607.5	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	277.9	234.1	276.0	311.4	228.0	362.7	GE[4] (UP7555)

Notes:

1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments – Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

OFFROAD Modeling Change Technical Memo

SUBJECT: Changes to the Locomotive Inventory

LEAD: Walter Wong

Summary

The statewide locomotive emission inventory has not been updated since 2002. Using the Booz-Allen Hamilton's (BAH) study (Locomotive Emission Study) published in 1992 as a guideline (summary of inventory methodology can be found in Appendix A), staff updated the locomotive inventory.

The history of locomotive emission inventory updates began in 1992 using the results from the BAH report as the baseline inventory. In 2003, staff began updating the emissions inventory by revising the growth assumptions used in the inventory. The revised growth factors were incorporated into the ARB's 2003 Almanac Emission Inventory. With additional data, staff is proposing further update to the locomotive inventory to incorporate fuel correction factors, add passenger train data and Class III locomotives. Changes from updated locomotive activity data have made a significant impact on the total inventory (see Table 1).

Table 1. Impact of Changes on Statewide Locomotive Inventory

	Pre 2003 ARB Almanac Inventory (tons/day)			Revised Inventory (tons/day)			Difference (tons/day)		
Year	HC	NOx	PM	HC	NOx	PM	HC	NOx	PM
1987	7.2	158.8	3.6	7.2	158.8	3.6	0.0	0.0	0.0
2000	7.2	144.8	2.8	9.8	207.2	4.7	2.6	62.4	1.9
2010	7.2	77.8	2.8	9.5	131.9	4.2	2.3	54.1	1.4
2020	7.2	77.8	2.8	9.4	134.6	4.1	2.2	56.8	1.3

Reasons For Change

During the 2003 South Coast's State Implementation Plan (SIP) development process, industry consultants approached Air Resources Board (ARB) staff to refine the locomotive emissions inventory. Specifically, their concerns were related to the growth factors and fuel correction factors used in the inventory

calculations. This document outlines how the locomotive emissions inventory was updated and the subsequent changes made to address industry's concerns.

Background : Baseline 1987 Locomotive Emissions Inventory (BAH report)

Locomotive operations can be characterized by the type of service performed. For emission inventory purposes, locomotives are classified into five different service types as defined in BAH's report.

Line-haul/intermodal – Intermodal locomotives generally operate at higher speeds and with higher power than other types and incorporate modern, high-speed engines.

Mixed/bulk – Mixed locomotives are the most common and operate with a wide range of power. They also perform line-haul duties.

Local/Short Haul – Local locomotives perform services that are a mixture of mixed freight and yard service. They operate with lower power and use older horsepower engines.

Yard/Switcher – Yard operations are used in switching locomotives and characterized by stop and start type movements. They operate with smaller engines and have the oldest locomotive engines.

Passenger – Passenger locomotives are generally high speed line haul type operations.

Categories of railroads are further explained by a precise revenue-based definition found in the regulations of the Surface Transportation Board (STB). Rail carriers are grouped into three classes for the purposes of accounting and reporting:

Class I –Carriers with annual operating revenues of $250 million or more

Class II – Carriers with annual operating revenues of less than $250 million but in excess of $20 million

Class III – Carriers with annual operating revenues of less than $20 million or less, and all switching companies regardless of operating revenues.

The threshold figures are adjusted annually for inflation using the base year of 1991.

The 1987 locomotive inventory as shown in Table 2 is taken from the BAH report prepared for the ARB entitled "Locomotive Emission Study" completed in 1992 (http://www.arb.ca.gov/app/library/libcc.php). Information was gathered from many sources including ARB, the South Coast Air Quality Management District, the California Energy Commission, the Association of American Railroads (AAR), locomotive and large engine manufacturers, and Southwest Research Institute. Railroad companies, such as Southern Pacific, Union Pacific, and Atchison, Topeka and Santa Fe (ATSF), provided emission factors, train operation data, and throttle position profiles for trains operating in their respective territories. Southwest Research Institute provided emission test data.

Table 2. 1987 Locomotive Inventory in Tons Per Day, Statewide, BAH report

TYPE	HC	CO	NOX	PM	SOX
Line-Haul/Intermodal	3.97	12.89	86.21	1.97	6.36
Short-Haul/Local	0.96	3.06	21.30	0.46	1.59
Mixed	1.51	4.85	37.34	0.81	2.76
Passenger	0.10	0.22	3.24	0.07	0.30
Yard/Switcher	0.62	1.57	10.69	0.24	0.58
Total	7.16	22.59	158.78	3.55	11.59

The assumed average fuel sulfur content is 2700 parts per million (ppm) obtained from the BAH report.

Current Growth Estimates

Prior to the 2003 South Coast SIP update, growth factors were based on employment data in the railroad industry. Staff believes that the use of historic employment data, which translates to a decline in emissions in future years, may be masking actual positive growth in locomotive operations. It may be assumed that the number of employees is declining due to increased efficiency.

Changes to the Locomotive Inventory

Summary of Growth in Emission Based on BAH Report

Growth is estimated based on train operation type and by several operating characteristics.

> Increased Rail Lube and Aerodynamics – this arises from reduction in friction and will help reduce power requirements.

Introduction of New Locomotives – older locomotive units will be replaced by newer models.

Changes in Traffic Level – the increase or decrease in railroad activity

In the BAH report, projected emission estimates for years 2000 and 2010 were based on the factors shown in Tables 3 and 4. A substantial part of the locomotive emission inventory forecast is based upon projections of rail traffic levels. BAH projected future rail traffic level as a function of population and economic growth in the state. BAH also projected growth in emission only to 2010.

Table 3. Changes in Emissions from 1987-2000 (Exhibit 4 p. 11 of the 8/92 Locomotive Emission Study Supplement) (1987 Base Year)

Train Operation Type	Increased Rail Lube and Aerodynamics	Introduction of New Locomotive	Changes in Traffic Levels	Cumulative Net Growth in Emissions
Intermodal	-7.0%	-8.0%	17.0%	2.0%
Mixed & Bulk	-7.0%	-8.0%	2.0%	-13.0%
Local	-3.0%	-3.0%	-2.0%	-8.0%
Yard	0.0%	-1.0%	-25.0%	-26.0%
Passenger	-7.0%	-8.0%	10.0%	-5.0%

Table 4. Changes in Emissions from 2001-2010 (Exhibit 4 p. 11 of the 8/92 Locomotive Emission Study Supplement) (2000 Base Year)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Introduction of New Locomotive	Changes in Traffic Levels	Cumulative Net Growth in Emissions
Intermodal	-2.0%	-3.0%	-8.0%	25.0%	12.0%
Mixed & Bulk	-2.0%	-3.0%	-8.0%	0.0%	-13.0%
Local	-1.0%	0.0%	-12.0%	-10.0%	-23.0%
Yard	0.0%	0.0%	-10.0%	-15.0%	-25.0%
Passenger	-2.0%	-3.0%	-8.0%	15.0%	2.0%

BAH added “Improved Dispatching and Train Control” to differentiate these impacts from the “Increased Rail Lubing” which helps to improve fuel efficiency from locomotive engines. Since train control techniques are emerging from the

signal company research work, these assumed changes will not impact emission until year 2000.

Based on industry's input, staff recommends several changes to the locomotive emissions inventory. These include modifying growth factors, making adjustments to control factors reflecting the U. S. EPA regulations that went into effect in year 2000, incorporating fuel correction factors, adding smaller class III railroad and industrial locomotive, and updating passenger data.

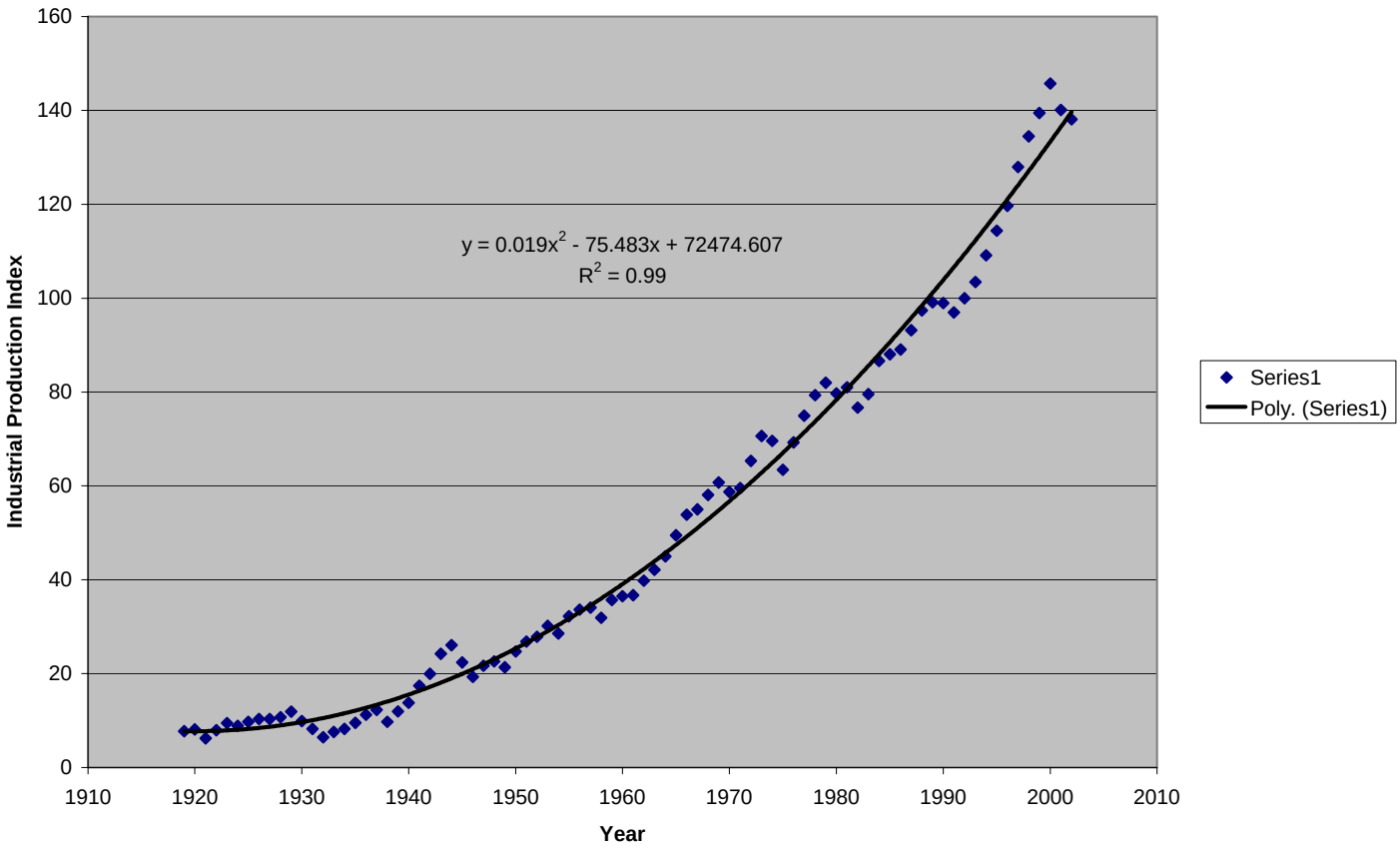
Revised Growth in Emissions

Staff revised the growth factors for locomotives based on new data that better reflect locomotive operations. This includes U.S. industrial production and various railroad statistics available from the AAR.

Based on historic data recently obtained from U.S. industrial productions and the AAR, the changes in traffic levels were revised. A better estimate for changes in traffic levels for locomotives can be made to the line-haul class of railroad, which are the intermodal and mixed and bulk type of locomotives, using industrial production and AAR's data.

Industrial production data is considered to be a surrogate for changes in traffic levels of the line-haul locomotive. It is assumed that railroad activity would increase in order to accommodate the need to move more product. Industrial production is the total output of U.S. factories and mines, and is a key economic indicator released monthly by the Federal Reserve Board. U.S. industrial production historical data from 1920 to 2002 was obtained and analyzed from government sources. Figure 1 shows the historical industrial production trend (Source : http://www.research.stlouisfed.org/fred2/series/INDPRO/3/Max). Statistical analysis was used to derive a polynomial equation to fit the data.

Figure 1. Long-term Industrial Production



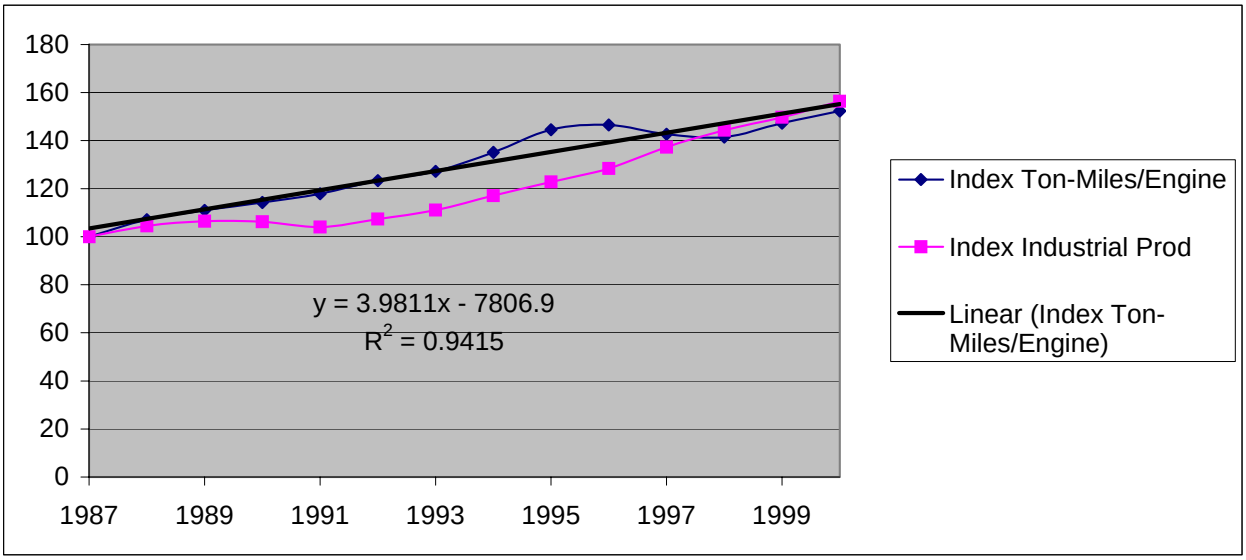
Another surrogate for growth is net ton-miles per engine. Consequently, staff analyzed railroad data from the AAR's Railroad Facts booklet (2001 edition). The booklet contains line-haul railroad statistics including financial status, operation and employment data, and usage profiles. Revenue ton-mile and locomotives in service data from the booklet were used to compute the net ton-miles per engine as shown in Table 5.

Table 5. Revenue Ton-Miles and Ton-Miles/Engine (AAR Railroad Facts 2001 edition)

Year	Locomotive Diesel in Service (US)	Revenue Ton-Miles	Ton-Miles/Engine
1987	19,647	943,747	48.04
1988	19,364	996,182	51.45
1989	19,015	1,013,841	53.32
1990	18,835	1,033,969	54.90
1991	18,344	1,038,875	56.63
1992	18,004	1,066,781	59.25
1993	18,161	1,109,309	61.08
1994	18,496	1,200,701	64.92
1995	18,810	1,305,688	69.41
1996	19,267	1,355,975	70.38
1997	19,682	1,348,926	68.54
1998	20,259	1,376,802	67.96
1999	20,254	1,433,461	70.77
2000	20,026	1,465,960	73.20

As shown in Figure 2, there is a relatively good correlation between net ton-miles per engine growth and industrial production. Because net ton-miles per engine data are compiled by the railroad industry and pertains directly to the railroad segment, staff believes that net ton-miles per engine will better characterize future traffic level changes.

Figure 2. Ton-miles/Engine vs. Industrial Production (index base year = 1987)



The ton-miles/engine data were projected to calculate the future growth rate of traffic level using a linear equation.

Staff also made changes to the "Increased Rail Lube and Aerodynamics" assumption shown in Tables 3 and 4. Rail lubing does not benefit the idling portion of locomotive activity. Since idling contributes 20% of the weighting in the line-haul duty cycle, staff reduced the rail lubing benefit by 20%. Meanwhile, improved dispatching and train control is assumed only to reduce engine idling. Therefore, staff reduced the improved dispatching benefit by 80%.

The benefit of the introduction of new locomotives to the fleet was decreased from the original BAH assumption. BAH assumed 50% penetration of the new engines by 2000. Literature research suggests that the new engines accounted for only about 34% of the fleet in 2000 (www.railwatch.com, http://utahrails.net/all-time/modern-index.php). These new engines are assumed to be 15% cleaner. Therefore, the benefit from new locomotive engines has been reduced to 5% (34% x 15% = 5% reduction).

Tables 6, 7, and 8 present the revised growth factors to be used to project the baseline (1987) locomotive emissions inventory into the future.

Table 6. ARB Revised Growth 1987-2000, ARB's 2003 Almanac Emission Inventory

Train Operation Type	Increased Rail Lube and Aerodynamics	Introduction of New Locos	Population Increase	Changes in Traffic Levels	Cumulative Net Growth in Emissions	Annual Growth
Intermodal	-5.6%	-5.1%	1.9%	50.0%	41.2%	2.69%
Mixed & Bulk	-5.6%	-5.1%	1.9%	50.0%	41.2%	2.69%
Local	-2.4%	0%	0%	-2.0%	-4.4%	-0.35%
Yard	0.0%	0%	0%	-25.0%	-25.0%	-2.19%
Passenger	-5.6%	0%	1.9%	10.0%	6.3%	0.47%

The benefit of new locomotives with cleaner burning engines is accounted for in the control factor from EPA's regulation beginning in 2001, which takes into account introduction of new locomotive engines meeting Tier I and Tier II standards.

Table 7. ARB Revised Growth 2001-2010 (2000 Base Year, ARB's 2003 Almanac Emission Inventory)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Changes in Traffic Levels	Cumulative Net Growth in Emissions	Annual Growth
Intermodal	-1.6%	-0.6%	22.5%	20.3%	1.87%
Mixed & Bulk	-1.6%	-0.6%	22.5%	20.3%	1.87%
Local	-0.8%	-0.6%	-10.0%	-11.4%	-1.20%
Yard	0.0%	0.0%	-15.0%	-15.0%	-1.61%
Passenger	-1.6%	0.0%	15.0%	13.4%	1.27%

Table 8. ARB Revised Growth 2010-2020 (2010 Base Year, ARB's 2003 Almanac Emission Inventory)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Changes in Traffic Levels	Cumulative Net Growth	Annual Growth
Intermodal	0.0%	0.0%	18.0%	18.0%	1.67%
Mixed & Bulk	0.0%	0.0%	18.0%	18.0%	1.67%
Local	0.0%	0.0%	0.0%	0.0%	0.00%
Yard	0.0%	0.0%	0.0%	0.0%	0.00%
Passenger	0.0%	0.0%	0.0%	0.0%	0.00%

In Table 8, staff assumes no benefit from aerodynamics and improved train controls. Staff seeks guidance from industry as to their input regarding future benefits.

Table 9. Revised Growth in Emissions (Base Year 1987)

Year	Intermodal	Mixed & Bulk	Local	Yard	Passenger
1987	1.00	1.00	1.00	1.00	1.00
1988	1.03	1.03	1.00	0.98	1.00
1989	1.05	1.05	0.99	0.96	1.01
1990	1.08	1.08	0.99	0.94	1.01
1991	1.11	1.11	0.99	0.92	1.02
1992	1.14	1.14	0.98	0.90	1.02
1993	1.17	1.17	0.98	0.88	1.03
1994	1.20	1.20	0.98	0.86	1.03
1995	1.24	1.24	0.97	0.84	1.04
1996	1.27	1.27	0.97	0.82	1.04
1997	1.30	1.30	0.97	0.80	1.05
1998	1.34	1.34	0.96	0.78	1.05
1999	1.38	1.38	0.96	0.77	1.06
2000	1.41	1.41	0.96	0.75	1.06
2001	1.44	1.44	0.94	0.74	1.08
2002	1.47	1.47	0.93	0.73	1.09
2003	1.49	1.49	0.92	0.71	1.10
2004	1.52	1.52	0.91	0.70	1.12
2005	1.55	1.55	0.90	0.69	1.13
2006	1.58	1.58	0.89	0.68	1.15
2007	1.61	1.61	0.88	0.67	1.16
2008	1.64	1.64	0.87	0.66	1.18
2009	1.67	1.67	0.86	0.65	1.19
2010	1.70	1.70	0.85	0.64	1.21
2011	1.73	1.73	0.85	0.64	1.21
2012	1.76	1.76	0.85	0.64	1.21
2013	1.79	1.79	0.85	0.64	1.21
2014	1.81	1.81	0.85	0.64	1.21
2015	1.85	1.85	0.85	0.64	1.21
2016	1.88	1.88	0.85	0.64	1.21
2017	1.91	1.91	0.85	0.64	1.21
2018	1.94	1.94	0.85	0.64	1.21
2019	1.97	1.97	0.85	0.64	1.21
2020	2.00	2.00	0.85	0.64	1.21

Control Factors for U.S. EPA regulation

In December 1997, the U.S. EPA finalized the locomotive emission standard regulation. The regulatory support document lists the control factors used (http://www.epa.gov/otaq/regs/nonroad/locomotv/frm/locorsd.pdf). Staff modified the control factors to incorporate the existing memorandum of understanding (http://www.arb.ca.gov/msprog/offroad/loco/loco.htm) between the South Coast AQMD and the railroads that operate in the region. Previously, one control factor was applied statewide. In the revised emissions inventory starting in 2010, a lower control factor reflecting the introduction of lower emitting locomotive

engines in the SCAB region was applied. Tables 10 and 11 show the revised control factors. Road hauling definition as used by U.S. EPA applies to the line-haul/intermodal, mixed, and local/short haul train type in the emissions inventory.

Table 10. Revised Statewide Control Factors

Year	State Road Hauling HC	State Road Hauling NOx	State Road Hauling PM	State Switcher HC	State Switcher NOx	State Switcher PM	State Passenger HC	State Passenger NOx	State Passenger PM
1999	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2000	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2001	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2002	1.00	0.88	1.00	1.00	0.98	1.00	1.00	0.98	1.00
2003	1.00	0.82	1.00	1.00	0.97	1.00	1.00	0.96	1.00
2004	1.00	0.75	1.00	1.00	0.95	1.00	1.00	0.94	1.00
2005	0.96	0.68	0.96	0.99	0.93	0.99	0.98	0.92	0.98
2006	0.92	0.62	0.92	0.99	0.91	0.99	0.96	0.90	0.96
2007	0.89	0.59	0.89	0.98	0.89	0.98	0.94	0.83	0.94
2008	0.87	0.57	0.86	0.98	0.87	0.97	0.92	0.76	0.92
2009	0.84	0.55	0.84	0.97	0.85	0.97	0.91	0.69	0.90
2010	0.82	0.54	0.81	0.96	0.83	0.96	0.89	0.62	0.88
2011	0.81	0.53	0.80	0.96	0.81	0.95	0.87	0.57	0.87
2012	0.80	0.53	0.79	0.95	0.79	0.94	0.85	0.56	0.85
2013	0.79	0.52	0.78	0.94	0.77	0.93	0.83	0.54	0.83
2014	0.77	0.51	0.76	0.94	0.75	0.93	0.82	0.53	0.81
2015	0.76	0.50	0.75	0.93	0.73	0.92	0.80	0.52	0.79
2016	0.75	0.50	0.74	0.92	0.71	0.91	0.78	0.51	0.77
2017	0.74	0.49	0.72	0.91	0.70	0.90	0.76	0.50	0.75
2018	0.73	0.48	0.71	0.90	0.69	0.89	0.74	0.49	0.73
2019	0.71	0.48	0.70	0.89	0.68	0.88	0.73	0.48	0.71
2020+	0.70	0.47	0.69	0.89	0.67	0.87	0.71	0.47	0.69

Table 11. Revised SCAB Control Factors

Year	SCAB Road Hauling HC	SCAB Road Hauling NOx	SCAB Road Hauling PM	SCAB Switcher HC	SCAB Switcher NOx	SCAB Switcher PM
1999	1.00	1.00	1.00	1.00	1.00	1.00
2000	1.00	0.99	1.00	1.00	1.00	1.00
2001	1.00	0.95	1.00	1.00	1.00	1.00
2002	1.00	0.88	1.00	1.00	0.98	1.00
2003	1.00	0.82	1.00	1.00	0.97	1.00
2004	1.00	0.75	1.00	1.00	0.95	1.00
2005	0.96	0.68	0.96	0.99	0.93	0.99
2006	0.92	0.62	0.92	0.99	0.91	0.99
2007	0.89	0.59	0.89	0.98	0.89	0.98
2008	0.87	0.57	0.86	0.98	0.87	0.97
2009	0.84	0.55	0.84	0.97	0.85	0.97
2010	0.82	0.36	0.81	0.96	0.36	0.96
2011	0.81	0.36	0.80	0.96	0.36	0.95
2012	0.80	0.36	0.79	0.95	0.36	0.94
2013	0.79	0.36	0.78	0.94	0.36	0.93
2014	0.77	0.36	0.76	0.94	0.36	0.93
2015	0.76	0.36	0.75	0.93	0.36	0.92
2016	0.75	0.36	0.74	0.92	0.36	0.91
2017	0.74	0.36	0.72	0.91	0.36	0.90
2018	0.73	0.36	0.71	0.90	0.36	0.89
2019	0.71	0.36	0.70	0.89	0.36	0.88
2020+	0.70	0.36	0.69	0.89	0.36	0.87

Addition of Class III Locomotive and Industrial/Military Locomotive

The annual hours operated by the class III railroads are shown in Table 12. The results were tabulated from ARB Stationary Source Division's (SSD) survey (http://www.arb.ca.gov/regact/carblohc/carblohc.htm) conducted to support regulation with regards to ARB ultra-clean diesel fuel.

Table 12. Short-Haul and Switcher Annual Hours for Class III Railroads

Air Basin	Operations	Population	Annual Hours Operated
Mountain Counties	SW	2	10214
Mojave Desert	L	10	27440
North Coast	L	3	5700
North Central Coast	L	1	1332
	SW	3	3996
Northeast Plateau	L	5	9892
South Coast	SW	21	75379
South Central Coast	L	5	3200
San Diego	L	4	5000
San Francisco	L	8	31600
	SW	4	5059
San Joaquin Valley	L	29	68780
	SW	19	72248
Sacramento Valley	L	6	11400
Total		120	331240

L = local short-haul, SW = switcher

The short-haul and switcher emission rate are derived from BAH report. The report cites studies from testing done at EPA and Southwest Research Institute.

Table 13. Short-Haul and Switcher Emission Rate

Emission Rate	Short-Haul (g/bhp-hr)	Switcher (g/bhp-hr)
HC	0.38	0.44
CO	1.61	1.45
NOx	12.86	15.82
PM	0.26	0.28
SOx	0.89	0.90
Fuel Rate (lb/hr)	120.00	60.00

Table 14. Statewide Summary of Industrial Locomotives

Air Basin	Number of Locomotives	Avg. HP	Avg. Age
Mojave Desert	9	1,138	56
Others	11	587	54
San Francisco	11	525	54
San Joaquin Valley	38	1,176	54
South Coast	24	1,290	55
TOTALS	93	1,055	55

Table 15. Statewide Summary of Military Locomotives

Air Basin	Number of Locomotives	Avg. HP	Avg. Age
Mojave Desert	7	900	50
Northeast Plateau	2	1,850	50
Sacramento Valley	1	500	50
San Diego	7	835	50
San Francisco	4	1525	47.5
San Joaquin Valley	2	400	50
South Central Coast	1	500	50
TOTALS	24	930	49.6

The data from the survey provides a reasonable depiction of railroad activities in 2003. To forecast and backcast, an assumption was made to keep the data constant and have no growth. More research is needed to quantify the growth projections of smaller, local railroad activities.

Update to Passenger Trains

ARB's survey of intrastate locomotives included passenger agency trains that operated within the state. Staff attempted to reconcile the survey results by calculating the operation schedules posted by the operating agency to obtain hours of operation and mileage information. The results of the survey and calculated operating hours were comparable. Table 16 lists the calculated annual hours operated and miles traveled used to estimate emissions.

Table 16. Passenger Trains Annual Miles and Hours

Air Basin	Annual Miles Operated	Annual Hours Operated
South Coast	3,700,795	92,392
South Central Coast	151,864	4,020
San Diego	914,893	25,278
San Francisco	2,578,862	77,944
San Joaquin Valley	674,824	17,313
Sacramento Valley	635,384	20,058
Total	8,656,621	237,006

The passenger train emission rate is derived from testing done at SWRI on several passenger locomotives.

Table 17. Passenger Train Emission Rate

Emission Rate	Passenger Train (g/bhp-hr)
HC	0.50
CO	0.69
Nox	12.83
PM	0.36
Sox	0.90
Fuel Rate (lb/hr)	455.00

Fuel Correction Factors

Aromatics

Previous studies quantifying the effects of lowering aromatic content are listed in Table 18. These studies tested four-stroke heavy-duty diesel engines (HDD). Although staff would have preferred to analyze data from tests performed on various locomotive engines to determine the effects of lower aromatics, these HDD tests are the best available resources to determine the fuel corrections factors due to lower aromatics.

