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Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Oakland Rail Yard, Oakland, California

prepared for:

Union Pacific Railroad Company

March 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 air emissions inventory and air dispersion modeling analysis for the Oakland Rail Yard (Yard) in Oakland, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, and portable sources at the Yard. 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).

The Oakland Yard is an intermodal container facility. Cargo containers are received, sorted, and distributed from the facility. Activities at Oakland include receiving inbound trains, switching cars, loading and unloading intermodal trains, storage of intermodal containers and chassis, building and departing outbound trains, and repairing freight cars and intermodal containers/chassis, and servicing locomotives. Facilities within the Yard include: classification tracks, a gate complex for inbound and outbound intermodal truck traffic, intermodal loading and unloading tracks, a locomotive service track, a freight car repair shop, an on-site wastewater treatment plant, and various buildings and facilities supporting railroad and contractor operations. In addition, there are two warehouse distribution centers, operated by lessee Pacific Coast Containers, Inc. (PCC), located within the property boundary of the Oakland Yard. Emissions from heavy, heavy-duty Diesel truck traffic and transport refrigeration units (TRUs) and refrigerated rail cars (reefer cars) associated with PCC operations have been included in this inventory.

Emission sources include, but are not limited to, locomotives, on-road Diesel-fueled trucks, heavy-heavy-duty Diesel-fueled trucks, cargo handling equipment, heavy equipment, TRUs and reefer 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 the Oakland Yard. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations surrounding 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 hourly wind speed and direction, temperature, and cloud cover data from the Oakland International Airport. The meteorological data were 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 Emissions Inventory and Dispersion Modeling Report for the Oakland Rail Yard Oakland, California

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

LIST OF TABLES (continued)

Page

LIST OF APPENDICES

Toxic Air Contaminant Emissions Inventory
and Dispersion Modeling Report
for the
Oakland Rail Yard
Oakland, 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 and dispersion modeling analysis for the Oakland Rail Yard (Yard) in Oakland, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, and portable sources at the Yard. 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 the Oakland Yard. 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 hourly wind speed and direction, temperature, and cloud cover data from the Oakland International Airport. The meteorological data were 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).

PART II. FACILITY DESCRIPTION

A Facility Name and Address

Union Pacific Railroad Company
Oakland Rail Yard
1408 Middle Harbor Road
Oakland, CA 94607

B Facility Contact Information

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C Main Purpose of the Facility

The Oakland Yard is a cargo handling facility. Cargo includes intermodal containers and "manifest" cargo (mixed freight). Cargo containers and other freight 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 Yard. The Yard also includes facilities for crane and tractor maintenance, locomotive service and repair, and an on-site wastewater treatment plant.

D Types of Operations Performed at the Facility

Activities at Oakland include receiving inbound trains, switching cars, loading and unloading intermodal trains, storage of intermodal containers and chassis, building and departing outbound trains, and repairing freight cars and intermodal containers/chassis, and servicing locomotives. Facilities within the Yard include classification tracks, a gate complex for inbound and outbound intermodal truck traffic, intermodal loading and unloading tracks, a locomotive service track, a freight car repair shop, an on-site wastewater treatment plant, and various buildings and facilities supporting railroad and contractor operations. In addition, there are two warehouse distribution centers, operated by lessee Pacific Coast Containers, Inc. (PCC), located at the Oakland Yard. Emissions from heavy heavy-duty Diesel truck traffic and transport refrigeration units (TRUs) and refrigerated rail cars (reefer cars) associated with PCC operations have been included in this inventory.

E Facility Operating Schedule

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

F. General Land Use Surrounding the Facility

The Oakland Yard is surrounded by commercial and industrial properties, a residential area, and several freeways and major roadways. The Port of Oakland and its supporting facilities wrap around the south, southwest, and northwest sides of the Yard. The I-880 and the I-980 freeways are less than one-quarter mile north of the intermodal truck gate. The nearest residential housing area begins just north of the I-880. There are at least six schools within one mile of the intermodal truck gate. The location of sensitive receptors is further discussed in Part IX.