Table 18. Effect of Lowering Aromatic Volume on PM Emission

STUDY	**Sulfur (ppm)**	**Aromatics (Volume %)**	**PM Reduction (%)**
Chevron (1984)	2,800	31	Baseline
Chevron (1984)	500	31	23.8
Chevron (1984)	500	20	32.2
Chevron (1984)	500	15	36.0
Chevron (1984)	500	10	39.9
CRC-SWRI (1988)	500	31	Baseline
CRC-SWRI (1988)	500	20	9
CRC-SWRI (1988)	500	15	13
CRC-SWRI (1988)	500	10	17

Source : http://www.arb.ca.gov/fuels/diesel/diesel.htm

Using a linear regression of the data from the Table 18, the PM reduction from a change in aromatic content can be described as :

<u>4-Stroke Engine</u>
PM reduction = [(Difference in Aromatic Volume) * 0.785 + 0.05666]/100

For 2-Stroke engines, staff used test data from SWRI's report published in 2000 entitled "Diesel Fuel Effects on Locomotive Exhaust Emissions" to estimate indirectly the potential PM reduction for 2-Stroke engines due to lower aromatics. Table 19 lists the summary of the test results.

Table 19. SWRI 2000 Study Summary Results

Locomotive Engine	Aromatic Changes (Volume %)	PM Difference (g/bhp-hr)	PM % Difference
4 Stroke	28.35 to 21.84	0.080	37.6%
2 Stroke	28.35 to 21.84	0.056	14.1%

Staff assumes that PM emission reduction from 2-Stroke engine will have a factor of 0.38 (14.1%/37.6%) to the 4-Stroke engine PM emission reduction.

Currently, the baseline locomotive emissions inventory assumes an aromatic total volume percent of 31%. Table 21 describes the changes in PM emission due to changes in total volume percent of aromatics.

Table 20. Examples of PM Reductions Due to Changes in Aromatic Total Volume Percent

Aromatic Volume Percent		PM Reduction	PM Reduction	PM Reduction
From	To	2 Stroke	4 Stroke	Composite
31	28	0.9%	2.4%	1.3%
31	19	3.6%	9.5%	5.1%
31	10	6.3%	16.5%	8.9%

*composite is 75% 2 Stroke Engine and 25% 4 Stroke Engine

Table 21,Table 22, and Table 23 show the PM emission reduction for the different type of fuels used in the state.

Table 21. PM Emission Percent Change of Line-Haul Due to Aromatics, Statewide

Calendar Year	CARB Aromatic Volume (%)	EPA Aromatic Volume (%)	Off-road Aromatic Volume (%)	Weighted Aromatic Volume (%)	PM Emission Percent Change
1992	31	31	31	31.00	0.00
1993	10	31	31	31.00	0.00
1994	10	31	31	31.00	0.00
1995	10	31	31	31.00	0.00
1996	10	31	31	31.00	0.00
1997	10	31	31	31.00	0.00
1998-2001	10	31	31	30.18	-0.004
2002-2006	10	31	31	29.05	-0.009
2007+	10	31	31	29.05	-0.009

Table 22. Class I Line Haul Weighted Aromatic Volume Percent by Air Basin

Interstate Locomotive	Air Basin	1993-2001 Weighted Aromatic	2002+ Weighted Aromatic
		Volume Percent	Volume Percent
Class I Line Haul	SCC	31.0	31.0
	MC	31.0	26.6
	MD	30.0	29.8
	NEP	31.0	27.9
	SC	31.0	31.0
	SF	28.6	23.1
	SJV	29.1	29.4
	SS	31.0	31.0
	SV	31.0	27.4

Table 23. PM Emission Reduction from Intrastate Locomotives Due to Aromatics by Air Basin, 1993+

Intrastate Locomotive	Air Basin	CARB Aromatic	EPA Aromatic	Nonroad Aromatic	Weighted Aromatic	PM Emission Reduction
		Volume Percent	Volume Percent	Volume Percent	Volume Percent	Percent
Class I Local/Switcher	SC	10	31	31	29.0	-0.9%
	SJV	10	31	31	25.2	-2.4%
	MD	10	31	31	31.0	0.0%
	BA	10	31	31	13.9	-7.2%
	SD	10	31	31	13.2	-7.5%
	SV	10	31	31	13.2	-7.5%
	SCC	10	31	31	13.2	-7.5%
Class III Local/Switcher	SC	10	31	31	31.0	0.0%
	SJV	10	31	31	18.6	-5.2%
	MD	10	31	31	10.0	-8.8%
	BA	10	31	31	10.0	-8.8%
	SD	10	31	31	10.0	-8.8%
	SV	10	31	31	10.0	-8.8%
	SCC	10	31	31	10.0	-8.8%
	NEP	10	31	31	26.6	-1.9%
	MC	10	31	31	31.0	0.0%
	NC	10	31	31	10.0	-8.8%
	NCC	10	31	31	10.0	-8.8%
Industrial/Military	SC	10	31	31	24.0	-3.0%
	SJV	10	31	31	24.0	-3.0%
	MD	10	31	31	24.0	-3.0%
	BA	10	31	31	24.0	-3.0%
	NEP	10	31	31	24.0	-3.0%
	SD	10	31	31	24.0	-3.0%
	SV	10	31	31	24.0	-3.0%
	SCC	10	31	31	24.0	-3.0%
Passenger	SC	10	31	31	10.8	-8.5%
	SJV	10	31	31	10.0	-8.8%
	BA	10	31	31	10.0	-8.8%
	SD	10	31	31	10.0	-8.8%
	SV	10	31	31	10.0	-8.8%
	SCC	10	31	31	12.1	-8.0%

Source : Fuel Estimate from http://www.arb.ca.gov/regact/carblohc/carblohc.htm

Sulfur

Currently, the baseline locomotive emissions inventory assumes an average fuel sulfur content of 2700 ppm. Industry has provided information on the sulfur content of the fuel that is currently being used by intrastate locomotives. Together with industry data and prior locomotive tests, staff believes a fuel correction factor should be incorporated into the model.

Table 24 shows the test data collected by the ARB, U.S. EPA, and others, where locomotive engines were tested on different fuel sulfur levels.

Table 24. Locomotive Engine Test with Different Sulfur Levels

Locomotive Engine	Fuel Properties Sulfur Content	Percent Change PM	Percent Change NOX	Percent Change CO	Percent Change HC	Source
EMD 12-645E3B	100/3300ppm	-0.29	-0.06	0.17	0.07	Fritz, 1991
GE DASH9-40C	330/3150ppm	-0.43	-0.07	-0.05	-0.18	Fritz (1995, EPA/SWRI)
MK 5000C	330/3150ppm	-0.71	-0.03	-0.03	-0.07	Fritz (1995, EPA/SWRI)
EMD 16-710G3B, SD70MAC	330/3150ppm	-0.38	-0.08	-0.30	-0.01	Fritz (1995, EPA/SWRI)
EMD SD70MAC	50/330ppm	-0.03	-0.04	0.07	0.01	Fritz (ARB/AAR, 2000)
EMD SD70MAC	50/4760ppm	-0.16	-0.06	0.08	0.03	Fritz (ARB/AAR, 2000)
EMD SD70MAC	330/4760ppm	-0.13	-0.03	0.01	0.01	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/330ppm	-0.03	-0.03	-0.01	-0.04	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/4760ppm	-0.39	-0.07	-0.02	0.02	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	330/4760ppm	-0.38	-0.04	-0.02	0.06	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/3190ppm	-0.27	-0.05	-0.03	0.01	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	330/3190ppm	-0.25	-0.02	-0.02	0.04	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	3190/4760ppm	-0.17	-.02	0.00	0.02	Fritz (ARB/AAR, 2000)
Average		-0.28	-0.05	-0.01	0.00	

From the above table, staff concluded that HC and CO emissions are not affected by different sulfur levels in the fuel. From these tests, staff computed the changes in PM emissions associated with changes in sulfur level. Staff corrected the PM emissions to account for the aromatic differences because the test data were not tested at the same aromatic volume percent. Because the locomotive engine testing was performed at various fuel sulfur levels (some at 330 ppm vs. 3190 ppm and some at 50 ppm vs. 3190 ppm), staff cannot assume the average percent change in PM emission is characteristics over the whole range of sulfur levels. From previous studies that staff has analyzed, it is possible to generate estimates of the percent change at various sulfur levels and throttle positions. Locomotive engines have 8 throttle positions plus dynamic braking and idle. During idle, braking, and throttle positions 1 and 2, there are no significant differences in emissions attributable to sulfur level. For the GE 4-

stroke engine, effect of sulfur on PM for throttle positions 3 to 8 can be defined by using the following equations:

Equations to correct for PM for GE (4-Stroke) engines

Notch 8 : PM (g/bhp-hr) = 0.00001308 * (sulfur level,ppm) + 0.0967
Notch 7 : PM (g/bhp-hr) = 0.00001102 * (sulfur level,ppm) + 0.0845
Notch 6 : PM (g/bhp-hr) = 0.00000654 * (sulfur level,ppm) + 0.1037
Notch 5 : PM (g/bhp-hr) = 0.00000548 * (sulfur level,ppm) + 0.1320
Notch 4 : PM (g/bhp-hr) = 0.00000663 * (sulfur level,ppm) + 0.1513
Notch 3 : PM (g/bhp-hr) = 0.00000979 * (sulfur level,ppm) + 0.1565

For the EMD 2-stroke engine, throttle positions 3 to 8 can be defined by using the following equations:

Equations to correct for PM for EMD (2-Stroke) engines

Notch 8 : PM (g/bhp-hr) = 0.0000123 * (sulfur level,ppm) + 0.3563
Notch 7 : PM (g/bhp-hr) = 0.0000096 * (sulfur level,ppm) + 0.2840
Notch 6 : PM (g/bhp-hr) = 0.0000134 * (sulfur level,ppm) + 0.2843
Notch 5 : PM (g/bhp-hr) = 0.0000150 * (sulfur level,ppm) + 0.2572
Notch 4 : PM (g/bhp-hr) = 0.0000125 * (sulfur level,ppm) + 0.2629
Notch 3 : PM (g/bhp-hr) = 0.0000065 * (sulfur level,ppm) + 0.2635

Table 25. Examples of PM Reductions Due to Changes in Sulfur Level

Sulfur Level (ppm)		PM Reduction	PM Reduction	PM Reduction
From	To	2 Stroke	4 Stroke	Composite
3100	1900	4.1%	8.4%	5.2%
3100	1300	6.1%	12.6%	7.7%
1300	330	3.5%	7.9%	4.6%
1300	140	4.2%	9.5%	5.5%
140	15	1.8%	4.0%	2.4%

*composite is 75% 2 Stroke Engine and 25% 4 Stroke Engine

Data provided by industry show that when operating in California, the three main types of diesel fuel used in locomotive engines consists of CARB diesel, EPA On-Highway diesel fuel, and EPA Off-road or High Sulfur diesel fuel. Four-stroke engines and two-stroke engines show different characteristics with respect to sulfur content. From the BAH report, 4-stroke engines make up about 25%, and 2-stroke engines make up about 75% of the locomotive engine fleet. Combining industry data, 4-stroke/2-stroke engine percent change and fleet makeup, Table 26 shows the percent change in PM emissions by year for the line-haul segment of the fleet.

Table 26. PM Emission Percent Change of Line-Haul Due to Sulfur, Statewide

Calendar Year	CARB Sulfur Content	EPA On-Highway Sulfur Content	EPA Off-road Sulfur Content	Weighted Fuel Sulfur Content	4-Stroke Engines PM Percent Change	2-Stroke Engines PM Percent Change	Weighted PM Emission Percent Change
1992	3100	3100	3100	3100	0.03	0.01	0.015
1993	500	330	3100	2919	0.02	0.01	0.009
1994	150	330	3100	2740	0.01	0.00	0.003
1995	140	330	3100	2557	-0.01	0.00	-0.006
1996	140	330	3100	2377	-0.02	-0.01	-0.014
1997	140	330	3100	2196	-0.04	-0.02	-0.022
1998-2001	140	330	3100	1899	-0.06	-0.03	-0.035
2002-2006	140	330	3100	1312	-0.10	-0.05	-0.061
2007+	15	15	330	129	-0.19	-0.09	-0.113

Table 27 and Table 28 provide further details of weighted fuel sulfur level by air basin. Weighted sulfur levels vary significantly from one air basin to another.

Table 27. Class I Line Haul Weighted Fuel Sulfur by Air Basin

Interstate Locomotive	Air Basin	1998 Weighted Sulfur	2002-2006 Weighted Sulfur	2007+ Weighted Sulfur
		ppm	ppm	ppm
Class I Line Haul	SCC	1023	467	31
	MC	2333	1149	113
	MD	2352	1767	180
	NEP	2560	1632	166
	SC	1985	1472	145
	SF	1711	899	88
	SJV	1600	868	78
	SS	2425	1328	129
	SV	2473	1456	147

Table 28. Intrastate Locomotives Weighted Fuel Sulfur by Air Basin

Intrastate Locomotive	Air Basin	1993 Weighted Sulfur	1994-2006 Weighted Sulfur	2007+ Weighted Sulfur
		ppm	ppm	ppm
Class I Local/Switcher	SC	346	312	15
	SJV	377	278	15
	MD	330	330	15
	BA	468	175	15
	SD	475	169	15
	SV	475	169	15
	SCC	475	169	15
Class III Local/Switcher	SC	388	388	21
	SJV	1016	804	80
	MD	500	140	15
	BA	500	140	15
	SD	500	140	15
	SV	500	140	15
	SCC	500	140	15
	NEP	2628	2553	264
	MC	1573	1573	152
	NC	500	140	15
	NCC	500	140	15
Industrial/Military	SC	1340	1220	120
	SJV	1340	1220	120
	MD	1340	1220	120
	BA	1340	1220	120
	NEP	1340	1220	120
	SD	1340	1220	120
	SV	1340	1220	120
	SCC	1340	1220	120
Passenger	SC	493	147	15
	SJV	500	140	15
	BA	500	140	15
	SD	500	140	15
	SV	500	140	15
	SCC	483	159	15

Appendix B,C, and D contains the fuel correction factors for PM, NOx, and SOx emissions by air basin.

Revised Locomotive Emission Inventory

Tables 29-31 shows the revised locomotive emission inventory for calendar years 2000,2010 and 2020.

Table 29. 2000 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.61	18.21	113.03	2.68	6.22
Local/Short-Run	1.01	3.33	22.58	0.41	0.22
Mixed/Bulk	2.13	6.85	48.95	1.09	2.20
Passenger/Amtrak	0.53	1.01	12.21	0.29	0.05
Yard/Switcher	0.55	1.46	10.43	0.20	0.09
Total	9.83	30.86	207.20	4.67	8.78

Table 30. 2010 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.56	21.90	71.35	2.40	0.60
Local/Short-Run	0.77	2.99	12.03	0.30	0.01
Mixed/Bulk	2.11	8.24	29.46	0.99	0.19
Passenger/Amtrak	0.58	1.14	12.29	0.31	0.02
Yard/Switcher	0.47	1.29	6.78	0.17	0.01
Total	9.49	35.56	131.91	4.17	0.83

Table 31. 2020 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.60	25.84	74.33	2.38	0.71
Local/Short-Run	0.67	2.99	11.17	0.26	0.01
Mixed/Bulk	2.13	9.72	31.14	0.98	0.23
Passenger/Amtrak	0.56	1.14	11.72	0.30	0.02
Yard/Switcher	0.44	1.29	6.22	0.16	0.01
Total	9.40	40.98	134.58	4.08	0.98

Appendix A

Methodology to Calculate Locomotive Inventory

Methodology

The methodology and assumptions used for estimating locomotive emissions consists of several steps taken from the Booz-Allen Hamilton's Locomotive Emission Study report (http://www.arb.ca.gov/app/library/libcc.php). First, emission factor data from various engine manufacturers such as EMD and General Electric (GE) must be gathered to calculate average emission factors for locomotives operated by the railroad companies. Second, train operations data, including throttle position profiles and time spent on various types of operations from different railroad companies needs to be estimated. Finally, the locomotive emission inventory can be calculated using train operations data, emission factors, and throttle position profiles.

Step 1 – Average Emission Factors

Engine emission factors are required for the different locomotive engines manufactured by the major locomotive suppliers EMD or GE. Emission factors are obtained from testing done by either the engine manufacturers or by Southwest Research Institute, a consulting company that has performed many tests on locomotive engines. Table A-1 lists the available emission factors.

Table A-1. Available Emission Factors for Different Locomotive Engines

Engine Manufacturer	Engine Model	Locomotive Model
EMD	12-567BC	SW10
EMD	12-645E	SW1500,MP15,GP15-1
EMD	16-567C	GP9
EMD	16-645E	GP38,GP38-2, GP28
EMD	12-645E3B	GP39-2
EMD	12-645E3	GP39-2, SD39
EMD	16-645E3	GP40, SD40, F40PH
EMD	16-645E3B	GP40-2, SD40-2, SDF40-2, F40PH
EMD	16-645F3	GP40X, GP50, SD45
EMD	16-645F3B	SD50
EMD	20-645E3	SD45,SD45-2, F45, FP45
EMD	16-710G3	GP60, SD60, SD60M
GE	127FDL2500	B23-7
GE	127FDL3000	SF30B
GE	167FDL3000	C30-7, SF30C
GE	167FDL4000	B40-8

Source: BAH report, 1992

Next, the locomotive roster from the largest railroad companies operating in the state were obtained. Table A-2 lists the locomotive roster for railroad companies in 1987.

Table A-2. Locomotive Roster 1987

					Type of Service		
Railroad Company	Engine Manufacturer	Engine Model	Horspower Rating	Units	Line Haul	Local	Yard/Switcher
ATSF	EMD	16-567BC	1500	211			X
ATSF	EMD	16-567C	1750	53			X
ATSF	EMD	16-567D2	2000	71		X	X
ATSF	EMD	16-645E	2000	69		X	X
ATSF	EMD	12-645E3	2300	62		X	
ATSF	EMD	12-645E3B	2300	60		X	
ATSF	EMD	16-645E3	2500	231	X	X	
ATSF	EMD	16-645E3	3000	18	X	X	
ATSF	EMD	16-645E3B	3000	203	X	X	
ATSF	EMD	16-645F3	3500	52	X		
ATSF	EMD	16-645F3B	3600	15	X		
ATSF	EMD	20-645E3	3600	243	X		
ATSF	EMD	16-710G3	3800	20	X		
ATSF	GE	GE-12	2350	60		X	
ATSF	GE	GE-12	3000	10	X	X	
ATSF	GE	GE-16	3000	226	X	X	

ATSF	GE	GE-16	3600	43	X		
ATSF	GE	GE-16	3900	3	X		
ATSF	GE	GE-16	4000	20	X		
Union Pacific	EMD	16-645BC	1200	56			X
Union Pacific	EMD	12-567A	1200	12			X
Union Pacific	EMD	12-645E	1500	281			X
Union Pacific	EMD	16-567CE	1500	35			X
Union Pacific	EMD	16-645E	2000	365		X	X
Union Pacific	EMD	12-645E3C	2300	24		X	
Union Pacific	EMD	16-567D3A	2500	16		X	
Union Pacific	EMD	16-645E3	3000	828	X	X	
Union Pacific	EMD	16-645E3B	3000	446	X	X	
Union Pacific	EMD	16-645F3	3500	36	X		
Union Pacific	EMD	16-645F3B	3600	60	X		
Union Pacific	EMD	16-710G3	3800	227	X		
Union Pacific	GE	GE-12	2300	106		X	
Union Pacific	GE	GE-12	3000	57	X	X	
Union Pacific	GE	GE-16	3000	156	X	X	
Union Pacific	GE	GE-16	3750	60	X		
Union Pacific	GE	GE-16	3800	256	X		
Southern Pacific	EMD	12-567C	1200	11			X
Southern Pacific	EMD	12-645E	1500	286			X
Southern Pacific	EMD	16-567BC	1500	37			X
Southern Pacific	EMD	16-567C	1750	326		X	
Southern Pacific	EMD	16-567D2	2000	145		X	
Southern Pacific	EMD	16-645E	2000	84		X	
Southern Pacific	EMD	12-645E3	2300	12		X	
Southern Pacific	EMD	16-645E3	2500	137	X	X	
Southern Pacific	EMD	16-645E3	3000	92	X		
Southern Pacific	EMD	16-645E3B	3000	353	X		
Southern Pacific	EMD	16-645F3	3500	4	X		
Southern Pacific	EMD	20-645E3	3600	425	X		
Southern Pacific	EMD	16-710G3	3800	65	X		
Southern Pacific	GE	GE-12	2300	15		X	
Southern Pacific	GE	GE-12	3000	107	X		
Southern Pacific	GE	GE-16	3600	20	X		
Southern Pacific	GE	GE-16	3900	92	X		

Source : BAH report, 1992

Using the available emission factors and the locomotive rosters, the average emission factors for each class of service can be calculated. Emission factors for models that were not available were assigned an emission factor based on horsepower rating and the number of cylinders from similar engine models.

Step 2 – Throttle Position Profiles and Train Operations Data

The railroad companies provided throttle position profiles. Locomotive engines operate at eight different constant loads and speeds called throttle notches. In

addition, several other settings (idle and dynamic brake) are also common. For line haul and local operations, profiles were obtained from Train Performance Calculation (TPC) data and actual event recorder data, which are summarized in the BAH report.

For line haul operations, the data was modified to account for additional idle time between dispatch. Data supplied by Atchison, Topeka and Santa Fe (ATSF) indicates that the turnaround time for line haul locomotives in yards is approximately eight hours.

For local operations, several assumptions were used to develop throttle profiles. First, ten hours was used as an average hours per assignment. Second, the additional average idle time per day per locomotive was assumed to be ten hours.

The switch engine duty cycle is based upon actual tape data supplied by the ATSF railroad company on a switch engine that operated over a 2-day period. Yard engines are assumed to operate 350 days per year, with 2 weeks off for inspections and maintenance.

Train operations data provided by the railroad companies included :

Line Haul	Local	Yard/Switcher
Train type	Average trailing tons	Number of units assigned
Number of runs per year	Number of runs per year	Number of assignments
Average horsepower	Average horsepower	Average horsepower
Average units	Average units	
Origin/destination	Origin/destination	
Link miles		

Step 3 – Calculate Locomotive Emission Inventory

Emission inventories are calculated on a train-by-train basis using train operations data, average emission factor, and throttle position profiles.

Emission Inventory = Emission factor x average horsepower x time in notch per train x number of runs per year

Appendix B
PM Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	PM Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line H	SCC	1.000	0.991	0.982	0.973	0.964	0.955	0.937	0.931	0.925	0.919	0.913	0.913	0.913	0.913	0.913	0.883
	MC	1.000	0.998	0.996	0.994	0.992	0.990	0.987	0.971	0.955	0.939	0.923	0.923	0.923	0.923	0.923	0.867
	MD	1.000	0.998	0.995	0.993	0.991	0.988	0.984	0.978	0.973	0.967	0.962	0.962	0.962	0.962	0.962	0.884
	NEP	1.000	0.999	0.998	0.998	0.997	0.996	0.995	0.983	0.971	0.959	0.947	0.947	0.947	0.947	0.947	0.875
	SC	1.000	0.996	0.993	0.989	0.986	0.982	0.975	0.970	0.965	0.960	0.955	0.955	0.955	0.955	0.955	0.888
	SF	1.000	0.993	0.987	0.980	0.974	0.967	0.954	0.940	0.926	0.912	0.898	0.898	0.898	0.898	0.898	0.851
	SJV	1.000	0.993	0.986	0.979	0.972	0.965	0.952	0.944	0.937	0.930	0.923	0.923	0.923	0.923	0.923	0.878
	SS	1.000	0.999	0.997	0.996	0.995	0.993	0.991	0.980	0.970	0.959	0.949	0.949	0.949	0.949	0.949	0.887
	SV	1.000	0.993	0.986	0.979	0.972	0.965	0.952	0.948	0.945	0.942	0.939	0.939	0.939	0.939	0.939	0.873

Intrastate Loc	Air Basin	PM Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.890	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.865
	SJV	1.000	0.863	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.836
	MD	1.000	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.882
	BA	1.000	0.778	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.747
	SD	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
	SV	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
	SCC	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
Class III Loca	SC	1.000	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.882
	SJV	1.000	0.839	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.787
	MD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	BA	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SCC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	NEP	1.000	0.963	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.858
	MC	1.000	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.888
	NC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	NCC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.722
Industrial/Milit	SC	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SJV	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	MD	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	BA	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	NEP	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SD	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SV	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SCC	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
Passenger	SC	1.000	0.754	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.723
	SJV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	BA	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SCC	1.000	0.764	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.733

PRELIMINARY DRAFT – DO NOT CITE OR QUOTE

Appendix C
NOx Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	NOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line H	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SF	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SS	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940

Intrastate Loc	Air Basin	NOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Class III Loca	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Industrial/Milit	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Passenger	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940

PRELIMINARY DRAFT – DO NOT CITE OR QUOTE

Appendix D
SOx Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	SOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line H	SCC	1.000	0.896	0.793	0.689	0.586	0.482	0.379	0.327	0.276	0.225	0.173	0.173	0.173	0.173	0.173	0.011
	MC	1.000	0.977	0.955	0.932	0.909	0.887	0.864	0.755	0.645	0.535	0.426	0.426	0.426	0.426	0.426	0.042
	MD	1.000	0.979	0.957	0.936	0.914	0.893	0.871	0.817	0.763	0.709	0.654	0.654	0.654	0.654	0.654	0.067
	NEP	1.000	0.991	0.983	0.974	0.965	0.957	0.948	0.862	0.776	0.690	0.605	0.605	0.605	0.605	0.605	0.062
	SC	1.000	0.956	0.912	0.868	0.823	0.779	0.735	0.688	0.640	0.593	0.545	0.545	0.545	0.545	0.545	0.054
	SF	1.000	0.939	0.878	0.817	0.756	0.695	0.634	0.559	0.483	0.408	0.333	0.333	0.333	0.333	0.333	0.033
	SJV	1.000	0.932	0.864	0.796	0.728	0.660	0.593	0.525	0.457	0.389	0.322	0.322	0.322	0.322	0.322	0.029
	SS	1.000	0.983	0.966	0.949	0.932	0.915	0.898	0.797	0.695	0.594	0.492	0.492	0.492	0.492	0.492	0.048
	SV	1.000	0.986	0.972	0.958	0.944	0.930	0.916	0.822	0.728	0.634	0.539	0.539	0.539	0.539	0.539	0.054

Intrastate Loc	Air Basin	SOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.128	0.127	0.126	0.125	0.124	0.122	0.121	0.120	0.119	0.118	0.117	0.115	0.115	0.115	0.006
	SJV	1.000	0.139	0.136	0.133	0.130	0.126	0.123	0.120	0.116	0.113	0.110	0.106	0.103	0.103	0.103	0.006
	MD	1.000	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.006
	BA	1.000	0.173	0.164	0.154	0.144	0.134	0.124	0.114	0.104	0.095	0.085	0.075	0.065	0.065	0.065	0.006
	SD	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
	SV	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
	SCC	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
Class III Loca	SC	1.000	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.008
	SJV	1.000	0.376	0.369	0.362	0.355	0.348	0.341	0.333	0.326	0.319	0.312	0.305	0.298	0.298	0.298	0.029
	MD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	BA	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SCC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	NEP	1.000	0.973	0.971	0.968	0.966	0.963	0.961	0.958	0.956	0.953	0.951	0.948	0.946	0.946	0.946	0.098
	MC	1.000	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.056
	NC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	NCC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
Industrial/Milit	SC	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SJV	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	MD	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	BA	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	NEP	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SD	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SV	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SCC	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
Passenger	SC	1.000	0.183	0.171	0.159	0.148	0.136	0.124	0.113	0.101	0.090	0.078	0.066	0.055	0.055	0.055	0.006
	SJV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	BA	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SCC	1.000	0.179	0.168	0.157	0.146	0.135	0.124	0.113	0.103	0.092	0.081	0.070	0.059	0.059	0.059	0.006

APPENDIX B

EMISSION FACTOR DERIVATION AND EMFAC-WD 2006 OUTPUT FOR LHD DIESEL-FUELED TRUCK

Emission Factors for Light Duty Diesel-Fueled Trucks
Los Angeles Transportation Center, Los Angeles, CA

Running Exhaust Emissions

Equipment Type	Equip. ID	Vehicle Class	Make	Model	Year	Emission Factors (g/mi)				
						ROG	CO	NOx	DPM	SOx
Pickup	3518	LHDD	Dodge	2500	2003	0.32	1.65	6.69	0.08	0.05

Idling Exhaust Emissions

Equipment Type	Equip. ID	Vehicle Class	Make	Model	Year	Emission Factors (g/hr)				
						ROG	CO	NOx	DPM	SOx
Pickup	3518	LHDD	Dodge	2500	2003	3.173	26.300	75.051	0.753	0.357

Notes:
1. Emission factor calculations assumed an average speed of 15 mph.
2. Running exhaust emission factors calculated using the EMFAC-WD 2006 model with the BURDEN output option.
3. Idling exhaust emission factors for LHDT1 vehicles calculated using the EMFAC-WD 2006 model with the EMFAC output option.

Title : Statewide totals Avg Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg
Run Date : 2006/10/05 13:37:10
Scen Year: 2005 -- Model year 2003 selected
Season : Annual
Area : Statewide totals Average
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 59 Los Angeles (SC)
Emissions: Tons Per Day
****

	LHDT1-DSL
Vehicles	15991
VMT/1000	758
Trips	201147
Reactive Organic Gas Emissions	
Run Exh	0.27
Idle Exh	0
Start Ex	0

Total Ex	0.27
Diurnal	0
Hot Soak	0
Running	0
Resting	0

Total	0.27
Carbon Monoxide Emissions	
Run Exh	1.38
Idle Exh	0.02
Start Ex	0

Total Ex	1.4
Oxides of Nitrogen Emissions	
Run Exh	5.59
Idle Exh	0.05
Start Ex	0

Total Ex	5.63
Carbon Dioxide Emissions (000)	
Run Exh	0.43
Idle Exh	0
Start Ex	0

Total Ex	0.44
PM10 Emissions	
Run Exh	0.07
Idle Exh	0
Start Ex	0

Total Ex	0.07
TireWear	0.01
BrakeWr	0.01

Total	0.09
Lead	0
SOx	0.04
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	39.24

Title : Statewide totals Avg Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/11 12:20:17
Scen Year: 2005 -- Model year 2003 selected
Season : Annual
Area : Statewide totals
****
Year: 2005 -- Model Years 2003 to 2003 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

State Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	23.103	3.173	17.027

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	141.992	26.3	106.721

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	1.561	75.051	23.965

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0.049	0.357	0.143

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0.753	0.23

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0	0

APPENDIX C

EMISSION FACTOR DERIVATION AND EMFAC-WD 2006 OUTPUT FOR HHD DIESEL-FUELED TRUCKS

Emission Factors for Heavy-Heavy Duty Diesel-Fueled Trucks
Los Angeles Transportation Center, Los Angeles, CA

Running Exhaust Emissions

Emission Factors (g/mi)				
ROG	CO	NOx	DPM	SOx
5.73	15.40	27.41	2.27	0.24

Idling Exhaust Emissions

Emission Factors (g/hr)				
ROG	CO	NOx	DPM	SOx
16.163	52.988	100.382	2.845	0.550

Notes:
1. Running exhaust emission factors from EMFAC-WD 2006 with the BURDEN output option.
2. Idling exhaust emission factors from EMFAC-Wd 2006 with the EMFAC output option.
3. Emission factor calculations assumed an average speed of 15 mph.

Title : Los Angeles County Avg Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +
Run Date : 2006/08/22 16:01:02
Scen Year: 2005 -- All model years in the range 1965 to 2005 selected
Season : Annual
Area : Los Angeles County Average
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 59 Los Angeles (SC)
Emissions: Tons Per Day
****

	HHDT-DSL
Vehicles	23847
VMT/1000	4179
Trips	120678
Reactive Organic Gas Emissions	
Run Exh	26.4
Idle Exh	0.72
Start Ex	0

Total Ex	27.12
Diurnal	0
Hot Soak	0
Running	0
Resting	0

Total	27.12
Carbon Monoxide Emissions	
Run Exh	70.96
Idle Exh	2.35
Start Ex	0

Total Ex	73.31
Oxides of Nitrogen Emissions	
Run Exh	126.26
Idle Exh	4.45
Start Ex	0

Total Ex	130.71
Carbon Dioxide Emissions (000)	
Run Exh	13.21
Idle Exh	0.29
Start Ex	0

Total Ex	13.5
PM10 Emissions	
Run Exh	10.47
Idle Exh	0.13
Start Ex	0

Total Ex	10.6
TireWear	0.17
BrakeWr	0.13

Total	10.89
Lead	0
SOx	1.12
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	1214.88

Summary of Intermodal Traffic Gate Counts
Los Angeles Transfer Center, Los Angeles, CA

Month	In-Gate Total [1]	Out-Gate Total [1]	In & Out Bobtails [2]	In & Out Total
Jan	6,205	4,967	2,793	13,965
Feb	6,448	4,555	2,751	13,754
Mar	7,448	5,700	3,287	16,435
Apr	6,291	5,206	2,874	14,371
May	6,746	5,691	3,109	15,546
June	7,815	5,110	3,231	16,156
July	7,194	4,764	2,990	14,948
Aug	7,584	5,645	3,307	16,536
Sept	6,939	5,200	3,035	15,174
Oct	7,926	5,908	3,459	17,293
Nov	8,803	5,856	3,665	18,324
Dec	6,297	5,119	2,854	14,270
Totals	85,696	63,721	37,354	**186,771**

Notes:
1. Provided by UPRR. (In&Out Gate Box Balance.pdf Reports).
2. Personal communication with Tony Jardino and Ben Shelton of UPRR.

Title : Los Angeles County Avg Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/12/03 10:21:20
Scen Year: 2005 -- All model years in the range 1965 to 2005 selected
Season : Annual
Area : Los Angeles
****
Year: 2005 -- Model Years 1965 to 2005 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average Los Angeles

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	16.163	15.188

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	52.988	49.792

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	100.382	94.327

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.55	0.517

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	2.845	2.674

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

APPENDIX D

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR CARGO HANDLING EQUIPMENT

Emission Factors for Cargo Handling Equipment
Los Angeles Transfer Center, Los Angeles, CA

Equipment Type	Make	Model	Year	Load Factor	Emission Factors (g/bhp-hr)				
					THC	CO	NOx	DPM	SOx
Fork Lift	Taylor	THD200S	2000	0.30	0.5307	2.8296	6.8159	0.3536	0.0597
RTG	Mi Jack	1000RC	2004	0.43	0.0906	0.9456	4.1618	0.0972	0.0521
RTG	Mi Jack	1000R	1984	0.43	0.9965	5.4833	12.8557	0.7230	0.0521
RTG	Mi Jack	1000R	1984	0.43	0.9965	5.4833	12.8557	0.7230	0.0521
RTG	Mi Jack	1000R	1984	0.43	0.9965	5.4833	12.8557	0.7230	0.0521
Top Pick	Taylor	TEC 155H	1998	0.59	0.5505	2.8920	6.9482	0.3734	0.0597
Top Pick	Mi Jack	MJ9090	1990	0.59	0.6811	3.3000	9.0164	0.4547	0.0597
Yard Hostler	Ottawa	Commando 30	2003	0.55	0.2501	2.7810	5.1174	0.2136	0.0597
Yard Hostler	Ottawa	Commando 30	2004	0.55	0.1639	2.7540	4.5529	0.1648	0.0597

Notes:
1. Emission factors and load factors from CARB's Cargo Handling Equipment Emission Calculation Spreadsheet.

Cal Year	Yard	Equipment Type	Code	Useful Life (hours)	Model Year	Age (years)	Population	HP	HP Bin	Yearly Operational Hrs	Cummulative Hours
2005	LATC	Crane	1	39420	2003	3	1	275	500	2190	6570
2005	LATC	Forklift	3	5200	2000	6	1	154	175	260	1560
2005	LATC	Forklift	3	160000	2004	2	1	150	175	8000	16000
2005	LATC	Forklift	3	43800	1999	7	1	150	175	2190	15330
2005	LATC	Crane	1	52560	2004	2	2	300	500	2920	5840
2005	LATC	Crane	1	52560	1984	22	1	300	500	2920	64240
2005	LATC	Crane	1	0	1984	22	1	300	500	0	0
2005	LATC	Crane	1	0	1984	22	1	300	500	0	0
2005	LATC	Material Handling Equip	4	18720	1998	8	1	150	175	1040	8320
2005	LATC	Material Handling Equip	4	1080	1990	16	1	335	500	60	960
2005	LATC	Yard Tractor offroad	8	128000	2003	3	3	150	175	8000	24000
2005	LATC	Yard Tractor offroad	8	128000	2004	2	10	150	175	8000	16000

Emission Control Factor? (y/n)	Emission Control	Load Factor	HPMY	HC EF	Emission Control HC EF	HC dr	FCF HC	CO EF	Emission Control CO EF	CO dr	NOX EF	Emission Control NOX EF	NOX dr
n		0.43	5002003	1.20E-01	0.00E+00	0.000001	0.720000	9.20E-01	0.00E+00	0.000006	4.29E+00	0.00E+00	0.000023
n		0.30	1752000	6.80E-01	0.00E+00	0.000037	0.720000	2.70E+00	0.00E+00	0.000083	6.90E+00	0.00E+00	0.000186
n		0.30	1752004	2.20E-01	0.00E+00	0.000000	0.720000	2.70E+00	0.00E+00	0.000003	4.72E+00	0.00E+00	0.000004
n		0.30	1751999	6.80E-01	0.00E+00	0.000004	0.720000	2.70E+00	0.00E+00	0.000010	6.90E+00	0.00E+00	0.000022
n		0.43	5002004	1.20E-01	0.00E+00	0.000001	0.720000	9.20E-01	0.00E+00	0.000004	4.29E+00	0.00E+00	0.000017
n		0.43	5001984	9.00E-01	0.00E+00	0.000008	0.720000	4.20E+00	0.00E+00	0.000020	1.10E+01	0.00E+00	0.000044
n		0.43	5001984	9.00E-01	0.00E+00	#DIV/0!	0.720000	4.20E+00	0.00E+00	#DIV/0!	1.10E+01	0.00E+00	#DIV/0!
n		0.43	5001984	9.00E-01	0.00E+00	#DIV/0!	0.720000	4.20E+00	0.00E+00	#DIV/0!	1.10E+01	0.00E+00	#DIV/0!
n		0.59	1751998	6.80E-01	0.00E+00	0.000010	0.720000	2.70E+00	0.00E+00	0.000023	6.90E+00	0.00E+00	0.000052
n		0.59	5001990	6.80E-01	0.00E+00	0.000277	0.720000	2.70E+00	0.00E+00	0.000625	8.17E+00	0.00E+00	0.001589
n		0.55	1752003	3.30E-01	0.00E+00	0.000001	0.720000	2.70E+00	0.00E+00	0.000003	5.26E+00	0.00E+00	0.000006
n		0.55	1752004	2.20E-01	0.00E+00	0.000000	0.720000	2.70E+00	0.00E+00	0.000003	4.72E+00	0.00E+00	0.000005

FCF NOX	PM EF	Emission Control PM EF	PM dr	FCF PM	SOX EF	Final EF_HC	Final EF_CO	Final EF_NOX	Final EF_SOX	Final EF_PM	TOG	ROG	CO
0.948000	1.10E-01	0.00E+00	0.000002	0.822000	5.21E-02	9.27E-02	9.58E-01	4.21E+00	5.21E-02	1.01E-01	3.81E-02	3.35E-02	2.73E-01
0.948000	3.80E-01	0.00E+00	0.000032	0.822000	5.97E-02	5.31E-01	2.83E+00	6.82E+00	5.97E-02	3.54E-01	1.01E-02	8.88E-03	3.74E-02
0.948000	1.90E-01	0.00E+00	0.000001	0.822000	5.97E-02	1.63E-01	2.74E+00	4.54E+00	5.97E-02	1.63E-01	9.30E-02	8.17E-02	1.09E+00
0.948000	3.80E-01	0.00E+00	0.000004	0.822000	5.97E-02	5.38E-01	2.85E+00	6.86E+00	5.97E-02	3.60E-01	8.40E-02	7.38E-02	3.09E-01
0.948000	1.10E-01	0.00E+00	0.000001	0.822000	5.21E-02	9.06E-02	9.46E-01	4.16E+00	5.21E-02	9.72E-02	1.08E-01	9.51E-02	7.85E-01
0.930000	5.30E-01	0.00E+00	0.000007	0.750000	5.21E-02	9.96E-01	5.48E+00	1.29E+01	5.21E-02	7.23E-01	5.95E-01	5.23E-01	2.27E+00
0.930000	5.30E-01	0.00E+00	#DIV/0!	0.750000	5.21E-02	#DIV/0!	#DIV/0!	#DIV/0!	5.21E-02	#DIV/0!	0.00E+00	0.00E+00	0.00E+00
0.930000	5.30E-01	0.00E+00	#DIV/0!	0.750000	5.21E-02	#DIV/0!	#DIV/0!	#DIV/0!	5.21E-02	#DIV/0!	0.00E+00	0.00E+00	0.00E+00
0.948000	3.80E-01	0.00E+00	0.000009	0.822000	5.97E-02	5.51E-01	2.89E+00	6.95E+00	5.97E-02	3.73E-01	8.04E-02	7.06E-02	2.93E-01
0.930000	3.80E-01	0.00E+00	0.000236	0.750000	5.97E-02	6.81E-01	3.30E+00	9.02E+00	5.97E-02	4.55E-01	1.28E-02	1.13E-02	4.31E-02
0.948000	2.40E-01	0.00E+00	0.000001	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	7.85E-01	6.90E-01	6.06E+00
0.948000	1.90E-01	0.00E+00	0.000001	0.822000	5.97E-02	1.64E-01	2.75E+00	4.55E+00	5.97E-02	1.65E-01	1.72E+00	1.51E+00	2.00E+01

NOX	SOX	PM	PM10	PM2.5	TOG	ROG	CO	NOX	SOX	PM	PM10	PM2.5
1.20E+00	1.49E-02	2.87E-02	2.87E-02	2.64E-02	1.04E-04	9.17E-05	7.49E-04	3.29E-03	4.07E-05	7.85E-05	7.85E-05	7.23E-05
9.02E-02	7.90E-04	4.68E-03	4.68E-03	4.30E-03	2.77E-05	2.43E-05	1.03E-04	2.47E-04	2.17E-06	1.28E-05	1.28E-05	1.18E-05
1.80E+00	2.37E-02	6.46E-02	6.46E-02	5.95E-02	2.55E-04	2.24E-04	2.98E-03	4.93E-03	6.49E-05	1.77E-04	1.77E-04	1.63E-04
7.45E-01	6.48E-03	3.91E-02	3.91E-02	3.60E-02	2.30E-04	2.02E-04	8.48E-04	2.04E-03	1.78E-05	1.07E-04	1.07E-04	9.86E-05
3.45E+00	4.32E-02	8.06E-02	8.06E-02	7.42E-02	2.97E-04	2.61E-04	2.15E-03	9.46E-03	1.18E-04	2.21E-04	2.21E-04	2.03E-04
5.33E+00	2.16E-02	3.00E-01	3.00E-01	2.76E-01	1.63E-03	1.43E-03	6.23E-03	1.46E-02	5.92E-05	8.22E-04	8.22E-04	7.56E-04
0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.04E-01	6.06E-03	3.79E-02	3.79E-02	3.48E-02	2.20E-04	1.93E-04	8.03E-04	1.93E-03	1.66E-05	1.04E-04	1.04E-04	9.54E-05
1.18E-01	7.80E-04	5.94E-03	5.94E-03	5.46E-03	3.51E-05	3.08E-05	1.18E-04	3.23E-04	2.14E-06	1.63E-05	1.63E-05	1.50E-05
1.12E+01	1.30E-01	4.66E-01	4.66E-01	4.28E-01	2.15E-03	1.89E-03	1.66E-02	3.06E-02	3.57E-04	1.28E-03	1.28E-03	1.17E-03
3.31E+01	4.34E-01	1.20E+00	1.20E+00	1.10E+00	4.70E-03	4.13E-03	5.48E-02	9.07E-02	1.19E-03	3.28E-03	3.28E-03	3.02E-03

Type	Useful Life	Load Factor
Crane	18	0.43
Excavator	16	0.57
Forklift	20	0.30
Material Handling Equip	18	0.59
Other General Industrial Equip	16	0.51
Sweeper/Scrubber	16	0.68
Tractor/Loader/Backhoe	16	0.55
Yard Tractor offroad engine	8	0.65
Yard Tractor onroad engine	8	0.65

Fuel Correction Factor

t_fcf

	Calyr 1994 -2006		
Model Yr	NOX	PM	HC
1970	0.930	0.750	0.720
1971	0.930	0.750	0.720
1972	0.930	0.750	0.720
1973	0.930	0.750	0.720
1974	0.930	0.750	0.720
1975	0.930	0.750	0.720
1976	0.930	0.750	0.720
1977	0.930	0.750	0.720
1978	0.930	0.750	0.720
1979	0.930	0.750	0.720
1980	0.930	0.750	0.720
1981	0.930	0.750	0.720
1982	0.930	0.750	0.720
1983	0.930	0.750	0.720
1984	0.930	0.750	0.720
1985	0.930	0.750	0.720
1986	0.930	0.750	0.720
1987	0.930	0.750	0.720
1988	0.930	0.750	0.720
1989	0.930	0.750	0.720
1990	0.930	0.750	0.720
1991	0.930	0.750	0.720
1992	0.930	0.750	0.720
1993	0.930	0.750	0.720
1994	0.930	0.750	0.720
1995	0.930	0.750	0.720
1996	0.948	0.822	0.720
1997	0.948	0.822	0.720
1998	0.948	0.822	0.720
1999	0.948	0.822	0.720
2000	0.948	0.822	0.720
2001	0.948	0.822	0.720
2002	0.948	0.822	0.720
2003	0.948	0.822	0.720
2004	0.948	0.822	0.720
2005	0.948	0.822	0.720
2006	0.948	0.822	0.720
2007	0.948	0.822	0.720
2008	0.948	0.822	0.720
2009	0.948	0.822	0.720
2010	0.948	0.822	0.720
2011	0.948	0.822	0.720
2012	0.948	0.822	0.720
2013	0.948	0.822	0.720
2014	0.948	0.822	0.720
2015	0.948	0.822	0.720
2016	0.948	0.822	0.720
2017	0.948	0.822	0.720
2018	0.948	0.822	0.720

HP_dr

	Det. Rate			
HP	**HC**	**CO**	**NOx**	**PM**
50	51%	41%	6%	31%
120	28%	16%	14%	44%
175	28%	16%	14%	44%
250	44%	25%	21%	67%
500	44%	25%	21%	67%

***New Tier4 emfacs included with 43/57% split for 120 hp merged (diesel only)**

units = g/bhp hr

Lookup	Hp	Year	HC	CO	NOX	PM	CO2
251968	25	1968	1.84	5	6.92	0.764	10176.3
251969	25	1969	1.84	5	6.92	0.764	10176.3
251970	25	1970	1.84	5	6.92	0.764	10176.3
251971	25	1971	1.84	5	6.92	0.764	10176.3
251972	25	1972	1.84	5	6.92	0.764	10176.3
251973	25	1973	1.84	5	6.92	0.764	10176.3
251974	25	1974	1.84	5	6.92	0.764	10176.3
251975	25	1975	1.84	5	6.92	0.764	10176.3
251976	25	1976	1.84	5	6.92	0.764	10176.3
251977	25	1977	1.84	5	6.92	0.764	10176.3
251978	25	1978	1.84	5	6.92	0.764	10176.3
251979	25	1979	1.84	5	6.92	0.764	10176.3
251980	25	1980	1.84	5	6.92	0.764	10176.3
251981	25	1981	1.84	5	6.92	0.764	10176.3
251982	25	1982	1.84	5	6.92	0.764	10176.3
251983	25	1983	1.84	5	6.92	0.764	10176.3
251984	25	1984	1.84	5	6.92	0.764	10176.3
251985	25	1985	1.84	5	6.92	0.764	10176.3
251986	25	1986	1.84	5	6.92	0.764	10176.3
251987	25	1987	1.84	5	6.92	0.764	10176.3
251988	25	1988	1.84	5	6.92	0.764	10176.3
251989	25	1989	1.84	5	6.92	0.764	10176.3
251990	25	1990	1.84	5	6.92	0.764	10176.3
251991	25	1991	1.84	5	6.92	0.764	10176.3
251992	25	1992	1.84	5	6.92	0.764	10176.3
251993	25	1993	1.84	5	6.92	0.764	10176.3
251994	25	1994	1.84	5	6.92	0.764	10176.3
251995	25	1995	1.63	1.4	3.89	0.417	10176.3
251996	25	1996	1.63	1.4	3.89	0.417	10176.3
251997	25	1997	1.63	1.4	3.89	0.417	10176.3
251998	25	1998	1.63	1.4	3.89	0.417	10176.3
251999	25	1999	0.52	0.5	1.24	0.116	10176.3
252000	25	2000	0.52	0.5	1.24	0.116	10176.3
252001	25	2001	0.52	0.5	1.24	0.116	10176.3
252002	25	2002	0.52	0.5	1.24	0.116	10176.3
252003	25	2003	0.52	0.5	1.24	0.116	10176.3
252004	25	2004	0.52	0.5	1.24	0.116	10176.3
252005	25	2005	0.52	0.5	1.24	0.116	10176.3
252006	25	2006	0.52	0.5	1.24	0.116	10176.3
252007	25	2007	0.52	0.5	1.24	0.116	10176.3
252008	25	2008	0.52	0.5	1.24	0.116	10176.3
252009	25	2009	0.52	0.5	1.24	0.116	10176.3
252010	25	2010	0.52	0.5	1.24	0.116	10176.3
252011	25	2011	0.52	0.5	1.24	0.116	10176.3
252012	25	2012	0.52	0.5	1.24	0.116	10176.3
252013	25	2013	0.52	0.5	1.24	0.116	10176.3
252014	25	2014	0.52	0.5	1.24	0.116	10176.3
252015	25	2015	0.52	0.5	1.24	0.116	10176.3
252016	25	2016	0.52	0.5	1.24	0.116	10176.3
252017	25	2017	0.52	0.5	1.24	0.116	10176.3
252018	25	2018	0.52	0.5	1.24	0.116	10176.3
252019	25	2019	0.52	0.5	1.24	0.116	10176.3
252020	25	2020	0.52	0.5	1.24	0.116	10176.3
252021	25	2021	0.52	0.5	1.24	0.116	10176.3
252022	25	2022	0.52	0.5	1.24	0.116	10176.3
252023	25	2023	0.52	0.5	1.24	0.116	10176.3
252024	25	2024	0.52	0.5	1.24	0.116	10176.3
252025	25	2025	0.52	0.5	1.24	0.116	10176.3
252026	25	2026	0.52	0.5	1.24	0.116	10176.3
501969	50	1969	1.84	5	7	0.76	10176.3
501969	50	1969	1.84	5	7	0.76	10176.3
501970	50	1970	1.84	5	7	0.76	10176.3
501971	50	1971	1.84	5	7	0.76	10176.3
501972	50	1972	1.84	5	7	0.76	10176.3
501973	50	1973	1.84	5	7	0.76	10176.3
501974	50	1974	1.84	5	7	0.76	10176.3
501975	50	1975	1.84	5	7	0.76	10176.3

501976	50	1976	1.84	5	7	0.76	10176.3
501977	50	1977	1.84	5	7	0.76	10176.3
501978	50	1978	1.84	5	7	0.76	10176.3
501979	50	1979	1.84	5	7	0.76	10176.3
501980	50	1980	1.84	5	7	0.76	10176.3
501981	50	1981	1.84	5	7	0.76	10176.3
501982	50	1982	1.84	5	7	0.76	10176.3
501983	50	1983	1.84	5	7	0.76	10176.3
501984	50	1984	1.84	5	7	0.76	10176.3
501985	50	1985	1.84	5	7	0.76	10176.3
501986	50	1986	1.84	5	7	0.76	10176.3
501987	50	1987	1.84	5	7	0.76	10176.3
501988	50	1988	1.8	5	6.9	0.76	10176.3
501989	50	1989	1.8	5	6.9	0.76	10176.3
501990	50	1990	1.8	5	6.9	0.76	10176.3
501991	50	1991	1.8	5	6.9	0.76	10176.3
501992	50	1992	1.8	5	6.9	0.76	10176.3
501993	50	1993	1.8	5	6.9	0.76	10176.3
501994	50	1994	1.8	5	6.9	0.76	10176.3
501995	50	1995	1.8	5	6.9	0.76	10176.3
501996	50	1996	1.8	5	6.9	0.76	10176.3
501997	50	1997	1.8	5	6.9	0.76	10176.3
501998	50	1998	1.8	5	6.9	0.76	10176.3
501999	50	1999	1.45	4.1	5.55	0.6	10176.3
502000	50	2000	1.45	4.1	5.55	0.6	10176.3
502001	50	2001	1.45	4.1	5.55	0.6	10176.3
502002	50	2002	1.45	4.1	5.55	0.6	10176.3
502003	50	2003	1.45	4.1	5.55	0.6	10176.3
502004	50	2004	0.64	3.27	5.1	0.43	10176.3
502005	50	2005	0.37	3	4.95	0.38	10176.3
502006	50	2006	0.24	2.86	4.88	0.35	10176.3
502007	50	2007	0.24	2.86	4.88	0.35	10176.3
502008	50	2008	0.1	2.72	4.8	0.16	10176.3
502009	50	2009	0.1	2.72	4.8	0.16	10176.3
502010	50	2010	0.1	2.72	4.8	0.16	10176.3
502011	50	2011	0.1	2.72	4.8	0.16	10176.3
502012	50	2012	0.1	2.72	4.8	0.16	10176.3
502013	50	2013	0.1	2.72	2.9	0.01	10176.3
502014	50	2014	0.1	2.72	2.9	0.01	10176.3
502015	50	2015	0.1	2.72	2.9	0.01	10176.3
502016	50	2016	0.1	2.72	2.9	0.01	10176.3
502017	50	2017	0.1	2.72	2.9	0.01	10176.3
502018	50	2018	0.1	2.72	2.9	0.01	10176.3
502019	50	2019	0.1	2.72	2.9	0.01	10176.3
502020	50	2020	0.1	2.72	2.9	0.01	10176.3
502021	50	2021	0.1	2.72	2.9	0.01	10176.3
502022	50	2022	0.1	2.72	2.9	0.01	10176.3
502023	50	2023	0.1	2.72	2.9	0.01	10176.3
502024	50	2024	0.1	2.72	2.9	0.01	10176.3
502025	50	2025	0.1	2.72	2.9	0.01	10176.3
502026	50	2026	0.1	2.72	2.9	0.01	10176.3
1201968	120	1968	1.44	4.8	13	0.84	10176.3
1201969	120	1969	1.44	4.8	13	0.84	10176.3
1201970	120	1970	1.44	4.8	13	0.84	10176.3
1201971	120	1971	1.44	4.8	13	0.84	10176.3
1201972	120	1972	1.44	4.8	13	0.84	10176.3
1201973	120	1973	1.44	4.8	13	0.84	10176.3
1201974	120	1974	1.44	4.8	13	0.84	10176.3
1201975	120	1975	1.44	4.8	13	0.84	10176.3
1201976	120	1976	1.44	4.8	13	0.84	10176.3
1201977	120	1977	1.44	4.8	13	0.84	10176.3
1201978	120	1978	1.44	4.8	13	0.84	10176.3
1201979	120	1979	1.44	4.8	13	0.84	10176.3
1201980	120	1980	1.44	4.8	13	0.84	10176.3
1201981	120	1981	1.44	4.8	13	0.84	10176.3
1201982	120	1982	1.44	4.8	13	0.84	10176.3
1201983	120	1983	1.44	4.8	13	0.84	10176.3
1201984	120	1984	1.44	4.8	13	0.84	10176.3
1201985	120	1985	1.44	4.8	13	0.84	10176.3
1201986	120	1986	1.44	4.8	13	0.84	10176.3
1201987	120	1987	1.44	4.8	13	0.84	10176.3

1201988	120	1988	0.99	3.49	8.75	0.69	10176.3
1201989	120	1989	0.99	3.49	8.75	0.69	10176.3
1201990	120	1990	0.99	3.49	8.75	0.69	10176.3
1201991	120	1991	0.99	3.49	8.75	0.69	10176.3
1201992	120	1992	0.99	3.49	8.75	0.69	10176.3
1201993	120	1993	0.99	3.49	8.75	0.69	10176.3
1201994	120	1994	0.99	3.49	8.75	0.69	10176.3
1201995	120	1995	0.99	3.49	8.75	0.69	10176.3
1201996	120	1996	0.99	3.49	8.75	0.69	10176.3
1201997	120	1997	0.99	3.49	8.75	0.69	10176.3
1201998	120	1998	0.99	3.49	6.9	0.69	10176.3
1201999	120	1999	0.99	3.49	6.9	0.69	10176.3
1202000	120	2000	0.99	3.49	6.9	0.69	10176.3
1202001	120	2001	0.99	3.49	6.9	0.69	10176.3
1202002	120	2002	0.99	3.49	6.9	0.69	10176.3
1202003	120	2003	0.99	3.49	6.9	0.69	10176.3
1202004	120	2004	0.46	3.23	5.64	0.39	10176.3
1202005	120	2005	0.28	3.14	5.22	0.29	10176.3
1202006	120	2006	0.19	3.09	5.01	0.24	10176.3
1202007	120	2007	0.19	3.09	5.01	0.24	10176.3
1202008	120	2008	0.1	3.05	2.89	0.197	10176.3
1202009	120	2009	0.1	3.05	2.89	0.197	10176.3
1202010	120	2010	0.1	3.05	2.89	0.197	10176.3
1202011	120	2011	0.1	3.05	2.89	0.197	10176.3
1202012	120	2012	0.0943	3.05	2.5309	0.0659	10176.3
1202013	120	2013	0.0943	3.05	2.5309	0.01	10176.3
1202014	120	2014	0.0943	3.05	2.5309	0.01	10176.3
1202015	120	2015	0.0715	3.05	1.3966	0.01	10176.3
1202016	120	2016	0.0715	3.05	1.3966	0.01	10176.3
1202017	120	2017	0.0715	3.05	1.3966	0.01	10176.3
1202018	120	2018	0.0715	3.05	1.3966	0.01	10176.3
1202019	120	2019	0.0715	3.05	1.3966	0.01	10176.3
1202020	120	2020	0.0715	3.05	1.3966	0.01	10176.3
1202021	120	2021	0.0715	3.05	1.3966	0.01	10176.3
1202022	120	2022	0.0715	3.05	1.3966	0.01	10176.3
1202023	120	2023	0.0715	3.05	1.3966	0.01	10176.3
1202024	120	2024	0.0715	3.05	1.3966	0.01	10176.3
1202025	120	2025	0.0715	3.05	1.3966	0.01	10176.3
1202026	120	2026	0.0715	3.05	1.3966	0.01	10176.3
1751968	175	1968	1.32	4.4	14	0.77	10176.3
1751969	175	1969	1.32	4.4	14	0.77	10176.3
1751970	175	1970	1.1	4.4	13	0.66	10176.3
1751971	175	1971	1.1	4.4	13	0.66	10176.3
1751972	175	1972	1	4.4	12	0.55	10176.3
1751973	175	1973	1	4.4	12	0.55	10176.3
1751974	175	1974	1	4.4	12	0.55	10176.3
1751975	175	1975	1	4.4	12	0.55	10176.3
1751976	175	1976	1	4.4	12	0.55	10176.3
1751977	175	1977	1	4.4	12	0.55	10176.3
1751978	175	1978	1	4.4	12	0.55	10176.3
1751979	175	1979	1	4.4	12	0.55	10176.3
1751980	175	1980	0.94	4.3	11	0.55	10176.3
1751981	175	1981	0.94	4.3	11	0.55	10176.3
1751982	175	1982	0.94	4.3	11	0.55	10176.3
1751983	175	1983	0.94	4.3	11	0.55	10176.3
1751984	175	1984	0.94	4.3	11	0.55	10176.3
1751985	175	1985	0.88	4.2	11	0.55	10176.3
1751986	175	1986	0.88	4.2	11	0.55	10176.3
1751987	175	1987	0.88	4.2	11	0.55	10176.3
1751988	175	1988	0.68	2.7	8.17	0.38	10176.3
1751989	175	1989	0.68	2.7	8.17	0.38	10176.3
1751990	175	1990	0.68	2.7	8.17	0.38	10176.3
1751991	175	1991	0.68	2.7	8.17	0.38	10176.3
1751992	175	1992	0.68	2.7	8.17	0.38	10176.3
1751993	175	1993	0.68	2.7	8.17	0.38	10176.3
1751994	175	1994	0.68	2.7	8.17	0.38	10176.3
1751995	175	1995	0.68	2.7	8.17	0.38	10176.3
1751996	175	1996	0.68	2.7	8.17	0.38	10176.3
1751997	175	1997	0.68	2.7	6.9	0.38	10176.3
1751998	175	1998	0.68	2.7	6.9	0.38	10176.3
1751999	175	1999	0.68	2.7	6.9	0.38	10176.3