PART III. <u>MAP AND FACILITY PLOT PLAN</u>

Figure 1
Location Map

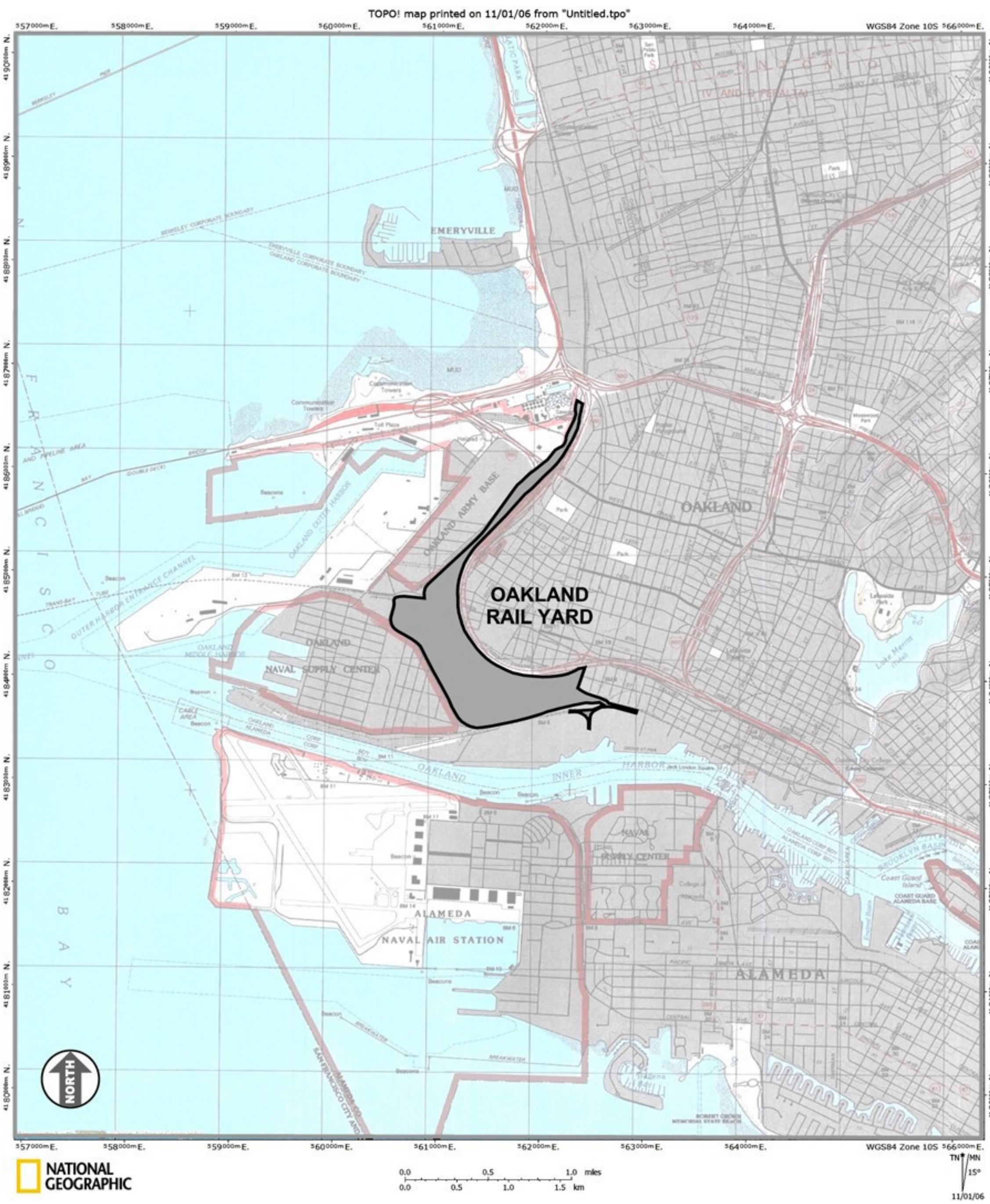
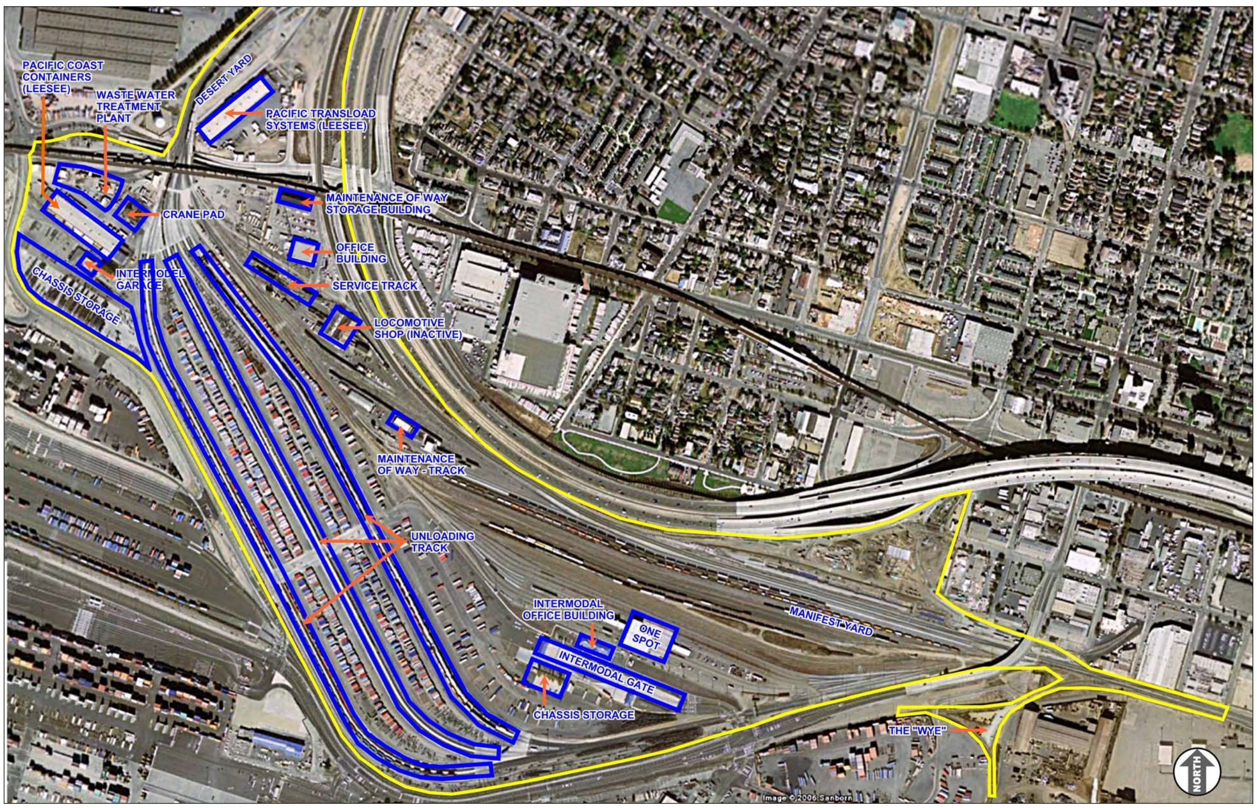