1752000	175	2000	0.68	2.7	6.9	0.38	10176.3
1752001	175	2001	0.68	2.7	6.9	0.38	10176.3
1752002	175	2002	0.68	2.7	6.9	0.38	10176.3
1752003	175	2003	0.33	2.7	5.26	0.24	10176.3
1752004	175	2004	0.22	2.7	4.72	0.19	10176.3
1752005	175	2005	0.16	2.7	4.44	0.16	10176.3
1752006	175	2006	0.16	2.7	4.44	0.16	10176.3
1752007	175	2007	0.1	2.7	2.45	0.14	10176.3
1752008	175	2008	0.1	2.7	2.45	0.14	10176.3
1752009	175	2009	0.1	2.7	2.45	0.14	10176.3
1752010	175	2010	0.1	2.7	2.45	0.14	10176.3
1752011	175	2011	0.1	2.7	2.45	0.14	10176.3
1752012	175	2012	0.09	2.7	2.27	0.01	10176.3
1752013	175	2013	0.09	2.7	2.27	0.01	10176.3
1752014	175	2014	0.09	2.7	2.27	0.01	10176.3
1752015	175	2015	0.05	2.7	0.27	0.01	10176.3
1752016	175	2016	0.05	2.7	0.27	0.01	10176.3
1752017	175	2017	0.05	2.7	0.27	0.01	10176.3
1752018	175	2018	0.05	2.7	0.27	0.01	10176.3
1752019	175	2019	0.05	2.7	0.27	0.01	10176.3
1752020	175	2020	0.05	2.7	0.27	0.01	10176.3
1752021	175	2021	0.05	2.7	0.27	0.01	10176.3
1752022	175	2022	0.05	2.7	0.27	0.01	10176.3
1752023	175	2023	0.05	2.7	0.27	0.01	10176.3
1752024	175	2024	0.05	2.7	0.27	0.01	10176.3
1752025	175	2025	0.05	2.7	0.27	0.01	10176.3
1752026	175	2026	0.05	2.7	0.27	0.01	10176.3
2501968	250	1968	1.32	4.4	14	0.77	10176.3
2501969	250	1969	1.32	4.4	14	0.77	10176.3
2501970	250	1970	1.1	4.4	13	0.66	10176.3
2501971	250	1971	1.1	4.4	13	0.66	10176.3
2501972	250	1972	1	4.4	12	0.55	10176.3
2501973	250	1973	1	4.4	12	0.55	10176.3
2501974	250	1974	1	4.4	12	0.55	10176.3
2501975	250	1975	1	4.4	12	0.55	10176.3
2501976	250	1976	1	4.4	12	0.55	10176.3
2501977	250	1977	1	4.4	12	0.55	10176.3
2501978	250	1978	1	4.4	12	0.55	10176.3
2501979	250	1979	1	4.4	12	0.55	10176.3
2501980	250	1980	0.94	4.3	11	0.55	10176.3
2501981	250	1981	0.94	4.3	11	0.55	10176.3
2501982	250	1982	0.94	4.3	11	0.55	10176.3
2501983	250	1983	0.94	4.3	11	0.55	10176.3
2501984	250	1984	0.94	4.3	11	0.55	10176.3
2501985	250	1985	0.88	4.2	11	0.55	10176.3
2501986	250	1986	0.88	4.2	11	0.55	10176.3
2501987	250	1987	0.88	4.2	11	0.55	10176.3
2501988	250	1988	0.68	2.7	8.17	0.38	10176.3
2501989	250	1989	0.68	2.7	8.17	0.38	10176.3
2501990	250	1990	0.68	2.7	8.17	0.38	10176.3
2501991	250	1991	0.68	2.7	8.17	0.38	10176.3
2501992	250	1992	0.68	2.7	8.17	0.38	10176.3
2501993	250	1993	0.68	2.7	8.17	0.38	10176.3
2501994	250	1994	0.68	2.7	8.17	0.38	10176.3
2501995	250	1995	0.68	2.7	8.17	0.38	10176.3
2501996	250	1996	0.32	0.92	6.25	0.15	10176.3
2501997	250	1997	0.32	0.92	6.25	0.15	10176.3
2501998	250	1998	0.32	0.92	6.25	0.15	10176.3
2501999	250	1999	0.32	0.92	6.25	0.15	10176.3
2502000	250	2000	0.32	0.92	6.25	0.15	10176.3
2502001	250	2001	0.32	0.92	6.25	0.15	10176.3
2502002	250	2002	0.32	0.92	6.25	0.15	10176.3
2502003	250	2003	0.19	0.92	5	0.12	10176.3
2502004	250	2004	0.14	0.92	4.58	0.11	10176.3
2502005	250	2005	0.12	0.92	4.38	0.11	10176.3
2502006	250	2006	0.12	0.92	4.38	0.11	10176.3
2502007	250	2007	0.1	0.92	2.45	0.11	10176.3
2502008	250	2008	0.1	0.92	2.45	0.11	10176.3
2502009	250	2009	0.1	0.92	2.45	0.11	10176.3
2502010	250	2010	0.1	0.92	2.45	0.11	10176.3
2502011	250	2011	0.07	0.92	1.36	0.01	10176.3

2502012	250	2012	0.07	0.92	1.36	0.01	10176.3
2502013	250	2013	0.07	0.92	1.36	0.01	10176.3
2502014	250	2014	0.05	0.92	0.27	0.01	10176.3
2502015	250	2015	0.05	0.92	0.27	0.01	10176.3
2502016	250	2016	0.05	0.92	0.27	0.01	10176.3
2502017	250	2017	0.05	0.92	0.27	0.01	10176.3
2502018	250	2018	0.05	0.92	0.27	0.01	10176.3
2502019	250	2019	0.05	0.92	0.27	0.01	10176.3
2502020	250	2020	0.05	0.92	0.27	0.01	10176.3
2502021	250	2021	0.05	0.92	0.27	0.01	10176.3
2502022	250	2022	0.05	0.92	0.27	0.01	10176.3
2502023	250	2023	0.05	0.92	0.27	0.01	10176.3
2502024	250	2024	0.05	0.92	0.27	0.01	10176.3
2502025	250	2025	0.05	0.92	0.27	0.01	10176.3
2502026	250	2026	0.05	0.92	0.27	0.01	10176.3
5001968	500	1968	1.26	4.2	14	0.74	10176.3
5001969	500	1969	1.26	4.2	14	0.74	10176.3
5001970	500	1970	1.05	4.2	13	0.63	10176.3
5001971	500	1971	1.05	4.2	13	0.63	10176.3
5001972	500	1972	0.95	4.2	12	0.53	10176.3
5001973	500	1973	0.95	4.2	12	0.53	10176.3
5001974	500	1974	0.95	4.2	12	0.53	10176.3
5001975	500	1975	0.95	4.2	12	0.53	10176.3
5001976	500	1976	0.95	4.2	12	0.53	10176.3
5001977	500	1977	0.95	4.2	12	0.53	10176.3
5001978	500	1978	0.95	4.2	12	0.53	10176.3
5001979	500	1979	0.95	4.2	12	0.53	10176.3
5001980	500	1980	0.9	4.2	11	0.53	10176.3
5001981	500	1981	0.9	4.2	11	0.53	10176.3
5001982	500	1982	0.9	4.2	11	0.53	10176.3
5001983	500	1983	0.9	4.2	11	0.53	10176.3
5001984	500	1984	0.9	4.2	11	0.53	10176.3
5001985	500	1985	0.84	4.1	11	0.53	10176.3
5001986	500	1986	0.84	4.1	11	0.53	10176.3
5001987	500	1987	0.84	4.1	11	0.53	10176.3
5001988	500	1988	0.68	2.7	8.17	0.38	10176.3
5001989	500	1989	0.68	2.7	8.17	0.38	10176.3
5001990	500	1990	0.68	2.7	8.17	0.38	10176.3
5001991	500	1991	0.68	2.7	8.17	0.38	10176.3
5001992	500	1992	0.68	2.7	8.17	0.38	10176.3
5001993	500	1993	0.68	2.7	8.17	0.38	10176.3
5001994	500	1994	0.68	2.7	8.17	0.38	10176.3
5001995	500	1995	0.68	2.7	8.17	0.38	10176.3
5001996	500	1996	0.32	0.92	6.25	0.15	10176.3
5001997	500	1997	0.32	0.92	6.25	0.15	10176.3
5001998	500	1998	0.32	0.92	6.25	0.15	10176.3
5001999	500	1999	0.32	0.92	6.25	0.15	10176.3
5002000	500	2000	0.32	0.92	6.25	0.15	10176.3
5002001	500	2001	0.19	0.92	4.95	0.12	10176.3
5002002	500	2002	0.14	0.92	4.51	0.11	10176.3
5002003	500	2003	0.12	0.92	4.29	0.11	10176.3
5002004	500	2004	0.12	0.92	4.29	0.11	10176.3
5002005	500	2005	0.1	0.92	4	0.11	10176.3
5002006	500	2006	0.1	0.92	2.45	0.11	10176.3
5002007	500	2007	0.1	0.92	2.45	0.11	10176.3
5002008	500	2008	0.1	0.92	2.45	0.11	10176.3
5002009	500	2009	0.1	0.92	2.45	0.11	10176.3
5002010	500	2010	0.1	0.92	2.45	0.11	10176.3
5002011	500	2011	0.07	0.92	1.36	0.01	10176.3
5002012	500	2012	0.07	0.92	1.36	0.01	10176.3
5002013	500	2013	0.07	0.92	1.36	0.01	10176.3
5002014	500	2014	0.05	0.92	0.27	0.01	10176.3
5002015	500	2015	0.05	0.92	0.27	0.01	10176.3
5002016	500	2016	0.05	0.92	0.27	0.01	10176.3
5002017	500	2017	0.05	0.92	0.27	0.01	10176.3
5002018	500	2018	0.05	0.92	0.27	0.01	10176.3
5002019	500	2019	0.05	0.92	0.27	0.01	10176.3
5002020	500	2020	0.05	0.92	0.27	0.01	10176.3
5002021	500	2021	0.05	0.92	0.27	0.01	10176.3
5002022	500	2022	0.05	0.92	0.27	0.01	10176.3
5002023	500	2023	0.05	0.92	0.27	0.01	10176.3

5002024	500	2024	0.05	0.92	0.27	0.01	10176.3
5002025	500	2025	0.05	0.92	0.27	0.01	10176.3
5002026	500	2026	0.05	0.92	0.27	0.01	10176.3
7501968	750	1968	1.26	4.2	14	0.74	10176.3
7501969	750	1969	1.26	4.2	14	0.74	10176.3
7501970	750	1970	1.05	4.2	13	0.63	10176.3
7501971	750	1971	1.05	4.2	13	0.63	10176.3
7501972	750	1972	0.95	4.2	12	0.53	10176.3
7501973	750	1973	0.95	4.2	12	0.53	10176.3
7501974	750	1974	0.95	4.2	12	0.53	10176.3
7501975	750	1975	0.95	4.2	12	0.53	10176.3
7501976	750	1976	0.95	4.2	12	0.53	10176.3
7501977	750	1977	0.95	4.2	12	0.53	10176.3
7501978	750	1978	0.95	4.2	12	0.53	10176.3
7501979	750	1979	0.95	4.2	12	0.53	10176.3
7501980	750	1980	0.9	4.2	11	0.53	10176.3
7501981	750	1981	0.9	4.2	11	0.53	10176.3
7501982	750	1982	0.9	4.2	11	0.53	10176.3
7501983	750	1983	0.9	4.2	11	0.53	10176.3
7501984	750	1984	0.9	4.2	11	0.53	10176.3
7501985	750	1985	0.84	4.1	11	0.53	10176.3
7501986	750	1986	0.84	4.1	11	0.53	10176.3
7501987	750	1987	0.84	4.1	11	0.53	10176.3
7501988	750	1988	0.68	2.7	8.17	0.38	10176.3
7501989	750	1989	0.68	2.7	8.17	0.38	10176.3
7501990	750	1990	0.68	2.7	8.17	0.38	10176.3
7501991	750	1991	0.68	2.7	8.17	0.38	10176.3
7501992	750	1992	0.68	2.7	8.17	0.38	10176.3
7501993	750	1993	0.68	2.7	8.17	0.38	10176.3
7501994	750	1994	0.68	2.7	8.17	0.38	10176.3
7501995	750	1995	0.68	2.7	8.17	0.38	10176.3
7501996	750	1996	0.32	0.92	6.25	0.15	10176.3
7501997	750	1997	0.32	0.92	6.25	0.15	10176.3
7501998	750	1998	0.32	0.92	6.25	0.15	10176.3
7501999	750	1999	0.32	0.92	6.25	0.15	10176.3
7502000	750	2000	0.32	0.92	6.25	0.15	10176.3
7502001	750	2001	0.32	0.92	6.25	0.15	10176.3
7502002	750	2002	0.19	0.92	4.95	0.12	10176.3
7502003	750	2003	0.14	0.92	4.51	0.11	10176.3
7502004	750	2004	0.12	0.92	4.29	0.11	10176.3
7502005	750	2005	0.12	0.92	4.29	0.11	10176.3
7502006	750	2006	0.1	0.92	2.45	0.11	10176.3
7502007	750	2007	0.1	0.92	2.45	0.11	10176.3
7502008	750	2008	0.1	0.92	2.45	0.11	10176.3
7502009	750	2009	0.1	0.92	2.45	0.11	10176.3
7502010	750	2010	0.1	0.92	2.45	0.11	10176.3
7502011	750	2011	0.07	0.92	1.36	0.01	10176.3
7502012	750	2012	0.07	0.92	1.36	0.01	10176.3
7502013	750	2013	0.07	0.92	1.36	0.01	10176.3
7502014	750	2014	0.05	0.92	0.27	0.01	10176.3
7502015	750	2015	0.05	0.92	0.27	0.01	10176.3
7502016	750	2016	0.05	0.92	0.27	0.01	10176.3
7502017	750	2017	0.05	0.92	0.27	0.01	10176.3
7502018	750	2018	0.05	0.92	0.27	0.01	10176.3
7502019	750	2019	0.05	0.92	0.27	0.01	10176.3
7502020	750	2020	0.05	0.92	0.27	0.01	10176.3
7502021	750	2021	0.05	0.92	0.27	0.01	10176.3
7502022	750	2022	0.05	0.92	0.27	0.01	10176.3
7502023	750	2023	0.05	0.92	0.27	0.01	10176.3
7502024	750	2024	0.05	0.92	0.27	0.01	10176.3
7502025	750	2025	0.05	0.92	0.27	0.01	10176.3
7502026	750	2026	0.05	0.92	0.27	0.01	10176.3
9991968	999	1968	1.26	4.2	14	0.74	10176.3
9991969	999	1969	1.26	4.2	14	0.74	10176.3
9991970	999	1970	1.05	4.2	13	0.63	10176.3
9991971	999	1971	1.05	4.2	13	0.63	10176.3
9991972	999	1972	0.95	4.2	12	0.53	10176.3
9991973	999	1973	0.95	4.2	12	0.53	10176.3
9991974	999	1974	0.95	4.2	12	0.53	10176.3
9991975	999	1975	0.95	4.2	12	0.53	10176.3
9991976	999	1976	0.95	4.2	12	0.53	10176.3

9991977	999	1977	0.95	4.2	12	0.53	10176.3
9991978	999	1978	0.95	4.2	12	0.53	10176.3
9991979	999	1979	0.95	4.2	12	0.53	10176.3
9991980	999	1980	0.9	4.2	11	0.53	10176.3
9991981	999	1981	0.9	4.2	11	0.53	10176.3
9991982	999	1982	0.9	4.2	11	0.53	10176.3
9991983	999	1983	0.9	4.2	11	0.53	10176.3
9991984	999	1984	0.9	4.2	11	0.53	10176.3
9991985	999	1985	0.84	4.1	11	0.53	10176.3
9991986	999	1986	0.84	4.1	11	0.53	10176.3
9991987	999	1987	0.84	4.1	11	0.53	10176.3
9991988	999	1988	0.68	2.7	8.17	0.38	10176.3
9991989	999	1989	0.68	2.7	8.17	0.38	10176.3
9991990	999	1990	0.68	2.7	8.17	0.38	10176.3
9991991	999	1991	0.68	2.7	8.17	0.38	10176.3
9991992	999	1992	0.68	2.7	8.17	0.38	10176.3
9991993	999	1993	0.68	2.7	8.17	0.38	10176.3
9991994	999	1994	0.68	2.7	8.17	0.38	10176.3
9991995	999	1995	0.68	2.7	8.17	0.38	10176.3
9991996	999	1996	0.68	2.7	8.17	0.38	10176.3
9991997	999	1997	0.68	2.7	8.17	0.38	10176.3
9991998	999	1998	0.68	2.7	8.17	0.38	10176.3
9991999	999	1999	0.68	2.7	8.17	0.38	10176.3
9992000	999	2000	0.32	0.92	6.25	0.15	10176.3
9992001	999	2001	0.32	0.92	6.25	0.15	10176.3
9992002	999	2002	0.32	0.92	6.25	0.15	10176.3
9992003	999	2003	0.32	0.92	6.25	0.15	10176.3
9992004	999	2004	0.32	0.92	6.25	0.15	10176.3
9992005	999	2005	0.32	0.92	6.25	0.15	10176.3
9992006	999	2006	0.19	0.92	4.95	0.12	10176.3
9992007	999	2007	0.14	0.92	4.51	0.11	10176.3
9992008	999	2008	0.12	0.92	4.29	0.11	10176.3
9992009	999	2009	0.12	0.92	4.29	0.11	10176.3
9992010	999	2010	0.1	0.92	4.08	0.11	10176.3
9992011	999	2011	0.1	0.92	2.36	0.06	10176.3
9992012	999	2012	0.1	0.92	2.36	0.06	10176.3
9992013	999	2013	0.1	0.92	2.36	0.06	10176.3
9992014	999	2014	0.1	0.92	2.36	0.06	10176.3
9992015	999	2015	0.05	0.92	2.36	0.02	10176.3
9992016	999	2016	0.05	0.92	2.36	0.02	10176.3
9992017	999	2017	0.05	0.92	2.36	0.02	10176.3
9992018	999	2018	0.05	0.92	2.36	0.02	10176.3
9992019	999	2019	0.05	0.92	2.36	0.02	10176.3
9992020	999	2020	0.05	0.92	2.36	0.02	10176.3
9992021	999	2021	0.05	0.92	2.36	0.02	10176.3
9992022	999	2022	0.05	0.92	2.36	0.02	10176.3
9992023	999	2023	0.05	0.92	2.36	0.02	10176.3
9992024	999	2024	0.05	0.92	2.36	0.02	10176.3
9992025	999	2025	0.05	0.92	2.36	0.02	10176.3
9992026	999	2026	0.05	0.92	2.36	0.02	10176.3

***New Tier4 emfacs included with 43/57% split for 120 hp merged (diesel only)**

units = g/bhp hr

Lookup	Hp	Year	HC	CO	NOX	PM	CO2
251968	25	1968	1.3	15.5	6	0.6	10176.3
251969	25	1969	1.3	15.5	6	0.6	10176.3
251970	25	1970	1.3	15.5	6	0.6	10176.3
251971	25	1971	1.3	15.5	6	0.6	10176.3
251972	25	1972	1.3	15.5	6	0.6	10176.3
251973	25	1973	1.3	15.5	6	0.6	10176.3
251974	25	1974	1.3	15.5	6	0.6	10176.3
251975	25	1975	1.3	15.5	6	0.6	10176.3
251976	25	1976	1.3	15.5	6	0.6	10176.3
251977	25	1977	1.3	15.5	6	0.6	10176.3
251978	25	1978	1.3	15.5	6	0.6	10176.3
251979	25	1979	1.3	15.5	6	0.6	10176.3
251980	25	1980	1.3	15.5	6	0.6	10176.3
251981	25	1981	1.3	15.5	6	0.6	10176.3
251982	25	1982	1.3	15.5	6	0.6	10176.3
251983	25	1983	1.3	15.5	6	0.6	10176.3
251984	25	1984	1.3	15.5	6	0.6	10176.3
251985	25	1985	1.3	15.5	6	0.6	10176.3
251986	25	1986	1.3	15.5	6	0.6	10176.3
251987	25	1987	1.3	15.5	6	0.6	10176.3
251988	25	1988	1.3	15.5	6	0.6	10176.3
251989	25	1989	1.3	15.5	6	0.6	10176.3
251990	25	1990	1.3	15.5	6	0.6	10176.3
251991	25	1991	1.3	15.5	5	0.25	10176.3
251992	25	1992	1.3	15.5	5	0.25	10176.3
251993	25	1993	1.3	15.5	5	0.25	10176.3
251994	25	1994	1.3	15.5	5	0.1	10176.3
251995	25	1995	1.3	15.5	5	0.1	10176.3
251996	25	1996	1.3	15.5	5	0.1	10176.3
251997	25	1997	1.3	15.5	5	0.1	10176.3
251998	25	1998	1.3	15.5	5	0.1	10176.3
251999	25	1999	1.3	15.5	5	0.1	10176.3
252000	25	2000	1.3	15.5	5	0.1	10176.3
252001	25	2001	1.3	15.5	5	0.1	10176.3
252002	25	2002	1.3	15.5	5	0.1	10176.3
252003	25	2003	1.3	15.5	5	0.1	10176.3
252004	25	2004	0.5	15.5	2	0.1	10176.3
252005	25	2005	0.5	15.5	2	0.1	10176.3
252006	25	2006	0.5	15.5	2	0.1	10176.3
252007	25	2007	0.14	15.5	2	0.01	10176.3
252008	25	2008	0.14	15.5	2	0.01	10176.3
252009	25	2009	0.14	15.5	2	0.01	10176.3
252010	25	2010	0.14	15.5	2	0.01	10176.3
252011	25	2011	0.14	15.5	2	0.01	10176.3
252012	25	2012	0.14	15.5	2	0.01	10176.3
252013	25	2013	0.14	15.5	2	0.01	10176.3
252014	25	2014	0.14	15.5	2	0.01	10176.3
252015	25	2015	0.14	15.5	2	0.01	10176.3
252016	25	2016	0.14	15.5	2	0.01	10176.3
252017	25	2017	0.14	15.5	2	0.01	10176.3
252018	25	2018	0.14	15.5	2	0.01	10176.3
252019	25	2019	0.14	15.5	2	0.01	10176.3
252020	25	2020	0.14	15.5	2	0.01	10176.3
252021	25	2021	0.14	15.5	2	0.01	10176.3
252022	25	2022	0.14	15.5	2	0.01	10176.3
252023	25	2023	0.14	15.5	2	0.01	10176.3
252024	25	2024	0.14	15.5	2	0.01	10176.3
252025	25	2025	0.14	15.5	2	0.01	10176.3
252026	25	2026	0.14	15.5	2	0.01	10176.3
501969	50	1969	1.3	15.5	6	0.6	10176.3
501969	50	1969	1.3	15.5	6	0.6	10176.3
501970	50	1970	1.3	15.5	6	0.6	10176.3
501971	50	1971	1.3	15.5	6	0.6	10176.3
501972	50	1972	1.3	15.5	6	0.6	10176.3
501973	50	1973	1.3	15.5	6	0.6	10176.3
501974	50	1974	1.3	15.5	6	0.6	10176.3
501975	50	1975	1.3	15.5	6	0.6	10176.3
501976	50	1976	1.3	15.5	6	0.6	10176.3
501977	50	1977	1.3	15.5	6	0.6	10176.3
501978	50	1978	1.3	15.5	6	0.6	10176.3
501979	50	1979	1.3	15.5	6	0.6	10176.3
501980	50	1980	1.3	15.5	6	0.6	10176.3
501981	50	1981	1.3	15.5	6	0.6	10176.3
501982	50	1982	1.3	15.5	6	0.6	10176.3
501983	50	1983	1.3	15.5	6	0.6	10176.3
501984	50	1984	1.3	15.5	6	0.6	10176.3
501985	50	1985	1.3	15.5	6	0.6	10176.3

501986	50	1986	1.3	15.5	6	0.6	10176.3
501987	50	1987	1.3	15.5	6	0.6	10176.3
501988	50	1988	1.3	15.5	6	0.6	10176.3
501989	50	1989	1.3	15.5	6	0.6	10176.3
501990	50	1990	1.3	15.5	6	0.6	10176.3
501991	50	1991	1.3	15.5	5	0.25	10176.3
501992	50	1992	1.3	15.5	5	0.25	10176.3
501993	50	1993	1.3	15.5	5	0.25	10176.3
501994	50	1994	1.3	15.5	5	0.1	10176.3
501995	50	1995	1.3	15.5	5	0.1	10176.3
501996	50	1996	1.3	15.5	5	0.1	10176.3
501997	50	1997	1.3	15.5	5	0.1	10176.3
501998	50	1998	1.3	15.5	5	0.1	10176.3
501999	50	1999	1.3	15.5	5	0.1	10176.3
502000	50	2000	1.3	15.5	5	0.1	10176.3
502001	50	2001	1.3	15.5	5	0.1	10176.3
502002	50	2002	1.3	15.5	5	0.1	10176.3
502003	50	2003	1.3	15.5	5	0.1	10176.3
502004	50	2004	0.5	15.5	2	0.1	10176.3
502005	50	2005	0.5	15.5	2	0.1	10176.3
502006	50	2006	0.5	15.5	2	0.1	10176.3
502007	50	2007	0.14	15.5	1.1	0.01	10176.3
502008	50	2008	0.14	15.5	1.1	0.01	10176.3
502009	50	2009	0.14	15.5	1.1	0.01	10176.3
502010	50	2010	0.14	15.5	0.2	0.01	10176.3
502011	50	2011	0.14	15.5	0.2	0.01	10176.3
502012	50	2012	0.14	15.5	0.2	0.01	10176.3
502013	50	2013	0.14	15.5	0.2	0.01	10176.3
502014	50	2014	0.14	15.5	0.2	0.01	10176.3
502015	50	2015	0.14	15.5	0.2	0.01	10176.3
502016	50	2016	0.14	15.5	0.2	0.01	10176.3
502017	50	2017	0.14	15.5	0.2	0.01	10176.3
502018	50	2018	0.14	15.5	0.2	0.01	10176.3
502019	50	2019	0.14	15.5	0.2	0.01	10176.3
502020	50	2020	0.14	15.5	0.2	0.01	10176.3
502021	50	2021	0.14	15.5	0.2	0.01	10176.3
502022	50	2022	0.14	15.5	0.2	0.01	10176.3
502023	50	2023	0.14	15.5	0.2	0.01	10176.3
502024	50	2024	0.14	15.5	0.2	0.01	10176.3
502025	50	2025	0.14	15.5	0.2	0.01	10176.3
502026	50	2026	0.14	15.5	0.2	0.01	10176.3
1201968	120	1968	1.3	15.5	6	0.6	10176.3
1201969	120	1969	1.3	15.5	6	0.6	10176.3
1201970	120	1970	1.3	15.5	6	0.6	10176.3
1201971	120	1971	1.3	15.5	6	0.6	10176.3
1201972	120	1972	1.3	15.5	6	0.6	10176.3
1201973	120	1973	1.3	15.5	6	0.6	10176.3
1201974	120	1974	1.3	15.5	6	0.6	10176.3
1201975	120	1975	1.3	15.5	6	0.6	10176.3
1201976	120	1976	1.3	15.5	6	0.6	10176.3
1201977	120	1977	1.3	15.5	6	0.6	10176.3
1201978	120	1978	1.3	15.5	6	0.6	10176.3
1201979	120	1979	1.3	15.5	6	0.6	10176.3
1201980	120	1980	1.3	15.5	6	0.6	10176.3
1201981	120	1981	1.3	15.5	6	0.6	10176.3
1201982	120	1982	1.3	15.5	6	0.6	10176.3
1201983	120	1983	1.3	15.5	6	0.6	10176.3
1201984	120	1984	1.3	15.5	6	0.6	10176.3
1201985	120	1985	1.3	15.5	6	0.6	10176.3
1201986	120	1986	1.3	15.5	6	0.6	10176.3
1201987	120	1987	1.3	15.5	6	0.6	10176.3
1201988	120	1988	1.3	15.5	6	0.6	10176.3
1201989	120	1989	1.3	15.5	6	0.6	10176.3
1201990	120	1990	1.3	15.5	6	0.6	10176.3
1201991	120	1991	1.3	15.5	5	0.25	10176.3
1201992	120	1992	1.3	15.5	5	0.25	10176.3
1201993	120	1993	1.3	15.5	5	0.25	10176.3
1201994	120	1994	1.3	15.5	5	0.1	10176.3
1201995	120	1995	1.3	15.5	5	0.1	10176.3
1201996	120	1996	1.3	15.5	5	0.1	10176.3
1201997	120	1997	1.3	15.5	5	0.1	10176.3
1201998	120	1998	1.3	15.5	5	0.1	10176.3
1201999	120	1999	1.3	15.5	5	0.1	10176.3
1202000	120	2000	1.3	15.5	5	0.1	10176.3
1202001	120	2001	1.3	15.5	5	0.1	10176.3
1202002	120	2002	1.3	15.5	5	0.1	10176.3
1202003	120	2003	1.3	15.5	5	0.1	10176.3
1202004	120	2004	0.5	15.5	2	0.1	10176.3
1202005	120	2005	0.5	15.5	2	0.1	10176.3
1202006	120	2006	0.5	15.5	2	0.1	10176.3
1202007	120	2007	0.14	15.5	1.1	0.01	10176.3

1202008	120	2008	0.14	15.5	1.1	0.01	10176.3
1202009	120	2009	0.14	15.5	1.1	0.01	10176.3
1202010	120	2010	0.14	15.5	0.2	0.01	10176.3
1202011	120	2011	0.14	15.5	0.2	0.01	10176.3
1202012	120	2012	0.14	15.5	0.2	0.01	10176.3
1202013	120	2013	0.14	15.5	0.2	0.01	10176.3
1202014	120	2014	0.14	15.5	0.2	0.01	10176.3
1202015	120	2015	0.14	15.5	0.2	0.01	10176.3
1202016	120	2016	0.14	15.5	0.2	0.01	10176.3
1202017	120	2017	0.14	15.5	0.2	0.01	10176.3
1202018	120	2018	0.14	15.5	0.2	0.01	10176.3
1202019	120	2019	0.14	15.5	0.2	0.01	10176.3
1202020	120	2020	0.14	15.5	0.2	0.01	10176.3
1202021	120	2021	0.14	15.5	0.2	0.01	10176.3
1202022	120	2022	0.14	15.5	0.2	0.01	10176.3
1202023	120	2023	0.14	15.5	0.2	0.01	10176.3
1202024	120	2024	0.14	15.5	0.2	0.01	10176.3
1202025	120	2025	0.14	15.5	0.2	0.01	10176.3
1202026	120	2026	0.14	15.5	0.2	0.01	10176.3
1751968	175	1968	1.3	15.5	6	0.6	10176.3
1751969	175	1969	1.3	15.5	6	0.6	10176.3
1751970	175	1970	1.3	15.5	6	0.6	10176.3
1751971	175	1971	1.3	15.5	6	0.6	10176.3
1751972	175	1972	1.3	15.5	6	0.6	10176.3
1751973	175	1973	1.3	15.5	6	0.6	10176.3
1751974	175	1974	1.3	15.5	6	0.6	10176.3
1751975	175	1975	1.3	15.5	6	0.6	10176.3
1751976	175	1976	1.3	15.5	6	0.6	10176.3
1751977	175	1977	1.3	15.5	6	0.6	10176.3
1751978	175	1978	1.3	15.5	6	0.6	10176.3
1751979	175	1979	1.3	15.5	6	0.6	10176.3
1751980	175	1980	1.3	15.5	6	0.6	10176.3
1751981	175	1981	1.3	15.5	6	0.6	10176.3
1751982	175	1982	1.3	15.5	6	0.6	10176.3
1751983	175	1983	1.3	15.5	6	0.6	10176.3
1751984	175	1984	1.3	15.5	6	0.6	10176.3
1751985	175	1985	1.3	15.5	6	0.6	10176.3
1751986	175	1986	1.3	15.5	6	0.6	10176.3
1751987	175	1987	1.3	15.5	6	0.6	10176.3
1751988	175	1988	1.3	15.5	6	0.6	10176.3
1751989	175	1989	1.3	15.5	6	0.6	10176.3
1751990	175	1990	1.3	15.5	6	0.6	10176.3
1751991	175	1991	1.3	15.5	5	0.25	10176.3
1751992	175	1992	1.3	15.5	5	0.25	10176.3
1751993	175	1993	1.3	15.5	5	0.25	10176.3
1751994	175	1994	1.3	15.5	5	0.1	10176.3
1751995	175	1995	1.3	15.5	5	0.1	10176.3
1751996	175	1996	1.3	15.5	5	0.1	10176.3
1751997	175	1997	1.3	15.5	5	0.1	10176.3
1751998	175	1998	1.3	15.5	5	0.1	10176.3
1751999	175	1999	1.3	15.5	5	0.1	10176.3
1752000	175	2000	1.3	15.5	5	0.1	10176.3
1752001	175	2001	1.3	15.5	5	0.1	10176.3
1752002	175	2002	1.3	15.5	5	0.1	10176.3
1752003	175	2003	1.3	15.5	5	0.1	10176.3
1752004	175	2004	0.5	15.5	2	0.1	10176.3
1752005	175	2005	0.5	15.5	2	0.1	10176.3
1752006	175	2006	0.5	15.5	2	0.1	10176.3
1752007	175	2007	0.14	15.5	1.1	0.01	10176.3
1752008	175	2008	0.14	15.5	1.1	0.01	10176.3
1752009	175	2009	0.14	15.5	1.1	0.01	10176.3
1752010	175	2010	0.14	15.5	0.2	0.01	10176.3
1752011	175	2011	0.14	15.5	0.2	0.01	10176.3
1752012	175	2012	0.14	15.5	0.2	0.01	10176.3
1752013	175	2013	0.14	15.5	0.2	0.01	10176.3
1752014	175	2014	0.14	15.5	0.2	0.01	10176.3
1752015	175	2015	0.14	15.5	0.2	0.01	10176.3
1752016	175	2016	0.14	15.5	0.2	0.01	10176.3
1752017	175	2017	0.14	15.5	0.2	0.01	10176.3
1752018	175	2018	0.14	15.5	0.2	0.01	10176.3
1752019	175	2019	0.14	15.5	0.2	0.01	10176.3
1752020	175	2020	0.14	15.5	0.2	0.01	10176.3
1752021	175	2021	0.14	15.5	0.2	0.01	10176.3
1752022	175	2022	0.14	15.5	0.2	0.01	10176.3
1752023	175	2023	0.14	15.5	0.2	0.01	10176.3
1752024	175	2024	0.14	15.5	0.2	0.01	10176.3
1752025	175	2025	0.14	15.5	0.2	0.01	10176.3
1752026	175	2026	0.14	15.5	0.2	0.01	10176.3
2501968	250	1968	1.3	15.5	6	0.6	10176.3
2501969	250	1969	1.3	15.5	6	0.6	10176.3
2501970	250	1970	1.3	15.5	6	0.6	10176.3

2501971	250	1971	1.3	15.5	6	0.6	10176.3
2501972	250	1972	1.3	15.5	6	0.6	10176.3
2501973	250	1973	1.3	15.5	6	0.6	10176.3
2501974	250	1974	1.3	15.5	6	0.6	10176.3
2501975	250	1975	1.3	15.5	6	0.6	10176.3
2501976	250	1976	1.3	15.5	6	0.6	10176.3
2501977	250	1977	1.3	15.5	6	0.6	10176.3
2501978	250	1978	1.3	15.5	6	0.6	10176.3
2501979	250	1979	1.3	15.5	6	0.6	10176.3
2501980	250	1980	1.3	15.5	6	0.6	10176.3
2501981	250	1981	1.3	15.5	6	0.6	10176.3
2501982	250	1982	1.3	15.5	6	0.6	10176.3
2501983	250	1983	1.3	15.5	6	0.6	10176.3
2501984	250	1984	1.3	15.5	6	0.6	10176.3
2501985	250	1985	1.3	15.5	6	0.6	10176.3
2501986	250	1986	1.3	15.5	6	0.6	10176.3
2501987	250	1987	1.3	15.5	6	0.6	10176.3
2501988	250	1988	1.3	15.5	6	0.6	10176.3
2501989	250	1989	1.3	15.5	6	0.6	10176.3
2501990	250	1990	1.3	15.5	6	0.6	10176.3
2501991	250	1991	1.3	15.5	5	0.25	10176.3
2501992	250	1992	1.3	15.5	5	0.25	10176.3
2501993	250	1993	1.3	15.5	5	0.25	10176.3
2501994	250	1994	1.3	15.5	5	0.1	10176.3
2501995	250	1995	1.3	15.5	5	0.1	10176.3
2501996	250	1996	1.3	15.5	5	0.1	10176.3
2501997	250	1997	1.3	15.5	5	0.1	10176.3
2501998	250	1998	1.3	15.5	5	0.1	10176.3
2501999	250	1999	1.3	15.5	5	0.1	10176.3
2502000	250	2000	1.3	15.5	5	0.1	10176.3
2502001	250	2001	1.3	15.5	5	0.1	10176.3
2502002	250	2002	1.3	15.5	5	0.1	10176.3
2502003	250	2003	1.3	15.5	5	0.1	10176.3
2502004	250	2004	0.5	15.5	2	0.1	10176.3
2502005	250	2005	0.5	15.5	2	0.1	10176.3
2502006	250	2006	0.5	15.5	2	0.1	10176.3
2502007	250	2007	0.14	15.5	1.1	0.01	10176.3
2502008	250	2008	0.14	15.5	1.1	0.01	10176.3
2502009	250	2009	0.14	15.5	1.1	0.01	10176.3
2502010	250	2010	0.14	15.5	0.2	0.01	10176.3
2502011	250	2011	0.14	15.5	0.2	0.01	10176.3
2502012	250	2012	0.14	15.5	0.2	0.01	10176.3
2502013	250	2013	0.14	15.5	0.2	0.01	10176.3
2502014	250	2014	0.14	15.5	0.2	0.01	10176.3
2502015	250	2015	0.14	15.5	0.2	0.01	10176.3
2502016	250	2016	0.14	15.5	0.2	0.01	10176.3
2502017	250	2017	0.14	15.5	0.2	0.01	10176.3
2502018	250	2018	0.14	15.5	0.2	0.01	10176.3
2502019	250	2019	0.14	15.5	0.2	0.01	10176.3
2502020	250	2020	0.14	15.5	0.2	0.01	10176.3
2502021	250	2021	0.14	15.5	0.2	0.01	10176.3
2502022	250	2022	0.14	15.5	0.2	0.01	10176.3
2502023	250	2023	0.14	15.5	0.2	0.01	10176.3
2502024	250	2024	0.14	15.5	0.2	0.01	10176.3
2502025	250	2025	0.14	15.5	0.2	0.01	10176.3
2502026	250	2026	0.14	15.5	0.2	0.01	10176.3
5001968	500	1968	1.3	15.5	6	0.6	10176.3
5001969	500	1969	1.3	15.5	6	0.6	10176.3
5001970	500	1970	1.3	15.5	6	0.6	10176.3
5001971	500	1971	1.3	15.5	6	0.6	10176.3
5001972	500	1972	1.3	15.5	6	0.6	10176.3
5001973	500	1973	1.3	15.5	6	0.6	10176.3
5001974	500	1974	1.3	15.5	6	0.6	10176.3
5001975	500	1975	1.3	15.5	6	0.6	10176.3
5001976	500	1976	1.3	15.5	6	0.6	10176.3
5001977	500	1977	1.3	15.5	6	0.6	10176.3
5001978	500	1978	1.3	15.5	6	0.6	10176.3
5001979	500	1979	1.3	15.5	6	0.6	10176.3
5001980	500	1980	1.3	15.5	6	0.6	10176.3
5001981	500	1981	1.3	15.5	6	0.6	10176.3
5001982	500	1982	1.3	15.5	6	0.6	10176.3
5001983	500	1983	1.3	15.5	6	0.6	10176.3
5001984	500	1984	1.3	15.5	6	0.6	10176.3
5001985	500	1985	1.3	15.5	6	0.6	10176.3
5001986	500	1986	1.3	15.5	6	0.6	10176.3
5001987	500	1987	1.3	15.5	6	0.6	10176.3
5001988	500	1988	1.3	15.5	6	0.6	10176.3
5001989	500	1989	1.3	15.5	6	0.6	10176.3
5001990	500	1990	1.3	15.5	6	0.6	10176.3
5001991	500	1991	1.3	15.5	5	0.25	10176.3
5001992	500	1992	1.3	15.5	5	0.25	10176.3

5001993	500	1993	1.3	15.5	5	0.25	10176.3
5001994	500	1994	1.3	15.5	5	0.1	10176.3
5001995	500	1995	1.3	15.5	5	0.1	10176.3
5001996	500	1996	1.3	15.5	5	0.1	10176.3
5001997	500	1997	1.3	15.5	5	0.1	10176.3
5001998	500	1998	1.3	15.5	5	0.1	10176.3
5001999	500	1999	1.3	15.5	5	0.1	10176.3
5002000	500	2000	1.3	15.5	5	0.1	10176.3
5002001	500	2001	1.3	15.5	5	0.1	10176.3
5002002	500	2002	1.3	15.5	5	0.1	10176.3
5002003	500	2003	1.3	15.5	5	0.1	10176.3
5002004	500	2004	0.5	15.5	2	0.1	10176.3
5002005	500	2005	0.5	15.5	2	0.1	10176.3
5002006	500	2006	0.5	15.5	2	0.1	10176.3
5002007	500	2007	0.14	15.5	1.1	0.01	10176.3
5002008	500	2008	0.14	15.5	1.1	0.01	10176.3
5002009	500	2009	0.14	15.5	1.1	0.01	10176.3
5002010	500	2010	0.14	15.5	0.2	0.01	10176.3
5002011	500	2011	0.14	15.5	0.2	0.01	10176.3
5002012	500	2012	0.14	15.5	0.2	0.01	10176.3
5002013	500	2013	0.14	15.5	0.2	0.01	10176.3
5002014	500	2014	0.14	15.5	0.2	0.01	10176.3
5002015	500	2015	0.14	15.5	0.2	0.01	10176.3
5002016	500	2016	0.14	15.5	0.2	0.01	10176.3
5002017	500	2017	0.14	15.5	0.2	0.01	10176.3
5002018	500	2018	0.14	15.5	0.2	0.01	10176.3
5002019	500	2019	0.14	15.5	0.2	0.01	10176.3
5002020	500	2020	0.14	15.5	0.2	0.01	10176.3
5002021	500	2021	0.14	15.5	0.2	0.01	10176.3
5002022	500	2022	0.14	15.5	0.2	0.01	10176.3
5002023	500	2023	0.14	15.5	0.2	0.01	10176.3
5002024	500	2024	0.14	15.5	0.2	0.01	10176.3
5002025	500	2025	0.14	15.5	0.2	0.01	10176.3
5002026	500	2026	0.14	15.5	0.2	0.01	10176.3
7501968	750	1968	1.3	15.5	6	0.6	10176.3
7501969	750	1969	1.3	15.5	6	0.6	10176.3
7501970	750	1970	1.3	15.5	6	0.6	10176.3
7501971	750	1971	1.3	15.5	6	0.6	10176.3
7501972	750	1972	1.3	15.5	6	0.6	10176.3
7501973	750	1973	1.3	15.5	6	0.6	10176.3
7501974	750	1974	1.3	15.5	6	0.6	10176.3
7501975	750	1975	1.3	15.5	6	0.6	10176.3
7501976	750	1976	1.3	15.5	6	0.6	10176.3
7501977	750	1977	1.3	15.5	6	0.6	10176.3
7501978	750	1978	1.3	15.5	6	0.6	10176.3
7501979	750	1979	1.3	15.5	6	0.6	10176.3
7501980	750	1980	1.3	15.5	6	0.6	10176.3
7501981	750	1981	1.3	15.5	6	0.6	10176.3
7501982	750	1982	1.3	15.5	6	0.6	10176.3
7501983	750	1983	1.3	15.5	6	0.6	10176.3
7501984	750	1984	1.3	15.5	6	0.6	10176.3
7501985	750	1985	1.3	15.5	6	0.6	10176.3
7501986	750	1986	1.3	15.5	6	0.6	10176.3
7501987	750	1987	1.3	15.5	6	0.6	10176.3
7501988	750	1988	1.3	15.5	6	0.6	10176.3
7501989	750	1989	1.3	15.5	6	0.6	10176.3
7501990	750	1990	1.3	15.5	6	0.6	10176.3
7501991	750	1991	1.3	15.5	5	0.25	10176.3
7501992	750	1992	1.3	15.5	5	0.25	10176.3
7501993	750	1993	1.3	15.5	5	0.25	10176.3
7501994	750	1994	1.3	15.5	5	0.1	10176.3
7501995	750	1995	1.3	15.5	5	0.1	10176.3
7501996	750	1996	1.3	15.5	5	0.1	10176.3
7501997	750	1997	1.3	15.5	5	0.1	10176.3
7501998	750	1998	1.3	15.5	5	0.1	10176.3
7501999	750	1999	1.3	15.5	5	0.1	10176.3
7502000	750	2000	1.3	15.5	5	0.1	10176.3
7502001	750	2001	1.3	15.5	5	0.1	10176.3
7502002	750	2002	1.3	15.5	5	0.1	10176.3
7502003	750	2003	1.3	15.5	5	0.1	10176.3
7502004	750	2004	0.5	15.5	2	0.1	10176.3
7502005	750	2005	0.5	15.5	2	0.1	10176.3
7502006	750	2006	0.5	15.5	2	0.1	10176.3
7502007	750	2007	0.14	15.5	1.1	0.01	10176.3
7502008	750	2008	0.14	15.5	1.1	0.01	10176.3
7502009	750	2009	0.14	15.5	1.1	0.01	10176.3
7502010	750	2010	0.14	15.5	0.2	0.01	10176.3
7502011	750	2011	0.14	15.5	0.2	0.01	10176.3
7502012	750	2012	0.14	15.5	0.2	0.01	10176.3
7502013	750	2013	0.14	15.5	0.2	0.01	10176.3
7502014	750	2014	0.14	15.5	0.2	0.01	10176.3

7502015	750	2015	0.14	15.5	0.2	0.01	10176.3
7502016	750	2016	0.14	15.5	0.2	0.01	10176.3
7502017	750	2017	0.14	15.5	0.2	0.01	10176.3
7502018	750	2018	0.14	15.5	0.2	0.01	10176.3
7502019	750	2019	0.14	15.5	0.2	0.01	10176.3
7502020	750	2020	0.14	15.5	0.2	0.01	10176.3
7502021	750	2021	0.14	15.5	0.2	0.01	10176.3
7502022	750	2022	0.14	15.5	0.2	0.01	10176.3
7502023	750	2023	0.14	15.5	0.2	0.01	10176.3
7502024	750	2024	0.14	15.5	0.2	0.01	10176.3
7502025	750	2025	0.14	15.5	0.2	0.01	10176.3
7502026	750	2026	0.14	15.5	0.2	0.01	10176.3
9991968	999	1968	1.3	15.5	6	0.6	10176.3
9991969	999	1969	1.3	15.5	6	0.6	10176.3
9991970	999	1970	1.3	15.5	6	0.6	10176.3
9991971	999	1971	1.3	15.5	6	0.6	10176.3
9991972	999	1972	1.3	15.5	6	0.6	10176.3
9991973	999	1973	1.3	15.5	6	0.6	10176.3
9991974	999	1974	1.3	15.5	6	0.6	10176.3
9991975	999	1975	1.3	15.5	6	0.6	10176.3
9991976	999	1976	1.3	15.5	6	0.6	10176.3
9991977	999	1977	1.3	15.5	6	0.6	10176.3
9991978	999	1978	1.3	15.5	6	0.6	10176.3
9991979	999	1979	1.3	15.5	6	0.6	10176.3
9991980	999	1980	1.3	15.5	6	0.6	10176.3
9991981	999	1981	1.3	15.5	6	0.6	10176.3
9991982	999	1982	1.3	15.5	6	0.6	10176.3
9991983	999	1983	1.3	15.5	6	0.6	10176.3
9991984	999	1984	1.3	15.5	6	0.6	10176.3
9991985	999	1985	1.3	15.5	6	0.6	10176.3
9991986	999	1986	1.3	15.5	6	0.6	10176.3
9991987	999	1987	1.3	15.5	6	0.6	10176.3
9991988	999	1988	1.3	15.5	6	0.6	10176.3
9991989	999	1989	1.3	15.5	6	0.6	10176.3
9991990	999	1990	1.3	15.5	6	0.6	10176.3
9991991	999	1991	1.3	15.5	5	0.25	10176.3
9991992	999	1992	1.3	15.5	5	0.25	10176.3
9991993	999	1993	1.3	15.5	5	0.25	10176.3
9991994	999	1994	1.3	15.5	5	0.1	10176.3
9991995	999	1995	1.3	15.5	5	0.1	10176.3
9991996	999	1996	1.3	15.5	5	0.1	10176.3
9991997	999	1997	1.3	15.5	5	0.1	10176.3
9991998	999	1998	1.3	15.5	5	0.1	10176.3
9991999	999	1999	1.3	15.5	5	0.1	10176.3
9992000	999	2000	1.3	15.5	5	0.1	10176.3
9992001	999	2001	1.3	15.5	5	0.1	10176.3
9992002	999	2002	1.3	15.5	5	0.1	10176.3
9992003	999	2003	1.3	15.5	5	0.1	10176.3
9992004	999	2004	0.5	15.5	2	0.1	10176.3
9992005	999	2005	0.5	15.5	2	0.1	10176.3
9992006	999	2006	0.5	15.5	2	0.1	10176.3
9992007	999	2007	0.14	15.5	1.1	0.01	10176.3
9992008	999	2008	0.14	15.5	1.1	0.01	10176.3
9992009	999	2009	0.14	15.5	1.1	0.01	10176.3
9992010	999	2010	0.14	15.5	0.2	0.01	10176.3
9992011	999	2011	0.14	15.5	0.2	0.01	10176.3
9992012	999	2012	0.14	15.5	0.2	0.01	10176.3
9992013	999	2013	0.14	15.5	0.2	0.01	10176.3
9992014	999	2014	0.14	15.5	0.2	0.01	10176.3
9992015	999	2015	0.14	15.5	0.2	0.01	10176.3
9992016	999	2016	0.14	15.5	0.2	0.01	10176.3
9992017	999	2017	0.14	15.5	0.2	0.01	10176.3
9992018	999	2018	0.14	15.5	0.2	0.01	10176.3
9992019	999	2019	0.14	15.5	0.2	0.01	10176.3
9992020	999	2020	0.14	15.5	0.2	0.01	10176.3
9992021	999	2021	0.14	15.5	0.2	0.01	10176.3
9992022	999	2022	0.14	15.5	0.2	0.01	10176.3
9992023	999	2023	0.14	15.5	0.2	0.01	10176.3
9992024	999	2024	0.14	15.5	0.2	0.01	10176.3
9992025	999	2025	0.14	15.5	0.2	0.01	10176.3
9992026	999	2026	0.14	15.5	0.2	0.01	10176.3

ARB Equipment	HP Bin	SOX (g SOX/hp-hr)
Excavator	50	0.0686448
Excavator	120	0.0622888
Excavator	175	0.0597464
Excavator	250	0.0597464
Excavator	500	0.0521192
Excavator	750	0.0533904
Crane	50	0.0686448
Crane	120	0.0622888
Crane	175	0.0597464
Crane	250	0.0597464
Crane	500	0.0521192
Crane	750	0.0533904
Crane	999	0.0533904
Forklift	50	0.0686448
Forklift	120	0.0622888
Forklift	175	0.0597464
Forklift	250	0.0597464
Forklift	500	0.0521192
Material Handling Equip	120	0.0597464
Other General Industrial Equip	50	0.0686448
Other General Industrial Equip	120	0.0622888
Other General Industrial Equip	175	0.0597464
Other General Industrial Equip	250	0.0597464
Other General Industrial Equip	500	0.0521192
Other General Industrial Equip	750	0.0533904
Other General Industrial Equip	999	0.0533904
Sweeper/Scrubber	50	0.0686448
Sweeper/Scrubber	120	0.0622888
Sweeper/Scrubber	175	0.0597464
Sweeper/Scrubber	250	0.0597464
Tractor/Loader/Backhoe	50	0.0686448
Tractor/Loader/Backhoe	120	0.0622888
Tractor/Loader/Backhoe	175	0.0597464
Tractor/Loader/Backhoe	250	0.0597464
Tractor/Loader/Backhoe	500	0.0597464
Tractor/Loader/Backhoe	750	0.0597464
Yard Tractor offroad engine	120	0.0622888
Yard Tractor offroad engine	175	0.0597464
Yard Tractor offroad engine	250	0.0597464
Yard Tractor offroad engine	750	0.0533904
Yard Tractor offroad engine	999	0.0533904
Yard Tractor onroad engine	120	0.0622888
Yard Tractor onroad engine	175	0.0597464
Yard Tractor onroad engine	250	0.0597464
Yard Tractor onroad engine	750	0.0533904
Yard Tractor onroad engine	999	0.0533904

Engine changes	Emission Changes %			
	HC	CO	NOx	PM
DOC	0.7	0.7	0	0.3
DPF (P)	0.9	0.9	0	0.85
DPF (A)	0	0	0	0.85
Emulsified Fuel	0	0	0.15	0.3
Emulsified Fuel+ DOC	0	0	0.2	0.5

Equipment Types	Code
Crane	1
Excavator	2
Forklift	3
Material Handling Equip	4
Other General Industrial Equ	5
Sweeper/Scrubber	6
Tractor/Loader/Backhoe	7
Yard Tractor offroad	8
Yard Tractor onroad	9

APPENDIX E

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR HEAVY EQUIPMENT

Emissions Factors for Heavy Equipment
Los Angeles Transportation Center, Los Angeles, CA

Equipment Type	Make	Model	Year	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions	
					ROG	CO	NOX	DPM	SOx	Part 1 (lb/hr)	Part 2 (lb/yr)
Crane	Grove	RT650E	2003	0.43	0.2332	0.2332	0.2332	0.1053	0.0478	-	-
Fork Lift	Lull	John Deere	2004	0.30	0.3500	0.3500	0.3500	0.1861	0.0548	-	-
Fork Lift	Toyota		1999	0.30	0.3500	0.3500	0.3500	0.5778	0.0548	-	-
Totals											

Notes:
1. Emission factors and load factors from CARB's OFFROAD2006 model.
2. Evaporative emissions are negligible.

Cnty	SubR	SCC	HP	TechType	MYr	Population	ROG-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust
Los Angeles		2270002045	500		2003		0.000775849	0.003250596	0.01410521	1.890868	0.000158969
Los Angeles		2270003020	175		2004		2.89E-03	2.38E-02	3.85E-02	4.68E+00	4.51E-04
Los Angeles		2270003020	175		1999		0.01312091	0.03678098	0.08651554	5.912413	0.000569808

PM-Exhaust	Crankcase FuelCons.	Activity	LF	HPAvg	ROG/ROG	ROG (lb/hp-hr)	CO (lb/hp-hr)	NOx (lb/hp-hr)	SOx (lb/hp-hr)	PM (lb/hp-hr)
0.000350414		21.0167	0.43	334	1	0.000514077	0.00215384	0.009346093	0.000105332	0.000232184
1.53E-03		167.2895	0.3	149	1	0.000771666	0.006377483	0.010289056	0.000120747	0.000410372
0.006011251		2.11E+02	0.3	149	1	0.002780425	0.007794182	0.01833333	0.000120747	0.001273832

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2005	7	2.45E+01	1.99E+02	5.40E-04	3.62E-03	1.48E-02	2.21E+00	1.86E-04	3.62E-04	0.00E+00	4.87E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2004	7	2.29E+01	1.86E+02	7.15E-04	3.45E-03	1.51E-02	2.06E+00	1.73E-04	3.60E-04	0.00E+00	6.45E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2003	6	2.10E+01	1.71E+02	7.76E-04	3.25E-03	1.41E-02	1.89E+00	1.59E-04	3.50E-04	0.00E+00	7.00E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2002	5	1.84E+01	1.50E+02	8.33E-04	2.92E-03	1.32E-02	1.66E+00	1.39E-04	3.27E-04	0.00E+00	7.52E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2001	5	1.77E+01	1.44E+02	1.01E-03	2.87E-03	1.43E-02	1.59E+00	1.34E-04	3.61E-04	0.00E+00	9.12E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	2000	6	2.06E+01	1.68E+02	1.56E-03	3.41E-03	2.15E-02	1.85E+00	1.56E-04	5.49E-04	0.00E+00	1.41E-04
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1999	6	2.13E+01	1.73E+02	1.67E-03	3.60E-03	2.27E-02	1.91E+00	1.61E-04	5.94E-04	0.00E+00	1.50E-04
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1998	6	2.04E+01	1.66E+02	1.65E-03	3.52E-03	2.21E-02	1.83E+00	1.54E-04	5.96E-04	0.00E+00	1.49E-04
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1997	5	1.84E+01	1.50E+02	1.54E-03	3.24E-03	2.03E-02	1.66E+00	1.39E-04	5.62E-04	0.00E+00	1.39E-04
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1996	2	7.85E+00	6.41E+01	6.78E-04	1.41E-03	8.82E-03	7.07E-01	5.94E-05	2.50E-04	0.00E+00	6.12E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1995	2	5.23E+00	4.32E+01	9.88E-04	2.82E-03	7.67E-03	4.71E-01	3.96E-05	4.01E-04	0.00E+00	8.92E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1994	1	3.87E+00	3.20E+01	7.53E-04	2.13E-03	5.78E-03	3.48E-01	2.93E-05	3.09E-04	0.00E+00	6.80E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1993	1	2.17E+00	1.79E+01	4.34E-04	1.21E-03	3.29E-03	1.95E-01	1.64E-05	1.79E-04	0.00E+00	3.92E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1992	1	1.72E+00	1.42E+01	3.54E-04	9.81E-04	2.65E-03	1.55E-01	1.30E-05	1.47E-04	0.00E+00	3.19E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1991	0	1.23E+00	1.02E+01	2.60E-04	7.14E-04	1.92E-03	1.11E-01	9.29E-06	1.09E-04	0.00E+00	2.34E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1990	0	1.08E+00	8.96E+00	2.35E-04	6.41E-04	1.72E-03	9.75E-02	8.20E-06	9.93E-05	0.00E+00	2.12E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1989	0	6.50E-01	5.38E+00	1.45E-04	3.92E-04	1.05E-03	5.85E-02	4.92E-06	6.16E-05	0.00E+00	1.31E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Los Angeles	SC	SC	1988	0	2.17E-01	1.79E+00	4.95E-05	1.33E-04	3.56E-04	1.95E-02	1.64E-06	2.12E-05	0.00E+00	4.47E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2005	2	5.89E+00	4.79E+01	1.30E-04	8.68E-04	3.56E-03	5.30E-01	4.45E-05	8.69E-05	0.00E+00	1.17E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2004	2	5.50E+00	4.48E+01	1.72E-04	8.31E-04	3.63E-03	4.95E-01	4.16E-05	8.66E-05	0.00E+00	1.55E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2003	1	5.10E+00	4.15E+01	1.88E-04	7.89E-04	3.42E-03	4.59E-01	3.86E-05	8.50E-05	0.00E+00	1.70E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2002	1	4.56E+00	3.71E+01	2.06E-04	7.22E-04	3.28E-03	4.10E-01	3.45E-05	8.10E-05	0.00E+00	1.86E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2001	1	4.36E+00	3.55E+01	2.49E-04	7.06E-04	3.51E-03	3.92E-01	3.30E-05	8.89E-05	0.00E+00	2.25E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	2000	1	3.88E+00	3.17E+01	2.94E-04	6.42E-04	4.06E-03	3.49E-01	2.94E-05	1.03E-04	0.00E+00	2.65E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1999	1	4.01E+00	3.27E+01	3.14E-04	6.77E-04	4.27E-03	3.60E-01	3.03E-05	1.12E-04	0.00E+00	2.83E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1998	1	3.84E+00	3.13E+01	3.11E-04	6.63E-04	4.16E-03	3.45E-01	2.90E-05	1.12E-04	0.00E+00	2.80E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1997	1	3.47E+00	2.83E+01	2.90E-04	6.11E-04	3.83E-03	3.12E-01	2.62E-05	1.06E-04	0.00E+00	2.62E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1996	0	1.48E+00	1.21E+01	1.28E-04	2.66E-04	1.66E-03	1.33E-01	1.12E-05	4.71E-05	0.00E+00	1.15E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1995	0	9.86E-01	8.13E+00	1.86E-04	5.31E-04	1.45E-03	8.87E-02	7.46E-06	7.56E-05	0.00E+00	1.68E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1994	0	7.30E-01	6.02E+00	1.42E-04	4.01E-04	1.09E-03	6.56E-02	5.52E-06	5.81E-05	0.00E+00	1.28E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1993	0	4.09E-01	3.37E+00	8.18E-05	2.29E-04	6.20E-04	3.68E-02	3.09E-06	3.38E-05	0.00E+00	7.38E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1992	0	3.24E-01	2.67E+00	6.66E-05	1.85E-04	4.99E-04	2.91E-02	2.45E-06	2.77E-05	0.00E+00	6.01E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1991	0	2.31E-01	1.91E+00	4.89E-05	1.34E-04	3.62E-04	2.08E-02	1.75E-06	2.05E-05	0.00E+00	4.41E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1990	0	2.04E-01	1.69E+00	4.43E-05	1.21E-04	3.25E-04	1.84E-02	1.54E-06	1.87E-05	0.00E+00	4.00E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1989	0	1.23E-01	1.01E+00	2.73E-05	7.38E-05	1.98E-04	1.10E-02	9.27E-07	1.16E-05	0.00E+00	2.46E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SC	SC	1988	0	4.08E-02	3.38E-01	9.33E-06	2.50E-05	6.70E-05	3.67E-03	3.09E-07	3.99E-06	0.00E+00	8.42E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2005	35	1.71E+02	4.36E+02	1.86E-03	2.33E-02	3.60E-02	4.79E+00	4.62E-04	1.18E-03	0.00E+00	1.68E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2004	34	1.67E+02	4.26E+02	2.89E-03	2.38E-02	3.85E-02	4.68E+00	4.51E-04	1.53E-03	0.00E+00	2.60E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2003	34	1.70E+02	4.34E+02	4.59E-03	2.53E-02	4.52E-02	4.76E+00	4.59E-04	2.18E-03	0.00E+00	4.14E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2002	39	1.91E+02	4.91E+02	9.97E-03	2.97E-02	7.07E-02	5.36E+00	5.17E-04	4.29E-03	0.00E+00	8.99E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2001	38	1.89E+02	4.85E+02	1.05E-02	3.06E-02	7.24E-02	5.30E+00	5.10E-04	4.62E-03	0.00E+00	9.46E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	2000	44	2.18E+02	5.59E+02	1.28E-02	3.66E-02	8.63E-02	6.10E+00	5.88E-04	5.76E-03	0.00E+00	1.16E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1999	43	2.11E+02	5.43E+02	1.31E-02	3.68E-02	8.65E-02	5.91E+00	5.70E-04	6.01E-03	0.00E+00	1.18E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1998	42	2.06E+02	5.30E+02	1.35E-02	3.72E-02	8.73E-02	5.78E+00	5.57E-04	6.29E-03	0.00E+00	1.22E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1997	40	1.97E+02	5.07E+02	1.36E-02	3.68E-02	8.61E-02	5.52E+00	5.32E-04	6.41E-03	0.00E+00	1.23E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1996	39	1.93E+02	4.98E+02	1.39E-02	3.73E-02	1.01E-01	5.41E+00	5.21E-04	6.08E-03	0.00E+00	1.26E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1995	34	1.68E+02	4.33E+02	1.27E-02	3.35E-02	9.03E-02	4.70E+00	4.53E-04	5.59E-03	0.00E+00	1.14E-03
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1994	28	1.36E+02	3.50E+02	1.07E-02	2.79E-02	7.51E-02	3.80E+00	3.66E-04	4.77E-03	0.00E+00	9.66E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1993	8	3.74E+01	9.65E+01	3.08E-03	7.93E-03	2.13E-02	1.05E+00	1.01E-04	1.38E-03	0.00E+00	2.78E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1992	5	2.65E+01	6.86E+01	2.27E-03	5.80E-03	1.55E-02	7.43E-01	7.16E-05	1.03E-03	0.00E+00	2.05E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1991	5	2.31E+01	5.99E+01	2.06E-03	5.20E-03	1.39E-02	6.48E-01	6.25E-05	9.41E-04	0.00E+00	1.86E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1990	7	3.59E+01	9.30E+01	3.32E-03	8.30E-03	2.21E-02	1.01E+00	9.69E-05	1.53E-03	0.00E+00	2.99E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1989	6	2.84E+01	7.36E+01	2.72E-03	6.74E-03	1.79E-02	7.95E-01	7.66E-05	1.26E-03	0.00E+00	2.45E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1988	5	2.48E+01	6.44E+01	2.46E-03	6.06E-03	1.61E-02	6.96E-01	6.70E-05	1.15E-03	0.00E+00	2.22E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1987	4	2.01E+01	5.28E+01	2.66E-03	7.82E-03	1.79E-02	5.63E-01	5.43E-05	1.40E-03	0.00E+00	2.40E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1986	3	1.46E+01	3.84E+01	2.00E-03	5.82E-03	1.33E-02	4.08E-01	3.94E-05	1.05E-03	0.00E+00	1.80E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1985	2	1.08E+01	2.85E+01	1.53E-03	4.43E-03	1.01E-02	3.04E-01	2.93E-05	8.12E-04	0.00E+00	1.38E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1984	2	7.49E+00	1.98E+01	1.16E-03	3.22E-03	7.15E-03	2.10E-01	2.02E-05	5.81E-04	0.00E+00	1.05E-04
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1983	1	3.94E+00	1.04E+01	6.31E-04	1.73E-03	3.85E-03	1.10E-01	1.06E-05	3.16E-04	0.00E+00	5.70E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Los Angeles	SC	SC	1982	0	1.31E+00	3.48E+00	2.17E-04	5.91E-04	1.31E-03	3.68E-02	3.55E-06	1.09E-04	0.00E+00	1.95E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2005	2	9.13E+00	2.32E+01	9.91E-05	1.24E-03	1.92E-03	2.56E-01	2.46E-05	6.31E-05	0.00E+00	8.94E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2004	2	8.88E+00	2.26E+01	1.53E-04	1.27E-03	2.04E-03	2.49E-01	2.40E-05	8.15E-05	0.00E+00	1.38E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2003	2	8.89E+00	2.27E+01	2.40E-04	1.32E-03	2.36E-03	2.49E-01	2.40E-05	1.14E-04	0.00E+00	2.16E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2002	2	9.59E+00	2.46E+01	4.99E-04	1.49E-03	3.54E-03	2.69E-01	2.59E-05	2.15E-04	0.00E+00	4.50E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2001	2	9.41E+00	2.41E+01	5.21E-04	1.52E-03	3.60E-03	2.63E-01	2.54E-05	2.30E-04	0.00E+00	4.70E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	2000	2	8.03E+00	2.06E+01	4.72E-04	1.35E-03	3.18E-03	2.25E-01	2.17E-05	2.12E-04	0.00E+00	4.26E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1999	2	7.78E+00	2.00E+01	4.84E-04	1.36E-03	3.19E-03	2.18E-01	2.10E-05	2.22E-04	0.00E+00	4.36E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1998	2	7.60E+00	1.96E+01	4.98E-04	1.37E-03	3.22E-03	2.13E-01	2.05E-05	2.32E-04	0.00E+00	4.49E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1997	1	7.27E+00	1.87E+01	5.00E-04	1.36E-03	3.17E-03	2.04E-01	1.96E-05	2.36E-04	0.00E+00	4.52E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1996	1	7.12E+00	1.83E+01	5.14E-04	1.38E-03	3.72E-03	1.99E-01	1.92E-05	2.24E-04	0.00E+00	4.64E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1995	1	6.19E+00	1.60E+01	4.68E-04	1.23E-03	3.33E-03	1.73E-01	1.67E-05	2.06E-04	0.00E+00	4.22E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1994	1	5.00E+00	1.29E+01	3.95E-04	1.03E-03	2.77E-03	1.40E-01	1.35E-05	1.76E-04	0.00E+00	3.56E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1993	0	1.38E+00	3.56E+00	1.13E-04	2.92E-04	7.85E-04	3.86E-02	3.72E-06	5.10E-05	0.00E+00	1.02E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1992	0	9.78E-01	2.53E+00	8.38E-05	2.14E-04	5.72E-04	2.74E-02	2.64E-06	3.80E-05	0.00E+00	7.56E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1991	0	8.53E-01	2.21E+00	7.60E-05	1.92E-04	5.12E-04	2.39E-02	2.30E-06	3.47E-05	0.00E+00	6.85E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1990	0	1.32E+00	3.43E+00	1.22E-04	3.06E-04	8.16E-04	3.71E-02	3.57E-06	5.63E-05	0.00E+00	1.10E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1989	0	1.05E+00	2.71E+00	1.00E-04	2.49E-04	6.61E-04	2.93E-02	2.82E-06	4.64E-05	0.00E+00	9.04E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1988	0	9.16E-01	2.37E+00	9.07E-05	2.23E-04	5.93E-04	2.56E-02	2.47E-06	4.23E-05	0.00E+00	8.19E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1987	0	7.41E-01	1.95E+00	9.82E-05	2.88E-04	6.61E-04	2.08E-02	2.00E-06	5.16E-05	0.00E+00	8.86E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1986	0	5.38E-01	1.41E+00	7.36E-05	2.15E-04	4.91E-04	1.51E-02	1.45E-06	3.88E-05	0.00E+00	6.64E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1985	0	4.00E-01	1.05E+00	5.64E-05	1.63E-04	3.73E-04	1.12E-02	1.08E-06	2.99E-05	0.00E+00	5.09E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1984	0	2.76E-01	7.29E-01	4.29E-05	1.19E-04	2.64E-04	7.73E-03	7.45E-07	2.14E-05	0.00E+00	3.87E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1983	0	1.45E-01	3.84E-01	2.33E-05	6.39E-05	1.42E-04	4.07E-03	3.92E-07	1.17E-05	0.00E+00	2.10E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SC	SC	1982	0	4.84E-02	1.28E-01	7.98E-06	2.18E-05	4.83E-05	1.36E-03	1.31E-07	4.01E-06	0.00E+00	7.20E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2005	170	4.84E+02	1.77E+02	2.01E-03	1.18E-02	1.41E-02	1.94E+00	2.11E-04	1.07E-03	0.00E+00	1.82E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2004	161	4.57E+02	1.68E+02	2.64E-03	1.12E-02	1.86E-02	1.83E+00	1.99E-04	1.25E-03	0.00E+00	2.38E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2003	156	4.43E+02	1.62E+02	2.56E-03	1.08E-02	1.80E-02	1.78E+00	1.93E-04	1.21E-03	0.00E+00	2.31E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2002	158	4.48E+02	1.64E+02	2.59E-03	1.10E-02	1.82E-02	1.80E+00	1.95E-04	1.22E-03	0.00E+00	2.33E-04

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2001	178	5.08E+02	1.86E+02	2.93E-03	1.24E-02	2.07E-02	2.04E+00	2.21E-04	1.38E-03	0.00E+00	2.64E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2000	68	1.93E+02	7.09E+01	1.12E-03	4.73E-03	7.86E-03	7.75E-01	8.43E-05	5.27E-04	0.00E+00	1.01E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1999	77	2.20E+02	8.14E+01	1.96E-03	7.78E-03	1.38E-02	8.84E-01	9.61E-05	7.29E-04	0.00E+00	1.77E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1998	63	1.79E+02	6.63E+01	1.60E-03	6.33E-03	1.12E-02	7.19E-01	7.82E-05	5.93E-04	0.00E+00	1.44E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1997	40	1.15E+02	4.26E+01	1.03E-03	4.06E-03	7.20E-03	4.62E-01	5.02E-05	3.81E-04	0.00E+00	9.26E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1996	29	8.21E+01	3.03E+01	7.31E-04	2.90E-03	5.13E-03	3.29E-01	3.58E-05	2.71E-04	0.00E+00	6.60E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1995	24	6.92E+01	2.56E+01	6.17E-04	2.44E-03	4.33E-03	2.78E-01	3.02E-05	2.29E-04	0.00E+00	5.57E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1994	14	4.11E+01	1.52E+01	5.23E-04	1.45E-03	2.70E-03	1.65E-01	1.79E-05	2.17E-04	0.00E+00	4.72E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1993	7	1.85E+01	6.87E+00	2.36E-04	6.53E-04	1.22E-03	7.43E-02	8.07E-06	9.80E-05	0.00E+00	2.13E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1992	3	7.35E+00	2.73E+00	9.36E-05	2.59E-04	4.82E-04	2.95E-02	3.20E-06	3.89E-05	0.00E+00	8.44E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1991	1	1.98E+00	7.34E-01	2.52E-05	6.98E-05	1.30E-04	7.94E-03	8.63E-07	1.05E-05	0.00E+00	2.27E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1990	0	3.26E-01	1.21E-01	4.15E-06	1.15E-05	2.14E-05	1.31E-03	1.42E-07	1.72E-06	0.00E+00	3.74E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1989	0	4.67E-02	1.73E-02	5.95E-07	1.65E-06	3.06E-06	1.87E-04	2.04E-08	2.47E-07	0.00E+00	5.36E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1988	0	3.78E-03	1.40E-03	4.82E-08	1.33E-07	2.48E-07	1.52E-05	1.65E-09	2.00E-08	0.00E+00	4.35E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1987	0	2.21E-04	8.20E-05	2.81E-09	7.80E-09	1.45E-08	8.86E-07	9.63E-11	1.17E-09	0.00E+00	2.54E-10
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1986	0	1.11E-05	4.11E-06	1.41E-10	3.91E-10	7.26E-10	4.44E-08	4.82E-12	5.86E-11	0.00E+00	1.27E-11
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2005	27	7.63E+01	2.79E+01	3.17E-04	1.87E-03	2.23E-03	3.06E-01	3.32E-05	1.68E-04	0.00E+00	2.86E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2004	25	7.21E+01	2.64E+01	4.16E-04	1.76E-03	2.93E-03	2.89E-01	3.14E-05	1.96E-04	0.00E+00	3.75E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2003	25	6.99E+01	2.56E+01	4.03E-04	1.71E-03	2.84E-03	2.80E-01	3.04E-05	1.90E-04	0.00E+00	3.64E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2002	25	7.07E+01	2.59E+01	4.08E-04	1.73E-03	2.87E-03	2.83E-01	3.08E-05	1.93E-04	0.00E+00	3.68E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2001	28	8.01E+01	2.94E+01	4.62E-04	1.96E-03	3.26E-03	3.21E-01	3.49E-05	2.18E-04	0.00E+00	4.17E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2000	11	3.05E+01	1.12E+01	1.76E-04	7.47E-04	1.24E-03	1.22E-01	1.33E-05	8.31E-05	0.00E+00	1.59E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1999	12	3.48E+01	1.28E+01	3.10E-04	1.23E-03	2.17E-03	1.39E-01	1.51E-05	1.15E-04	0.00E+00	2.79E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1998	10	2.83E+01	1.04E+01	2.52E-04	9.98E-04	1.77E-03	1.13E-01	1.23E-05	9.35E-05	0.00E+00	2.27E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1997	6	1.82E+01	6.71E+00	1.62E-04	6.41E-04	1.14E-03	7.28E-02	7.91E-06	6.00E-05	0.00E+00	1.46E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1996	5	1.29E+01	4.78E+00	1.15E-04	4.57E-04	8.09E-04	5.19E-02	5.64E-06	4.28E-05	0.00E+00	1.04E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1995	4	1.09E+01	4.03E+00	9.73E-05	3.85E-04	6.83E-04	4.38E-02	4.76E-06	3.61E-05	0.00E+00	8.78E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1994	2	6.48E+00	2.40E+00	8.25E-05	2.29E-04	4.25E-04	2.60E-02	2.82E-06	3.43E-05	0.00E+00	7.44E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1993	1	2.92E+00	1.08E+00	3.72E-05	1.03E-04	1.92E-04	1.17E-02	1.27E-06	1.55E-05	0.00E+00	3.35E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1992	0	1.16E+00	4.30E-01	1.48E-05	4.09E-05	7.61E-05	4.65E-03	5.05E-07	6.13E-06	0.00E+00	1.33E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1991	0	3.12E-01	1.16E-01	3.97E-06	1.10E-05	2.05E-05	1.25E-03	1.36E-07	1.65E-06	0.00E+00	3.59E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1990	0	5.14E-02	1.91E-02	6.54E-07	1.81E-06	3.37E-06	2.06E-04	2.24E-08	2.72E-07	0.00E+00	5.90E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1989	0	7.37E-03	2.73E-03	9.37E-08	2.60E-07	4.83E-07	2.95E-05	3.21E-09	3.90E-08	0.00E+00	8.46E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1988	0	5.97E-04	2.21E-04	7.59E-09	2.10E-08	3.91E-08	2.39E-06	2.60E-10	3.16E-09	0.00E+00	6.85E-10
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1987	0	3.49E-05	1.29E-05	4.44E-10	1.23E-09	2.29E-09	1.40E-07	1.52E-11	1.84E-10	0.00E+00	4.00E-11
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1986	0	1.75E-06	6.47E-07	2.22E-11	6.16E-11	1.15E-10	7.00E-09	7.61E-13	9.24E-12	0.00E+00	2.00E-12
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2005	63	1.78E+02	1.10E+02	1.46E-03	4.99E-03	9.25E-03	1.21E+00	1.32E-04	6.67E-04	0.00E+00	1.32E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2004	60	1.70E+02	1.06E+02	1.57E-03	4.78E-03	1.12E-02	1.16E+00	1.26E-04	6.38E-04	0.00E+00	1.42E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2003	59	1.67E+02	1.04E+02	1.54E-03	4.69E-03	1.10E-02	1.14E+00	1.24E-04	6.26E-04	0.00E+00	1.39E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2002	60	1.72E+02	1.07E+02	1.59E-03	4.83E-03	1.13E-02	1.17E+00	1.27E-04	6.44E-04	0.00E+00	1.43E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2001	70	2.00E+02	1.24E+02	1.84E-03	5.61E-03	1.32E-02	1.36E+00	1.48E-04	7.49E-04	0.00E+00	1.66E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2000	29	8.14E+01	5.06E+01	7.52E-04	2.29E-03	5.36E-03	5.55E-01	6.03E-05	3.05E-04	0.00E+00	6.78E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1999	33	9.29E+01	5.82E+01	1.21E-03	5.57E-03	7.31E-03	6.33E-01	6.88E-05	5.22E-04	0.00E+00	1.09E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1998	27	7.55E+01	4.74E+01	9.81E-04	4.53E-03	5.94E-03	5.15E-01	5.60E-05	4.24E-04	0.00E+00	8.85E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1997	17	4.85E+01	3.04E+01	6.30E-04	2.91E-03	3.82E-03	3.31E-01	3.59E-05	2.73E-04	0.00E+00	5.68E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1996	12	3.46E+01	2.17E+01	4.49E-04	2.07E-03	2.72E-03	2.36E-01	2.56E-05	1.94E-04	0.00E+00	4.05E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1995	10	2.92E+01	1.83E+01	3.79E-04	1.75E-03	2.29E-03	1.99E-01	2.16E-05	1.64E-04	0.00E+00	3.42E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1994	6	1.73E+01	1.09E+01	4.59E-04	1.04E-03	1.34E-03	1.18E-01	1.28E-05	1.18E-04	0.00E+00	4.14E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1993	3	7.80E+00	4.93E+00	2.07E-04	4.68E-04	6.02E-04	5.32E-02	5.78E-06	5.33E-05	0.00E+00	1.87E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1992	1	3.10E+00	1.96E+00	8.22E-05	1.86E-04	2.39E-04	2.11E-02	2.29E-06	2.12E-05	0.00E+00	7.42E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1991	0	8.34E-01	5.27E-01	2.21E-05	5.00E-05	6.44E-05	5.68E-03	6.18E-07	5.70E-06	0.00E+00	2.00E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1990	0	1.37E-01	8.68E-02	3.64E-06	8.23E-06	1.06E-05	9.36E-04	1.02E-07	9.39E-07	0.00E+00	3.29E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1989	0	1.97E-02	1.24E-02	5.22E-07	1.18E-06	1.52E-06	1.34E-04	1.46E-08	1.34E-07	0.00E+00	4.71E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1988	0	1.59E-03	1.01E-03	4.23E-08	9.56E-08	1.23E-07	1.09E-05	1.18E-09	1.09E-08	0.00E+00	3.82E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1987	0	9.31E-05	5.88E-05	2.47E-09	5.58E-09	7.18E-09	6.34E-07	6.89E-11	6.36E-10	0.00E+00	2.23E-10
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1986	0	4.66E-06	2.95E-06	1.24E-10	2.80E-10	3.60E-10	3.18E-08	3.45E-12	3.19E-11	0.00E+00	1.12E-11
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2005	10	2.81E+01	1.74E+01	2.31E-04	7.88E-04	1.46E-03	1.91E-01	2.08E-05	1.05E-04	0.00E+00	2.08E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2004	9	2.68E+01	1.67E+01	2.48E-04	7.53E-04	1.77E-03	1.83E-01	1.99E-05	1.01E-04	0.00E+00	2.24E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2003	9	2.64E+01	1.64E+01	2.43E-04	7.40E-04	1.73E-03	1.80E-01	1.95E-05	9.87E-05	0.00E+00	2.20E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2002	10	2.71E+01	1.68E+01	2.50E-04	7.61E-04	1.79E-03	1.85E-01	2.01E-05	1.02E-04	0.00E+00	2.26E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2001	11	3.15E+01	1.96E+01	2.91E-04	8.84E-04	2.07E-03	2.15E-01	2.33E-05	1.18E-04	0.00E+00	2.62E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2000	5	1.28E+01	7.98E+00	1.19E-04	3.60E-04	8.45E-04	8.75E-02	9.51E-06	4.81E-05	0.00E+00	1.07E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1999	5	1.46E+01	9.18E+00	1.90E-04	8.78E-04	1.15E-03	9.98E-02	1.08E-05	8.23E-05	0.00E+00	1.72E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1998	4	1.19E+01	7.47E+00	1.55E-04	7.14E-04	9.37E-04	8.12E-02	8.82E-06	6.69E-05	0.00E+00	1.40E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1997	3	7.65E+00	4.80E+00	9.93E-05	4.59E-04	6.02E-04	5.21E-02	5.67E-06	4.30E-05	0.00E+00	8.96E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1996	2	5.45E+00	3.42E+00	7.08E-05	3.27E-04	4.29E-04	3.72E-02	4.04E-06	3.06E-05	0.00E+00	6.39E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1995	2	4.60E+00	2.88E+00	5.97E-05	2.76E-04	3.62E-04	3.13E-02	3.41E-06	2.58E-05	0.00E+00	5.39E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1994	1	2.73E+00	1.72E+00	7.24E-05	1.64E-04	2.11E-04	1.86E-02	2.02E-06	1.87E-05	0.00E+00	6.53E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1993	0	1.23E+00	7.78E-01	3.27E-05	7.38E-05	9.49E-05	8.38E-03	9.11E-07	8.41E-06	0.00E+00	2.95E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1992	0	4.88E-01	3.09E-01	1.30E-05	2.93E-05	3.77E-05	3.33E-03	3.62E-07	3.34E-06	0.00E+00	1.17E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1991	0	1.31E-01	8.31E-02	3.49E-06	7.88E-06	1.01E-05	8.96E-04	9.74E-08	8.99E-07	0.00E+00	3.15E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1990	0	2.16E-02	1.37E-02	5.75E-07	1.30E-06	1.67E-06	1.48E-04	1.60E-08	1.48E-07	0.00E+00	5.18E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1989	0	3.10E-03	1.96E-03	8.23E-08	1.86E-07	2.39E-07	2.11E-05	2.30E-09	2.12E-08	0.00E+00	7.43E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1988	0	2.51E-04	1.59E-04	6.67E-09	1.51E-08	1.94E-08	1.71E-06	1.86E-10	1.72E-09	0.00E+00	6.02E-10
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1987	0	1.47E-05	9.28E-06	3.90E-10	8.80E-10	1.13E-09	1.00E-07	1.09E-11	1.00E-10	0.00E+00	3.52E-11
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1986	0	7.35E-07	4.65E-07	1.95E-11	4.41E-11	5.67E-11	5.01E-09	5.45E-13	5.03E-12	0.00E+00	1.76E-12
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2005	1239	4.98E+03	5.88E+03	5.74E-02	3.66E-01	5.40E-01	6.45E+01	7.14E-03	3.74E-02	0.00E+00	5.18E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2004	1165	4.68E+03	5.56E+03	1.10E-01	4.27E-01	5.36E-01	6.06E+01	6.71E-03	4.42E-02	0.00E+00	9.90E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2003	1123	4.51E+03	5.44E+03	2.63E-01	5.80E-01	5.78E-01	5.84E+01	6.47E-03	6.51E-02	0.00E+00	2.37E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2002	1129	4.53E+03	5.49E+03	2.98E-01	6.46E-01	5.95E-01	5.87E+01	6.50E-03	7.12E-02	0.00E+00	2.69E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2001	1266	5.09E+03	6.19E+03	3.72E-01	7.96E-01	6.85E-01	6.59E+01	7.29E-03	8.64E-02	0.00E+00	3.36E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	2000	470	1.89E+03	2.30E+03	1.52E-01	3.22E-01	2.60E-01	2.44E+01	2.71E-03	3.45E-02	0.00E+00	1.37E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1999	536	2.15E+03	2.64E+03	1.89E-01	3.97E-01	3.04E-01	2.79E+01	3.08E-03	4.20E-02	0.00E+00	1.71E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1998	436	1.75E+03	2.18E+03	2.08E-01	4.24E-01	2.98E-01	2.27E+01	2.51E-03	4.21E-02	0.00E+00	1.87E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1997	280	1.12E+03	1.41E+03	1.44E-01	2.92E-01	1.95E-01	1.46E+01	1.61E-03	2.87E-02	0.00E+00	1.30E-02
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1996	199	8.01E+02	1.01E+03	1.10E-01	2.22E-01	1.42E-01	1.04E+01	1.15E-03	2.16E-02	0.00E+00	9.91E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1995	168	6.76E+02	8.53E+02	9.88E-02	1.98E-01	1.22E-01	8.75E+00	9.69E-04	1.92E-02	0.00E+00	8.92E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1994	100	4.01E+02	5.09E+02	6.24E-02	1.25E-01	7.35E-02	5.19E+00	5.75E-04	1.20E-02	0.00E+00	5.63E-03

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1993	45	1.81E+02	2.30E+02	2.98E-02	5.93E-02	3.37E-02	2.34E+00	2.59E-04	5.68E-03	0.00E+00	2.69E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1992	18	7.18E+01	9.19E+01	1.25E-02	2.48E-02	1.36E-02	9.29E-01	1.03E-04	2.36E-03	0.00E+00	1.13E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1991	5	1.93E+01	2.49E+01	3.54E-03	7.00E-03	3.73E-03	2.50E-01	2.77E-05	6.64E-04	0.00E+00	3.19E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1990	1	3.18E+00	4.11E+00	6.12E-04	1.21E-03	6.24E-04	4.12E-02	4.56E-06	1.14E-04	0.00E+00	5.52E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1989	0	4.56E-01	5.92E-01	9.19E-05	1.81E-04	9.09E-05	5.90E-03	6.54E-07	1.70E-05	0.00E+00	8.30E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1988	0	3.69E-02	4.82E-02	7.79E-06	1.53E-05	7.49E-06	4.78E-04	5.29E-08	1.43E-06	0.00E+00	7.03E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1987	0	2.16E-03	2.83E-03	4.85E-07	9.29E-07	4.50E-07	2.79E-05	3.09E-09	8.68E-08	0.00E+00	4.38E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Los Angeles	SC	SC	1986	0	1.08E-04	1.42E-04	2.53E-08	4.84E-08	2.29E-08	1.40E-06	1.55E-10	4.51E-09	0.00E+00	2.29E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2005	195	7.85E+02	9.27E+02	9.05E-03	5.77E-02	8.52E-02	1.02E+01	1.13E-03	5.90E-03	0.00E+00	8.16E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2004	184	7.38E+02	8.77E+02	1.73E-02	6.73E-02	8.46E-02	9.56E+00	1.06E-03	6.96E-03	0.00E+00	1.56E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2003	177	7.12E+02	8.58E+02	4.15E-02	9.14E-02	9.11E-02	9.21E+00	1.02E-03	1.03E-02	0.00E+00	3.74E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2002	178	7.15E+02	8.66E+02	4.70E-02	1.02E-01	9.39E-02	9.26E+00	1.03E-03	1.12E-02	0.00E+00	4.24E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2001	200	8.02E+02	9.75E+02	5.87E-02	1.26E-01	1.08E-01	1.04E+01	1.15E-03	1.36E-02	0.00E+00	5.30E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	2000	74	2.98E+02	3.63E+02	2.40E-02	5.07E-02	4.10E-02	3.85E+00	4.27E-04	5.43E-03	0.00E+00	2.16E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1999	84	3.39E+02	4.16E+02	2.99E-02	6.26E-02	4.79E-02	4.39E+00	4.86E-04	6.63E-03	0.00E+00	2.69E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1998	69	2.76E+02	3.44E+02	3.27E-02	6.69E-02	4.70E-02	3.57E+00	3.96E-04	6.64E-03	0.00E+00	2.95E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1997	44	1.77E+02	2.22E+02	2.27E-02	4.60E-02	3.08E-02	2.30E+00	2.54E-04	4.52E-03	0.00E+00	2.04E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1996	31	1.26E+02	1.59E+02	1.73E-02	3.49E-02	2.23E-02	1.64E+00	1.81E-04	3.41E-03	0.00E+00	1.56E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1995	27	1.07E+02	1.35E+02	1.56E-02	3.13E-02	1.92E-02	1.38E+00	1.53E-04	3.03E-03	0.00E+00	1.41E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1994	16	6.32E+01	8.02E+01	9.83E-03	1.97E-02	1.16E-02	8.19E-01	9.06E-05	1.89E-03	0.00E+00	8.87E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1993	7	2.85E+01	3.63E+01	4.70E-03	9.35E-03	5.32E-03	3.69E-01	4.09E-05	8.96E-04	0.00E+00	4.24E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1992	3	1.13E+01	1.45E+01	1.97E-03	3.90E-03	2.15E-03	1.46E-01	1.62E-05	3.72E-04	0.00E+00	1.78E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1991	1	3.05E+00	3.92E+00	5.58E-04	1.10E-03	5.88E-04	3.95E-02	4.37E-06	1.05E-04	0.00E+00	5.04E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1990	0	5.02E-01	6.48E-01	9.65E-05	1.90E-04	9.84E-05	6.50E-03	7.19E-07	1.80E-05	0.00E+00	8.71E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1989	0	7.19E-02	9.33E-02	1.45E-05	2.85E-05	1.43E-05	9.31E-04	1.03E-07	2.68E-06	0.00E+00	1.31E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1988	0	5.82E-03	7.59E-03	1.23E-06	2.41E-06	1.18E-06	7.54E-05	8.35E-09	2.26E-07	0.00E+00	1.11E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1987	0	3.40E-04	4.46E-04	7.65E-08	1.46E-07	7.10E-08	4.40E-06	4.88E-10	1.37E-08	0.00E+00	6.90E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SC	SC	1986	0	1.70E-05	2.24E-05	3.99E-09	7.63E-09	3.61E-09	2.21E-07	2.44E-11	7.11E-10	0.00E+00	3.60E-10
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2005	0	1.27E+00	1.03E+01	2.80E-05	1.88E-04	7.70E-04	1.14E-01	1.04E-05	1.88E-05	0.00E+00	2.53E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2004	0	1.19E+00	9.65E+00	3.71E-05	1.79E-04	7.83E-04	1.07E-01	9.67E-06	1.87E-05	0.00E+00	3.35E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2003	0	1.09E+00	8.91E+00	4.04E-05	1.69E-04	7.35E-04	9.85E-02	8.92E-06	1.83E-05	0.00E+00	3.65E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2002	0	9.69E-01	7.89E+00	4.38E-05	1.53E-04	6.96E-04	8.72E-02	7.89E-06	1.72E-05	0.00E+00	3.95E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2001	0	9.29E-01	7.57E+00	5.31E-05	1.50E-04	7.48E-04	8.36E-02	7.57E-06	1.89E-05	0.00E+00	4.79E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	2000	0	9.62E-01	7.84E+00	7.27E-05	1.59E-04	1.01E-03	8.65E-02	7.84E-06	2.56E-05	0.00E+00	6.56E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1999	0	9.93E-01	8.10E+00	7.77E-05	1.68E-04	1.06E-03	8.93E-02	8.09E-06	2.77E-05	0.00E+00	7.01E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1998	0	9.51E-01	7.76E+00	7.70E-05	1.64E-04	1.03E-03	8.56E-02	7.75E-06	2.78E-05	0.00E+00	6.95E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1997	0	8.59E-01	7.01E+00	7.18E-05	1.51E-04	9.48E-04	7.73E-02	7.00E-06	2.62E-05	0.00E+00	6.48E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1996	0	3.67E-01	2.99E+00	3.16E-05	6.60E-05	4.12E-04	3.30E-02	2.99E-06	1.17E-05	0.00E+00	2.85E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1995	0	2.44E-01	2.01E+00	4.61E-05	1.32E-04	3.58E-04	2.20E-02	1.99E-06	1.87E-05	0.00E+00	4.16E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1994	0	1.81E-01	1.49E+00	3.52E-05	9.93E-05	2.70E-04	1.63E-02	1.47E-06	1.44E-05	0.00E+00	3.17E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1993	0	1.01E-01	8.36E-01	2.03E-05	5.67E-05	1.54E-04	9.11E-03	8.25E-07	8.37E-06	0.00E+00	1.83E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1992	0	8.02E-02	6.63E-01	1.65E-05	4.58E-05	1.24E-04	7.22E-03	6.54E-07	6.87E-06	0.00E+00	1.49E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1991	0	5.73E-02	4.74E-01	1.21E-05	3.33E-05	8.98E-05	5.16E-03	4.67E-07	5.08E-06	0.00E+00	1.09E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1990	0	5.06E-02	4.18E-01	1.10E-05	2.99E-05	8.05E-05	4.55E-03	4.12E-07	4.64E-06	0.00E+00	9.91E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1989	0	3.04E-02	2.51E-01	6.76E-06	1.83E-05	4.91E-05	2.73E-03	2.47E-07	2.87E-06	0.00E+00	6.10E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	500	Construction and Mining Equipment	U	N	NHH	P	Riverside	SS	SC	1988	0	1.01E-02	8.37E-02	2.31E-06	6.20E-06	1.66E-05	9.10E-04	8.24E-08	9.88E-07	0.00E+00	2.09E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2005	0	1.85E+00	4.70E+00	2.00E-05	2.52E-04	3.88E-04	5.17E-02	5.37E-06	1.28E-05	0.00E+00	1.81E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2004	0	1.80E+00	4.59E+00	3.10E-05	2.56E-04	4.14E-04	5.04E-02	5.23E-06	1.65E-05	0.00E+00	2.80E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2003	0	1.82E+00	4.63E+00	4.90E-05	2.70E-04	4.83E-04	5.08E-02	5.28E-06	2.33E-05	0.00E+00	4.42E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2002	0	2.00E+00	5.13E+00	1.04E-04	3.11E-04	7.39E-04	5.60E-02	5.82E-06	4.49E-05	0.00E+00	9.40E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2001	0	1.97E+00	5.06E+00	1.09E-04	3.18E-04	7.55E-04	5.52E-02	5.73E-06	4.82E-05	0.00E+00	9.86E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	2000	0	1.99E+00	5.11E+00	1.17E-04	3.34E-04	7.88E-04	5.57E-02	5.78E-06	5.26E-05	0.00E+00	1.06E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1999	0	1.93E+00	4.96E+00	1.20E-04	3.36E-04	7.90E-04	5.40E-02	5.61E-06	5.49E-05	0.00E+00	1.08E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1998	0	1.88E+00	4.85E+00	1.23E-04	3.40E-04	7.97E-04	5.28E-02	5.48E-06	5.74E-05	0.00E+00	1.11E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1997	0	1.80E+00	4.64E+00	1.24E-04	3.37E-04	7.86E-04	5.04E-02	5.23E-06	5.85E-05	0.00E+00	1.12E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1996	0	1.76E+00	4.54E+00	1.27E-04	3.41E-04	9.22E-04	4.94E-02	5.13E-06	5.55E-05	0.00E+00	1.15E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1995	0	1.53E+00	3.95E+00	1.16E-04	3.06E-04	8.25E-04	4.29E-02	4.46E-06	5.11E-05	0.00E+00	1.05E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1994	0	1.24E+00	3.20E+00	9.78E-05	2.55E-04	6.86E-04	3.47E-02	3.60E-06	4.36E-05	0.00E+00	8.83E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1993	0	3.41E-01	8.82E-01	2.81E-05	7.25E-05	1.94E-04	9.56E-03	9.92E-07	1.26E-05	0.00E+00	2.54E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1992	0	2.42E-01	6.26E-01	2.08E-05	5.30E-05	1.42E-04	6.79E-03	7.04E-07	9.41E-06	0.00E+00	1.87E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1991	0	2.11E-01	5.47E-01	1.88E-05	4.75E-05	1.27E-04	5.92E-03	6.14E-07	8.60E-06	0.00E+00	1.70E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1990	0	3.28E-01	8.49E-01	3.03E-05	7.59E-05	2.02E-04	9.19E-03	9.54E-07	1.39E-05	0.00E+00	2.73E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1989	0	2.59E-01	6.72E-01	2.48E-05	6.16E-05	1.64E-04	7.26E-03	7.54E-07	1.15E-05	0.00E+00	2.24E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1988	0	2.27E-01	5.88E-01	2.25E-05	5.53E-05	1.47E-04	6.35E-03	6.59E-07	1.05E-05	0.00E+00	2.03E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1987	0	1.84E-01	4.82E-01	2.43E-05	7.15E-05	1.64E-04	5.14E-03	5.34E-07	1.28E-05	0.00E+00	2.20E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1986	0	1.33E-01	3.50E-01	1.82E-05	5.32E-05	1.22E-04	3.73E-03	3.87E-07	9.62E-06	0.00E+00	1.64E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1985	0	9.90E-02	2.61E-01	1.40E-05	4.05E-05	9.25E-05	2.77E-03	2.88E-07	7.41E-06	0.00E+00	1.26E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1984	0	6.84E-02	1.81E-01	1.06E-05	2.94E-05	6.53E-05	1.92E-03	1.99E-07	5.31E-06	0.00E+00	9.60E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1983	0	3.60E-02	9.52E-02	5.77E-06	1.58E-05	3.51E-05	1.01E-03	1.05E-07	2.89E-06	0.00E+00	5.20E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	175	Industrial Equipment	U	P	NHH	NP	Riverside	SS	SC	1982	0	1.20E-02	3.18E-02	1.98E-06	5.40E-06	1.20E-05	3.36E-04	3.49E-08	9.95E-07	0.00E+00	1.78E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2005	7	1.89E+01	6.92E+00	7.86E-05	4.63E-04	5.53E-04	7.58E-02	8.87E-06	4.17E-05	0.00E+00	7.09E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2004	6	1.79E+01	6.55E+00	1.03E-04	4.37E-04	7.26E-04	7.16E-02	8.38E-06	4.87E-05	0.00E+00	9.30E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2003	6	1.73E+01	6.35E+00	9.99E-05	4.24E-04	7.04E-04	6.94E-02	8.12E-06	4.72E-05	0.00E+00	9.01E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2002	6	1.75E+01	6.42E+00	1.01E-04	4.29E-04	7.12E-04	7.02E-02	8.22E-06	4.77E-05	0.00E+00	9.12E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2001	7	1.98E+01	7.28E+00	1.15E-04	4.86E-04	8.07E-04	7.96E-02	9.31E-06	5.41E-05	0.00E+00	1.03E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2000	3	7.56E+00	2.77E+00	4.36E-05	1.85E-04	3.07E-04	3.03E-02	3.55E-06	2.06E-05	0.00E+00	3.93E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1999	3	8.61E+00	3.18E+00	7.68E-05	3.04E-04	5.39E-04	3.45E-02	4.04E-06	2.85E-05	0.00E+00	6.93E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1998	2	7.01E+00	2.59E+00	6.24E-05	2.47E-04	4.38E-04	2.81E-02	3.29E-06	2.32E-05	0.00E+00	5.63E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1997	2	4.50E+00	1.66E+00	4.01E-05	1.59E-04	2.81E-04	1.80E-02	2.11E-06	1.49E-05	0.00E+00	3.62E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1996	1	3.21E+00	1.18E+00	2.86E-05	1.13E-04	2.01E-04	1.29E-02	1.50E-06	1.06E-05	0.00E+00	2.58E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1995	1	2.71E+00	9.99E-01	2.41E-05	9.54E-05	1.69E-04	1.08E-02	1.27E-06	8.94E-06	0.00E+00	2.17E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1994	1	1.61E+00	5.95E-01	2.04E-05	5.66E-05	1.05E-04	6.44E-03	7.53E-07	8.49E-06	0.00E+00	1.84E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1993	0	7.24E-01	2.68E-01	9.21E-06	2.55E-05	4.75E-05	2.90E-03	3.40E-07	3.83E-06	0.00E+00	8.31E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1992	0	2.87E-01	1.07E-01	3.66E-06	1.01E-05	1.88E-05	1.15E-03	1.35E-07	1.52E-06	0.00E+00	3.30E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1991	0	7.74E-02	2.87E-02	9.85E-07	2.73E-06	5.08E-06	3.10E-04	3.63E-08	4.09E-07	0.00E+00	8.88E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1990	0	1.27E-02	4.72E-03	1.62E-07	4.49E-07	8.36E-07	5.11E-05	5.98E-09	6.74E-08	0.00E+00	1.46E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1989	0	1.82E-03	6.77E-04	2.32E-08	6.44E-08	1.20E-07	7.32E-06	8.56E-10	9.66E-09	0.00E+00	2.10E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1988	0	1.48E-04	5.48E-05	1.88E-09	5.22E-09	9.70E-09	5.93E-07	6.94E-11	7.82E-10	0.00E+00	1.70E-10

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1987	0	8.64E-06	3.20E-06	1.10E-10	3.05E-10	5.67E-10	3.46E-08	4.05E-12	4.57E-11	0.00E+00	9.92E-12
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1986	0	4.33E-07	1.60E-07	5.51E-12	1.53E-11	2.84E-11	1.73E-09	2.03E-13	2.29E-12	0.00E+00	4.97E-13
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2005	2	6.95E+00	4.32E+00	5.72E-05	1.95E-04	3.61E-04	4.74E-02	5.55E-06	2.60E-05	0.00E+00	5.16E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2004	2	6.65E+00	4.13E+00	6.14E-05	1.87E-04	4.38E-04	4.53E-02	5.31E-06	2.49E-05	0.00E+00	5.54E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2003	2	6.53E+00	4.06E+00	6.03E-05	1.83E-04	4.30E-04	4.45E-02	5.21E-06	2.45E-05	0.00E+00	5.44E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2002	2	6.72E+00	4.17E+00	6.20E-05	1.89E-04	4.42E-04	4.58E-02	5.36E-06	2.52E-05	0.00E+00	5.60E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2001	3	7.81E+00	4.85E+00	7.21E-05	2.19E-04	5.14E-04	5.32E-02	6.23E-06	2.92E-05	0.00E+00	6.50E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2000	1	3.18E+00	1.98E+00	2.94E-05	8.93E-05	2.09E-04	2.17E-02	2.54E-06	1.19E-05	0.00E+00	2.65E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1999	1	3.63E+00	2.28E+00	4.71E-05	2.18E-04	2.85E-04	2.47E-02	2.89E-06	2.04E-05	0.00E+00	4.25E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1998	1	2.95E+00	1.85E+00	3.83E-05	1.77E-04	2.32E-04	2.01E-02	2.35E-06	1.66E-05	0.00E+00	3.46E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1997	1	1.90E+00	1.19E+00	2.46E-05	1.14E-04	1.49E-04	1.29E-02	1.51E-06	1.07E-05	0.00E+00	2.22E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1996	0	1.35E+00	8.47E-01	1.75E-05	8.10E-05	1.06E-04	9.21E-03	1.08E-06	7.59E-06	0.00E+00	1.58E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1995	0	1.14E+00	7.14E-01	1.48E-05	6.83E-05	8.96E-05	7.77E-03	9.09E-07	6.40E-06	0.00E+00	1.33E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1994	0	6.76E-01	4.27E-01	1.79E-05	4.05E-05	5.22E-05	4.61E-03	5.39E-07	4.62E-06	0.00E+00	1.62E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1993	0	3.05E-01	1.93E-01	8.09E-06	1.83E-05	2.35E-05	2.08E-03	2.43E-07	2.08E-06	0.00E+00	7.30E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1992	0	1.21E-01	7.65E-02	3.21E-06	7.25E-06	9.34E-06	8.25E-04	9.65E-08	8.27E-07	0.00E+00	2.90E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1991	0	3.26E-02	2.06E-02	8.65E-07	1.95E-06	2.51E-06	2.22E-04	2.60E-08	2.23E-07	0.00E+00	7.80E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1990	0	5.36E-03	3.39E-03	1.42E-07	3.22E-07	4.14E-07	3.66E-05	4.28E-09	3.67E-08	0.00E+00	1.28E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1989	0	7.69E-04	4.86E-04	2.04E-08	4.61E-08	5.93E-08	5.24E-06	6.13E-10	5.25E-09	0.00E+00	1.84E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1988	0	6.23E-05	3.94E-05	1.65E-09	3.73E-09	4.81E-09	4.24E-07	4.97E-11	4.26E-10	0.00E+00	1.49E-10
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1987	0	3.64E-06	2.30E-06	9.65E-11	2.18E-10	2.81E-10	2.48E-08	2.90E-12	2.49E-11	0.00E+00	8.71E-12
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1986	0	1.82E-07	1.15E-07	4.84E-12	1.09E-11	1.41E-11	1.24E-09	1.45E-13	1.25E-12	0.00E+00	4.36E-13
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2005	48	1.95E+02	2.30E+02	2.24E-03	1.43E-02	2.11E-02	2.52E+00	3.00E-04	1.46E-03	0.00E+00	2.02E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2004	46	1.83E+02	2.17E+02	4.29E-03	1.67E-02	2.10E-02	2.37E+00	2.82E-04	1.73E-03	0.00E+00	3.87E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2003	44	1.76E+02	2.13E+02	1.03E-02	2.27E-02	2.26E-02	2.28E+00	2.72E-04	2.54E-03	0.00E+00	9.28E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2002	44	1.77E+02	2.15E+02	1.16E-02	2.52E-02	2.33E-02	2.29E+00	2.74E-04	2.78E-03	0.00E+00	1.05E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2001	49	1.99E+02	2.42E+02	1.45E-02	3.11E-02	2.67E-02	2.57E+00	3.07E-04	3.38E-03	0.00E+00	1.31E-03
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	2000	18	7.37E+01	9.00E+01	5.94E-03	1.26E-02	1.02E-02	9.55E-01	1.14E-04	1.35E-03	0.00E+00	5.36E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1999	21	8.41E+01	1.03E+02	7.40E-03	1.55E-02	1.19E-02	1.09E+00	1.30E-04	1.64E-03	0.00E+00	6.68E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1998	17	6.84E+01	8.51E+01	8.11E-03	1.66E-02	1.17E-02	8.85E-01	1.06E-04	1.64E-03	0.00E+00	7.32E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1997	11	4.39E+01	5.49E+01	5.61E-03	1.14E-02	7.63E-03	5.69E-01	6.78E-05	1.12E-03	0.00E+00	5.07E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1996	8	3.13E+01	3.93E+01	4.29E-03	8.66E-03	5.54E-03	4.05E-01	4.83E-05	8.45E-04	0.00E+00	3.87E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1995	7	2.64E+01	3.33E+01	3.86E-03	7.75E-03	4.75E-03	3.42E-01	4.08E-05	7.52E-04	0.00E+00	3.48E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1994	4	1.57E+01	1.99E+01	2.44E-03	4.87E-03	2.87E-03	2.03E-01	2.42E-05	4.69E-04	0.00E+00	2.20E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1993	2	7.06E+00	9.00E+00	1.16E-03	2.32E-03	1.32E-03	9.15E-02	1.09E-05	2.22E-04	0.00E+00	1.05E-04
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1992	1	2.80E+00	3.59E+00	4.88E-04	9.67E-04	5.32E-04	3.63E-02	4.33E-06	9.22E-05	0.00E+00	4.40E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1991	0	7.55E-01	9.71E-01	1.38E-04	2.73E-04	1.46E-04	9.77E-03	1.17E-06	2.59E-05	0.00E+00	1.25E-05
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1990	0	1.24E-01	1.61E-01	2.39E-05	4.71E-05	2.44E-05	1.61E-03	1.92E-07	4.45E-06	0.00E+00	2.16E-06
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1989	0	1.78E-02	2.31E-02	3.59E-06	7.06E-06	3.55E-06	2.31E-04	2.75E-08	6.65E-07	0.00E+00	3.24E-07
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1988	0	1.44E-03	1.88E-03	3.04E-07	5.97E-07	2.92E-07	1.87E-05	2.23E-09	5.60E-08	0.00E+00	2.75E-08
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1987	0	8.43E-05	1.11E-04	1.90E-08	3.63E-08	1.76E-08	1.09E-06	1.30E-10	3.39E-09	0.00E+00	1.71E-09
2005	Annual	Mon-Sun	2270009005	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N	NHH	NP	Riverside	SS	SC	1986	0	4.22E-06	5.56E-06	9.89E-10	1.89E-09	8.94E-10	5.47E-08	6.52E-12	1.76E-10	0.00E+00	8.93E-11

APPENDIX F

TANKS OUTPUT AND SPECIATE DATABASE SECTIONS FOR THE GASOLINE STORAGE TANK

Summary of Storage Tank Specifications and Emissions
Los Angeles Transfer Center, Los Angeles, CA

Owner	Tank No.	Tank Location	Material Stored	Tank Capacity	Tank Dimensions	Shell Color	Shell Condition	Annual Throughput (gal/yr)	VOC Emissions (tpy)	Permitted?	Citation
UP	TBD	Convault - RIP	Diesel	500	5 x 4 (H)	Blue	Good	NA	NA	Exempt	Rule 219(n)(4)
UP	**TBD**	**Convault - RIP**	**Gasoline**	**500**	**5 x 4 (H)**	**White**	**Good**	**6,000**	**0.081**	**Yes**	**Rule 461**
PARSEC	1	Crane Maintenance	Diesel	1,000	12 x 4 (H)	Gray	Good	NA	NA	Exempt	Rule 219(n)(4)
PARSEC	2	Crane Maintenance	Hydraulic Oil	762	3.8 x 4 x 6.7 [R]	Gray	Good	NA	NA	Exempt	Rule 219(n)(4)
PARSEC	3	Crane Maintenance	SAE 15w-40 Motor Oil	136	2.7 x 2.7 x 2.5 [R]	Gray	Good	NA	NA	Exempt	Rule 219(n)(9)
PARSEC	4	Crane Maintenance	Used Oil	394	2.7 x 3 x 6.5 [R]	Black	Good	NA	NA	Exempt	Rule 219(n)(4)
PARSEC	5	Crane Maintenance	SAE 15w-40 Motor Oil	367	3.5 x 3.5 x 4 [4]	Gray	Fair	NA	NA	Exempt	Rule 219(n)(4)
PARSEC	6	Crane Maintenance	Auto. Transmission Fluid	314	3.5 x 4 x 3 [R]	Gray	Good	NA	NA	Exempt	Rule 219(n)(4)

Notes:
1. UP owned tank throughput estimates provided by David Hawthorne.
2. Emissions calculated using EPA's TANKS programs.
3. Tanks exempt from SCAQMD permitting requirements are not being included in the inventory; therefore, emissions have not been calculated.

Exerpts from CARB's Speciation Profile Database

ORGPROF	SAROAD	ORGFRAC	ORGPROFN	CAS	CHEM_NAME
661	43231	0.01540998	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	110543	n-hexane
661	43248	0.01028	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	110827	cyclohexane
661	43276	0.01294998	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	540841	2,2,4-trimethylpentane
661	45201	0.0036	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	71432	benzene
661	45202	0.01702	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	108883	toluene
661	45203	0.00118	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	100414	ethylbenzene
661	45204	0.00128	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	95476	o-xylene
661	45205	0.00343	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	108383	m-xylene
661	45206	0.00107	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	106423	p-xylene
661	98043	0.00011	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	98828	isopropylbenzene (cumene)
661	98132	0.37335999	Headspace vapors 1996 SSD etoh 2.0% o (MTBE phaseout)	78784	isopentane

TANKS 4.0
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	LATC - Gasoline Tank
City:	Los Angeles C.O.
State:	California
Company:	UPRR
Type of Tank:	Horizontal Tank
Description:	RIP Track

Tank Dimensions

Shell Length (ft):	5.00
Diameter (ft):	4.00
Volume (gallons):	500.00
Turnovers:	12.00
Net Throughput (gal/yr):	6,000.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Los Angeles C.O., California (Avg Atmospheric Pressure = 14.67 psia)

TANKS 4.0
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 10)	All	68.08	62.92	73.24	65.99	6.0512	5.4862	6.6617	66.0000			92.00	Option 4: RVP=10, ASTM Slope=3

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)

Annual Emission Calculations	
Standing Losses (lb):	105.7441
Vapor Space Volume (cu ft):	40.0203
Vapor Density (lb/cu ft):	0.0705
Vapor Space Expansion Factor:	0.1685
Vented Vapor Saturation Factor:	0.6092
Tank Vapor Space Volume	
Vapor Space Volume (cu ft):	40.0203
Tank Diameter (ft):	4.0000
Effective Diameter (ft):	5.0475
Vapor Space Outage (ft):	2.0000
Tank Shell Length (ft):	5.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0705
Vapor Molecular Weight (lb/lb-mole):	66.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.0512
Daily Avg. Liquid Surface Temp. (deg. R):	527.7526
Daily Average Ambient Temp. (deg. F):	65.9667
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	525.6567
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,567.1816
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.1685
Daily Vapor Temperature Range (deg. R):	20.6478
Daily Vapor Pressure Range (psia):	1.1755
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.0512
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	5.4862
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	6.6617
Daily Avg. Liquid Surface Temp. (deg R):	527.7526
Daily Min. Liquid Surface Temp. (deg R):	522.5906
Daily Max. Liquid Surface Temp. (deg R):	532.9145
Daily Ambient Temp. Range (deg. R):	18.3167
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.6092
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.0512
Vapor Space Outage (ft):	2.0000
Working Losses (lb):	57.0542
Vapor Molecular Weight (lb/lb-mole):	66.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.0512
Annual Net Throughput (gal/yr.):	6,000.0000
Annual Turnovers:	12.0000
Turnover Factor:	1.0000
Tank Diameter (ft):	4.0000

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)- (Continued)

Working Loss Product Factor:	1.0000
Total Losses (lb):	162.7984

TANKS 4.0
Emissions Report - Detail Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 10)	57.05	105.74	162.80

APPENDIX G

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR TRUs AND REEFER CARS

Emission Factors for Transport Refrigeration Units and Refrigerated Railcars
Los Angeles Transportation Center, Los Angeles, CA

TRU Equip Type	Average Rating (hp)[1]	Emission Factors (g/hp-hr)[2]					VOC Evaporative Emission Factors[2,3]	
		HC	CO	NOx	DPM	SOx	Part 1 (lb/hr)	Part 2 (lb/yr)
Container	28.56	2.85	6.78	6.43	0.71	0.07	-	-
Railcar	34	3.23	7.49	6.71	0.79	0.07	-	-
Total								

Notes:
1. Based on the average horsepower distribution in the OFFROAD 2006 model.
2. Emission factors from OFFROAD 2006 model.
3. Evaporative emissions are negligible.

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre
2005	Annual	Mon-Sun	2.27E+09	Transport Refrigeration Units	D	15	Transport Refrigeration Units	U	N
2005	Annual	Mon-Sun	2.27E+09	Transport Refrigeration Units	D	25	Transport Refrigeration Units	U	N
2005	Annual	Mon-Sun	2.27E+09	Transport Refrigeration Units	D	50	Transport Refrigeration Units	U	N

Hand	Port	County	Air Basin	Air Dist.	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust
NHH	NP	Los Angeles	SC	SC	1.15E+03	3.27E+03	1.20E+03	2.07E-02	8.80E-02	1.44E-01
NHH	NP	Los Angeles	SC	SC	4.49E+02	1.28E+03	7.96E+02	1.32E-02	4.58E-02	8.56E-02
NHH	NP	Los Angeles	SC	SC	8.18E+03	3.29E+04	3.98E+04	2.11E+00	4.89E+00	4.38E+00
								ROG Exhaust	CO Exhaust	NOX Exhaust
						0-15	lb/hr	1.26E-02	5.38E-02	8.79E-02
						15-25	lb/hr	2.06E-02	7.16E-02	1.34E-01
						25-50	lb/hr	1.28E-01	2.97E-01	2.67E-01
						container	lb/hr	0.100144986	0.237934225	0.225580552
						rail	lb/hr	0.128462617	0.297410608	0.266558642
						container	lb/hp-hr	0.006289645	0.014943552	0.014167675
						rail	lb/hp-hr	0.007128891	0.016504473	0.014792377
						0-15	lb/hp-hr	0.001974637	0.008409021	0.013736294
						15-25	lb/hp-hr	0.001895241	0.006580025	0.012312135
						25-50	lb/hp-hr	0.007128891	0.016504473	0.014792377

CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust	
1.31E+01	1.42E-03	9.22E-03	0.00E+00	1.86E-03	
8.71E+00	9.47E-04	5.41E-03	0.00E+00	1.19E-03	
4.26E+02	4.71E-02	5.13E-01	0.00E+00	1.90E-01	
CO2 Exhaust	SO2 Exhaust	PM Exhaust	load	avg hp	container
8.02E+00	8.71E-04	5.64E-03	0.64	10	0.17
1.36E+01	1.48E-03	8.46E-03	0.64	17	0.08
2.59E+01	2.87E-03	3.12E-02	0.53	34	0.75
21.87652896	0.002417326	0.025063786	0.5575	28.56	
25.89716742	0.002867557	0.031237629	0.53	34	
1.37396396	0.000151821	0.001574141			
1.437134707	0.000159132	0.001733498			
1.252887439	0.000136161	0.000881526			
1.252885877	0.000136161	0.000777189			
1.437134707	0.000159132	0.001733498			

APPENDIX H

DETAILED EMISSION CALCULATIONS

Summary of Diesel Particulate Matter Emissions
Los Angeles Transportation Center, Los Angeles, CA

Source	DPM Emissions (tpy)
Locomotives	3.190
Light Heavy Duty Diesel Trucks	0.001
Heavy-Heavy Duty Diesel Trucks	0.995
Cargo Handling Equipment	2.094
Heavy Equipment	0.167
TRUs and Refrigerated Railcars	0.457
Total	**6.903**

Summary of Diesel Particulate Emissions from Locomotives
Los Angeles Transportation Center, Los Angeles, CA

Source	DPM Emissions (tpy)
Through Trains and Power Moves	0.20
Arriving and Departing Trains	0.47
Arriving and Departing Power Moves	0.06
Yard Operations	2.46
Total	**3.19**

Summary of Emissions from Light Duty Diesel-Fueled Trucks
Los Angeles Transportation Center, Los Angeles, CA

Running Exhaust Emissions

Equipment Type	Equip. ID	Vehicle Class	Make	Model	Year	Annual VMT	Emission Factors (g/mi)					Emissions (tpy)				
							ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Pickup	3518	LHDD	Dodge	2500	2003	5,000	0.32	1.65	6.69	0.08	0.05	0.002	0.009	0.037	0.0005	0.000

Idling Exhaust Emissions

Equip. ID	Vehicle Class	Make	Model	Year	Idling		Emission Factors (g/hr)					Emissions (tpy)				
					(min/day)	(hr/yr)	ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
3518	LHDD	Dodge	2500	2003	15	91	3.173	26.300	75.051	0.753	0.357	0.000	0.003	0.008	0.0001	0.000

Notes:
1. Annual VMT provided by Tony Madrigal of PARSEC.
2. Emission factor calculations assumed an average speed of 15 mph.
3. Running exhaust emission factors calculated using the EMFAC-WD 2006 model with the BURDEN output option.
4. Idling exhaust emission factors for LHDT1 vehicles calculated using the EMFAC-WD 2006 model with the EMFAC output option.

Summary of Emissions from Heavy-Heavy Duty Diesel-Fueled Trucks
Los Angeles Transportation Center, Los Angeles, CA

Running Exhaust Emissions

Number of Truck Trips	VMT per Trip	VMT per Year	Emission Factors (g/mi)					Emissions (tpy)				
			ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
186,771	1.5	280,156.88	5.73	15.40	27.41	2.27	0.24	1.77	4.76	8.46	0.70	0.08

Idling Exhaust Emissions

Number of Truck Trips	Idling		Emission Factors (g/hr)					Emissions (tpy)				
	(min/trip)	(hr/yr)	ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
186,771	30	93,385.63	16.16	52.99	100.38	2.85	0.550	1.66	5.45	10.34	0.29	0.06

Notes:
1. Number of truck trips calculated from UPRR provided gate counts. The total gate counts were increased by 25% to account for bobtail trucks (trucks without a chassis or trailer and trucks with an empty chassis).
2. VMT and idling time per trip estimated based on personal observation.
3. Running exhaust emission factors from EMFAC-WD 2006 with the BURDEN output option.
4. Idling exhaust emission factors from EMFAC-Wd 2006 with the EMFAC output option.
5. Emission factor calculations assumed an average speed of 15 mph.

Summary of Emissions from Cargo Handling Equipment
Los Angeles Transfer Center, Los Angeles, CA

Equipment Type	Equipment ID	Make	Model	Year	Rating (hp)	No of Units	Annual Hours of Operation	Load Factor	Emission Factors (g/bhp-hr)					Emission Factors (tpy)				
									THC	CO	NOx	DPM	SOx	THC	CO	NOx	DPM	SOx
Fork Lift	60003	Taylor	THD200S	2000	154	1	260	0.30	0.5307	2.8296	6.8159	0.3536	0.0597	0.007	0.037	0.090	0.005	0.001
RTG	90403	Mi Jack	1000RC	2004	300	2	2,920	0.43	0.0906	0.9456	4.1618	0.0972	0.0521	0.075	0.785	3.456	0.081	0.043
RTG	98462	Mi Jack	1000R	1984	300	1	2,920	0.43	0.9965	5.4833	12.8557	0.7230	0.0521	0.414	2.277	5.338	0.300	0.022
RTG	98463	Mi Jack	1000R	1984	300	1	0	0.43	0.9965	5.4833	12.8557	0.7230	0.0521	0.000	0.000	0.000	0.000	0.000
RTG	98464	Mi Jack	1000R	1984	300	1	0	0.43	0.9965	5.4833	12.8557	0.7230	0.0521	0.000	0.000	0.000	0.000	0.000
Top Pick	89879	Taylor	TEC 155H	1998	150	1	1,040	0.59	0.5505	2.8920	6.9482	0.3734	0.0597	0.056	0.293	0.705	0.038	0.006
Top Pick	89066	Mi Jack	MJ9090	1990	335	1	60	0.59	0.6811	3.3000	9.0164	0.4547	0.0597	0.009	0.043	0.118	0.006	0.001
Yard Hostler	32008	Ottawa	Commando 30	2003	150	3	8,000	0.55	0.2501	2.7810	5.1174	0.2136	0.0597	0.546	6.070	11.169	0.466	0.130
Yard Hostler	42041	Ottawa	Commando 30	2004	150	10	8,000	0.55	0.1639	2.7540	4.5529	0.1648	0.0597	1.193	20.036	33.123	1.199	0.435
Totals														**2.299**	**29.542**	**54.000**	**2.094**	**0.638**

Notes:
1. Annual hours of operation estimates provided by Ton Madrigal of PARSEC and Raul Perez of UPRR.
2. Emission factors and load factors from CARB's Cargo Handling Equipment Emission Calculation Spreadsheet.

Summary of Emissions from Heavy Equipment
Los Angeles Transportation Center, Los Angeles, CA

Equipment Type	Equipment ID	Make	Model	Year	Rating (hp)	No of Units	Annual Hours of Operation	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions		Emission Factors (tpy)				
									ROG	CO	NOx	DPM	SOx	Part 1 (lb/hr)	Part 2 (lb/yr)	ROG	CO	NOx	DPM	SOx
Crane		Grove	RT650E	2003	275	1	2,190	0.43	0.2332	0.2332	0.2332	0.1053	0.0478	-	-	0.067	0.067	0.067	0.030	0.014
Fork Lift	80402	Lull	John Deere	2004	150	1	8,000	0.30	0.3500	0.3500	0.3500	0.1861	0.0548	-	-	0.139	0.139	0.139	0.074	0.022
Fork Lift		Toyota		1999	150	1	2,190	0.30	0.3500	0.3500	0.3500	0.5778	0.0548	-	-	0.038	0.038	0.038	0.063	0.006
Totals																**0.243**	**0.243**	**0.243**	**0.167**	**0.041**

Notes:
1. Annual hours of operation estimates provided by Ton Madrigal of PARSEC and Raul Perez of UP.
2. Emission factors and load factors from CARB's OFFROAD2006 model.
3. Evaporative emissions are negligible.

Toxic Air Contaminant Emissions from the Gasoline Storage Tank
Los Angeles Transfer Center, Los Angeles, CA

CAS	Chemical Name	Organic Fraction	Emissions (tpy)
540841	2,2,4-trimethylpentane	0.0129	0.0011
71432	benzene	0.0036	0.0003
110827	cyclohexane	0.0103	0.0008
100414	ethylbenzene	0.0012	0.0001
78784	isopentane	0.3734	0.0304
98828	isopropylbenzene (cumene)	0.0001	0.0000
108383	m-xylene	0.0034	0.0003
110543	n-hexane	0.0154	0.0013
95476	o-xylene	0.0013	0.0001
106423	p-xylene	0.0011	0.0001
108883	toluene	0.0170	0.0014
Total		**0.44**	**0.0358**

Notes:
1. Organic fraction from ARBs SPECIATE database. Data is from "Headspace vapors 1996 SSD etoh 2.0% (MTBE phaseout)" option.
2. Emissions were calculated for only chemicals that were in both the speciation profile database and the AB2588 list.

Summary of Emissions from Transport Refrigeration Units and Refrigerated Railcars
Los Angeles Transportation Center, Los Angeles, CA

TRU Equip Type	Average Rating (hp)[1]	Fuel Type	Average No. Units in Yard[2]	Hours of Operation (hr/day)[3]	Hours of Operation (hr/yr)[4]	Load Factor[5]	Emission Factors (g/hp-hr)[6] HC	CO	NOx	DPM	SOx	VOC Evaporative Emission Factors[6, 7] Part 1 (lb/hr)	Part 2 (lb/yr)	Emissions (tpy) HC	CO	NOx	DPM	SOx
Container	28.56	Diesel	20	4	1,460	0.56	2.85	6.78	6.43	0.71	0.07	-	-	1.46	3.47	3.29	0.366	0.04
Railcar	34	Diesel	4	4	1,460	0.53	3.23	7.49	6.71	0.79	0.07	-	-	0.38	0.87	0.78	0.091	0.01
Total			**24**		**2,920**									**1.84**	**4.34**	**4.07**	**0.457**	**0.04**

Notes:
1. Based on the average horsepower distribution in the OFFROAD 2006 model.
2. UPRR staff estimate that there are 8-10 TRUs and 0-2 reefer cars and in the Yard at any given time. To be conservative, these estimates were increased by 100%.
3. From CARB's Staff Report: ISOR, ATCM for TRUs, Section V.a.2.
4. It was assumed that the number of units and the annual hours of operations remains constant, with individual units cycling in and out of the yard.
5. Load factors are the default factors from the OFFROAD 2006 model.
6. Emission factors from OFFROAD 2006 model.
7. Evaporative emissions are negligible.

Equipment Specifications for Portable Welders
Los Angeles Transfer Center, Los Angeles, CA

Location	Make	Serial No.	Fuel Type	Rating (hp)
RIP Track	Miller Blue Stars 6000	LC507236	Gasoline	9
RIP Track	Miller Blue Stars 6000	LC248313	Gasoline	9
Crane Maintenance Area	Miller Bobcat 225	KH393622	Gasoline	16

Notes:
1. Welding equipment and operations are exempt from SCAQMD permitting requirements per Rule 219(f)(8).
2. IC engines meet the exempt requirements of SCAQMD Rule 219(b)(1).

Equipment Specifications for Miscellaneous Combustion Sources
Los Angeles Transfer Center, Los Angeles, CA

Location	Equipment Type	Make	Serial No.	Fuel Type	Rating (hp)
RIP Track	Air Compressor	Ingersoll-Rand	82825 L-6 TH	Gasoline	49
RIP Track	Air Compressor	Briggs and Straton	33106906M221	Diesel	45
Admin. Bldg.	Light Tower	Coleman	Unknown	Diesel	18
Admin. Bldg.	Light Tower	Dyna	17840J81	Diesel	10.7

Notes:
1. Per David Hawthorne, one of the light towers has been removed and the other hasn't been used.
2. All equipment is exempt from SCAQMD permitting requirements, per Rule 219(b)(1).

APPENDIX I

DETAILED RISK SCREENING CALCULATIONS

Summary of Risk Index Values
Los Angeles Transportation Center, Los Angeles, CA

Source	Risk Index Value Cancer	% of Total Cancer Risk	Risk Index Value Chronic	% of Total Chronic Risk
Locomotives	9.57E-04	46.21	1.60E+01	36.04
LHD Diesel Trucks	1.61E-07	0.01	2.69E-03	0.01
HHD Diesel Trucks	2.98E-04	14.41	4.97E+00	11.24
Cargo Handling Equipment	6.28E-04	30.34	1.05E+01	23.66
Heavy Equipment	5.00E-05	2.41	8.33E-01	1.88
Tanks	8.50E-09	0.00	9.74E+00	22.00
TRUs and Reefer Cars	1.37E-04	6.62	2.29E+00	5.17
Total	2.07E-03	100.00	4.43E+01	100.00
De Minimis Sources (% of Total)		2.42		1.89

Calculation of Risk Index Values for Diesel-Fueled Sources
Los Angeles Transportation Center, Los Angeles, CA

Source	DPM Emissions (tpy)	Unit Risk Factor Cancer	Cancer Risk Index Value	Unit Risk Factor Chronic	Chronic Risk Index Value
Locomotives	3.190	3.00E-04	9.57E-04	5.00E+00	1.60E+01
LHD Diesel Trucks	0.001	3.00E-04	1.61E-07	5.00E+00	2.69E-03
HHD Diesel Trucks	0.995	3.00E-04	2.98E-04	5.00E+00	4.97E+00
Cargo Handling Equipment	2.094	3.00E-04	6.28E-04	5.00E+00	1.05E+01
Heavy Equipment	0.167	3.00E-04	5.00E-05	5.00E+00	8.33E-01
TRUs and Reefer Cars	0.457	3.00E-04	1.37E-04	5.00E+00	2.29E+00
Total	**6.903**		**2.07E-03**		**3.45E+01**

Notes:
1. Unit risk factor from Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values, April 25, 2005. Cancer inhalation risk used.

Summary of Toxic Air Contaminant Emissions
Los Angeles Transportation Center, Los Angeles, CA

CAS	Chemical Name	Emissions (tpy) Gasoline Tank	Unit Risk Factor Cancer	Unit Risk Factor Chronic	Cancer Risk Index Value	Chronic Risk Index Value
540841	2,2,4-trimethylpentane	0.0011				
71432	Benzene	0.0003	2.90E-05	6.00E+01	8.50E-09	1.76E-02
110827	Cyclohexane	0.0008			0.00E+00	0.00E+00
100414	Ethylbenzene	0.0001		2.00E+03	0.00E+00	1.92E-01
78784	isopentane	0.0304			0.00E+00	0.00E+00
98828	Isopropylbenzene (cumene)	0.0000			0.00E+00	0.00E+00
108383	m-xylene	0.0003		7.00E+02	0.00E+00	1.95E-01
110543	n-hexane	0.0013		7.00E+03	0.00E+00	8.78E+00
95476	o-xylene	0.0001		7.00E+02	0.00E+00	7.29E-02
106423	p-xylene	0.0001		7.00E+02	0.00E+00	6.10E-02
108883	Toluene	0.0014		3.00E+02	0.00E+00	4.16E-01
1330207	Xylene (total)	0.0000		7.00E+02	0.00E+00	0.00E+00
Total		**0.0358**			**8.50E-09**	**9.74E+00**

APPENDIX J

SOURCE TREATMENT AND ASSUMPTIONS FOR AIR DISPERSION MODELING FOR NON-LOCOMOTIVE SOURCES

Appendix J

Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources

As shown in Figure 3 emissions were allocated spatially throughout the Yard in the areas where each source type operates or is most likely to operate. Emissions from mobile sources, low-level cargo handling equipment, heavy equipment, and moving locomotives were simulated as a series of volume sources along their corresponding travel routes and work areas. Yard hostlers, heavy duty trucks, and other low-level emission sources are first allocated to the areas of the yard where their activity occurs, and are then allocated uniformly to a series of sources within the defined areas. Depending on their magnitude and proximity to yard boundaries, idling emissions for heavy duty trucks may be treated as point sources rather than being included in the non-idling volume sources used to characterize moving vehicles. Idling of locomotives and elevated cargo handling equipment (cranes) were simulated as a series of point sources within the areas where these events occur. Large sources such as RTGs and cranes that are stationary or slow moving are treated as point sources with appropriate stack parameters

Emissions from stationary sources, such as fuel tanks, were simulated as a point source corresponding to the actual equipment location with in the Yard. Assumptions used spatially to allocate emissions for each source group are shown in the Table below. See Figure 3 for the source locations. See Appendix A-4 for assumptions regarding the spatial allocation of locomotive emissions.

Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources Los Angeles Transportation Center		
Source	Source Treatment	Assumptions for Spatial Allocation of Emissions
Gasoline Storage Tank	Point	Assumed all emissions occurred at the storage tank location.
HHD Diesel-Fueled Trucks – Intermodal Trucks (idling)	Volume	Assumed 1/3 of the total HHD truck idling occurred at the intermodal gate and the remainder occurred in the trailer parking area.
HHD Diesel-Fueled Trucks –(traveling)	Volume	Assumed that all of the emissions from HHD truck traveling occurred in the trailer parking area. Emissions were evenly split between the North and South trailer parking areas.
Cargo Handling Equipment (low level)	Volume	Yard Hostlers – assumed all of the emissions occurred in the trailer parking areas. Emissions were evenly allocated between the North and South trailer parking areas. Top Picks (2) and Taylor Forklift - allocated all emissions the trailer parking areas. Emissions were evenly allocated between the North and South trailer parking areas.
Cargo Handling Equipment (RTGs)	Point	Assumed 10% of the total emissions from RTGs occurred at the crane pad and the remaining emission occurred in the areas around the unloading tracks.
Heavy Equipment (idling and traveling)	Volume	Emissions from all heavy equipment were assumed to occur in and around the car shop.

APPENDIX K

SEASONAL AND DIURNAL ACTIVITY PROFILES

Appendix K

Development of Temporal Activity Profiles for the UPRR LATC Facility

Locomotive activity can vary by time of day and season. For each yard, the number of trains arriving and departing from the yard in each month and each hour of the day was tabulated and used to develop temporal activity profiles for modeling. The number of locomotives released from service facilities in each month was also tabulated. The AERMOD EMISFACT SEASHR option was used to adjust emission rates by season and hour of the day, and the EMISFACT SEASON option was used where only seasonal adjustments were applied. Where hour of day adjustments (but not seasonal) were applied, the EMISFACT HROFDY option was used.

Time of day profiles for train idling activity were developed assuming that departure events involved locomotive idling during the hour of departure and the two preceding hours, and that arrival events involved locomotive idling during the hour of arrival and the two hours following. Thus, the hourly activity adjustment factor for hour *i* is given by

$$\frac{\frac{1}{3}\cdot\sum_{j=i}^{i+2} NA(j) + \frac{1}{3}\cdot\sum_{j=i-2}^{i} ND(j)}{\sum_{j=1}^{24}(NA(j)+ND(j))} ,$$

where *NA(j)* and *ND(j)* are respectively the number of arriving and departing trains in hour *j*. These factors were applied to both idling on arriving and departing trains and idling in the service area (if applicable).

Similarly, time of day profiles for road power movements in the yard (arrivals, departures, and power moves) were developed without including arrivals in preceding hours and departures in subsequent hours. In this case, the hourly activity adjustment factor for hour *i* is given by

$$\frac{NA(i)+ND(i)}{\sum_{j=1}^{24}(NA(j)+ND(j))} .$$

Seasonal adjustment factors are calculated as the sum of trains arriving and departing in each three month season, divided by the total number of arrivals and departures for the year. The hourly adjustment factors for each season are simply the product of the seasonal adjustment factor and the 24 hourly adjustment factors.

For yards with heavy duty truck and cargo handling activities related to rail traffic, seasonal train activity adjustments were applied, but not hour of day adjustments. Temporal profiles for yard switching operations were based on hourly (but not seasonal) factors developed from the operating shifts for the individual yard switching jobs. In some cases, locomotive load testing diurnal profiles were developed based on the specific times of day when load testing is conducted.

Table K-1 lists the hourly activity factors derived for train movements, train idling, and yard operations at the UPRR LATC Facility. Separate temporal profiles are listed for day and night moving emissions as different volume source parameters are used for day and night. Table K-2 lists the seasonal activity factors for train activity.

Table K-1. Hourly Activity Factors for the UPRR LATC Facility

Hour	Train Idling	Train Movements (Daytime)	Train Movements (Nighttime)	Yard Switching Idling	Yard Switching (Daytime)	Yard Switching (Nighttime)
1	0.890	0.000	0.779	1.286	0.000	1.286
2	0.869	0.000	0.754	1.286	0.000	1.286
3	0.931	0.000	2.412	1.286	0.000	1.286
4	0.964	0.000	1.116	1.286	0.000	1.286
5	1.053	0.000	1.140	1.286	0.000	1.286
6	1.124	0.000	1.814	1.286	0.000	1.286
7	1.109	0.947	0.000	1.286	1.286	0.000
8	1.056	0.947	0.000	0.857	0.857	0.000
9	0.949	1.035	0.000	0.857	0.857	0.000
10	0.959	1.253	0.000	0.857	0.857	0.000
11	0.964	0.704	0.000	0.857	0.857	0.000
12	1.027	0.517	0.000	0.857	0.857	0.000
13	1.080	0.735	0.000	0.857	0.857	0.000
14	1.148	0.829	0.000	0.857	0.857	0.000
15	1.111	0.891	0.000	0.857	0.857	0.000
16	1.061	1.165	0.000	0.857	0.857	0.000
17	1.003	0.810	0.000	0.857	0.857	0.000
18	0.999	0.816	0.000	0.857	0.857	0.000
19	0.970	0.000	0.823	0.857	0.000	0.857
20	0.971	0.000	0.735	0.857	0.000	0.857
21	0.995	0.000	0.904	0.857	0.000	0.857
22	0.968	0.000	1.035	0.857	0.000	0.857
23	0.936	0.000	0.960	0.857	0.000	0.857
24	0.865	0.000	0.879	1.286	0.000	1.286

Table K-2. Seasonal Activity Factors for the UPRR LATC Facility

Activity Type	Winter	Spring	Summer	Fall
Trains	1.020	1.066	1.020	0.894

APPENDIX L

SELECTION OF POPULATION FOR THE URBAN OPTION INPUT IN AERMOD AIR DISPERSION MODELING ANALYSIS

Appendix L

Selection of Population for the Urban Option Input in AERMOD Air Dispersion Modeling Analysis

Urban heat islands and the thermal domes generated by them extend over an entire urbanized area[1]. Hot spots within the urban heat island are associated with roads and roofs, which surround each Union Pacific (UP) rail yard in high density. Following guidance cited by the ARB ("*For urban areas adjacent to or near other urban areas, or part of urban corridors, the user should attempt to identify that part of the urban area that will contribute to the urban heat island plume affecting the source.*"), it is the entire metropolitan area that contributes to the urban heat island plume affecting the rail yard. For metropolitan areas containing substantial amounts of open water, the area of water should not be included.

To simulate the effect of the urban heat island on turbulence in the boundary layer, especially at night, when the effect is substantial, AERMOD adjusts the height of the nighttime urban boundary layer for the heat flux emitted into the boundary layer by the urban surface, which is warmer than surrounding rural areas[2,3]. The difference between the urban and rural boundary layer temperatures is proportional to the maximum temperature difference of 12 Celsius degrees observed in a study of several Canadian cities, and directly related to the logarithm of the ratio of the urban population to a reference population of 2,000,000 (i.e., Montreal, the Canadian city with the maximum urban-rural temperature difference)[4].

The adjusted height of the nocturnal urban boundary layer is proportional to the one-fourth power of the ratio of the population of the city of interest to the reference population, based on the observation that the convective boundary layer depth is proportional to the square root of the city size, and city size is roughly proportional to the square root of its population, assuming constant population density[5]. Regardless of wind direction during any specific hour used by AERMOD, it is the entire metropolitan area, minus bodies of water, which moves additional heat flux into the atmosphere and affects its dispersive properties, not just the 400 km^2 area of the air dispersion modeling domain that surrounds the each rail yard, which was chosen purely for modeling convenience.

Continuing to follow the guidance cited by the ARB (*"If this approach results in the identification of clearly defined MSAs, then census data may be used as above to determine the appropriate population for input to AERMOD")*, the population of each Metropolitan Statistical Area is being used in the modeling run for each rail yard.

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[1] USEPA. *Thermally-Sensed Image of Houston*, http://www.epa.gov/heatisland/pilot/houston_thermal.htm, included in Heat Island Effect website, http://www.epa.gov/heatisland/about/index.html, accessed November 8, 2006.
[2] USEPA. *AERMOD: Description of Model Formulation*, Section 5.8 – Adjustments for the Urban Boundary Layer, pages 66-67, EPA-454/R-03-004, September 2004, accessed at http://www.epa.gov/scram001/7thconf/aermod/aermod_mfd.pdf on November 9,
[3] Oke, T.R. *City Size and the Urban Heat Island*, Atmospheric Environment, Volume 7, pp. 769-779, 1973.
[4] Ibid for References 3 and 4.
[5] Ibid.

APPENDIX M

DEMOGRAPHIC DATA

Appendix M

Population Shape Files for UPRR Rail Yards

The accompanying shape files include census boundaries as polygons and the corresponding residential populations from the 2000 U.S. Census. Separate shape files are included at the tract, block group, and block levels. The primary ID for each polygon begins with *ssccctttttt*, where *ss* is the FIPS state code (06 for California), *cc* is the county code, and *tttttt* is the tract code. The primary IDs for block groups have a single additional digit which is the block group number within each tract. Those for blocks have four additional digits identifying the block number. The population for each polygon are included as both the secondary ID and as attribute 1. Polygon coordinates are UTM zone 10 (Oakland and Stockton) or 11 (southern California yards), NAD83, in meters. The files contain entire tracts, block groups, or blocks that are completely contained within a specified area. For all yards except Stockton, the area included extends 10 kilometers beyond the 20 x 20 kilometer modeling domains. For Stockton, this area was extended to 20 kilometers beyond the modeling domain boundaries to avoid excluding some very large blocks.

In merging the population data[1] with the corresponding boundaries[2], it was noted that at all locations, there are defined census areas (primarily blocks, but in some cases block groups and tracts) for which there are no population records listed in the population files. Overlaying these boundaries on georeferenced aerial photos indicates that these are areas that likely have no residential populations (e.g., industrial areas and parks). The defined areas without population data have been excluded from these files. Areas with an identified population of zero have been included. It was also observed that some blocks, block groups and tracts with residential populations cover both residential areas and significant portions of the rail yards themselves. For this reason, any analysis of population exposures based on dispersion modeling should exclude receptors that are within the yard boundaries or within 20 meters of any modeled emission source locations.

To facilitate the exclusion of non-representative receptors, separate shape files have been generated that define the area within 20 meters of the yard boundaries for each yard. These files are also included with the accompanying population files. It should also be noted that the spatial extent of individual polygons can vary widely, even within the same type. For example, single blocks may be as small as 20 meters or as large as 10,000 meters or more in length. To estimate populations contained within specific areas, it may prove most useful to generate populations on a regular grid (e.g., 250 x 250 m cells) rather than attempting to process irregularly shaped polygons.

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[1] Population data were extracted from the *Census 2000 Summary File 1* DVD, issued by the U.S. Department of Commerce, September 2001.

[2] Boundaries were extracted from ESRI shapefiles (*.shp) created from the U.S. Census TIGER Line Files downloaded from ESRI (*http://arcdata.esri.com/data/tiger2000/tiger_download.cfm*).