Figure 2
Oakland Rail Yard



PART IV. COVERED SOURCES

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

In accordance with the UPRR *Emission Inventory Protocol,* stationary point and area sources that are exempt from local air district rules have been identified but not included in the detailed emission inventory. Also, de minimis sources, based on weighted risk, have been identified in the inventory but have not been 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 the Oakland Yard. The mobile sources include locomotives, on-road Diesel-fueled trucks, heavy heavy-duty (HHD) Diesel-fueled trucks, cargo handling equipment (CHE), and other heavy equipment. The stationary emission sources include storage tanks, a sand tower, a wastewater treatment plant, heaters, and an emergency generator. Portable equipment operating at the Yard includes transport refrigeration units (TRUs) and refrigerated railcars (reefer cars), welders, air compressors, emergency generators, and a hydraulic lift. 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 and passenger trains) include hauling through trains on the main line; pulling arriving trains into the yard and departing trains out of the yard; and moving locomotives to and from the service and shop areas after arrival and prior to departure. Yard operations include the use of four low horsepower switcher locomotives used 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. They are also used to move road power from service to departing trains Three of the switchers are remote control locomotives operating exclusively within the yard, and the fourth operates both inside the yard and at other locations away from the yard. Locomotive servicing and maintenance involves both road power and yard locomotives, and includes idling associated with refueling, sanding, oiling, and waiting to move to outbound trains. Although the locomotive repair shop at Oakland is no longer active, some minor repairs are made at the service track, and occasionally, this maintenance can include additional periods of idling and higher throttle settings during a limited number of load test events following specific maintenance tasks.

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, including both working and non-working units. Through trains, including both freight trains and Amtrak passenger trains, use the main line passing by the facility. Intermodal trains and other trains enter the yard on specified tracks. Power moves are a group of locomotives with no attached railcars, 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.

B On-Road Diesel-Fueled Trucks

A variety of on-road trucks are used within the Yard to support Yard activities. Table 2 provides the vehicle specifications for the on-road Diesel-fueled trucks operating at the Yard.

Table 1
Locomotive Models (Road Power) Identified at
Oakland Rail Yard

Locomotive Model Group	Train Types[1]							
	Through Trains	Intermodal Trains			Other Trains			Power Moves
		Arriving	Departing	Arrive & Depart	Arriving	Departing	Arrive & Depart	
Switch[2]	1	2	3	0	11	15	0	29
GP3x	237	4	1	0	31	47	23	117
GP4x	12,730	167	112	11	1,495	1,550	84	252
GP50	38	37	24	4	6	19	7	4
GP60	272	90	61	20	101	145	40	30
SD7x	1,993	2,029	1,650	249	197	605	314	196
SD90	77	6	9	1	6	6	2	4
Dash7	59	7	0	0	1	0	5	2
Dash8	728	322	245	25	60	144	72	37
Dash9	2,247	732	558	76	89	269	294	113
C60A	19	17	13	1	2	6	0	1
Unknown	170	23	13	1	17	19	9	4
Total	**18,588**	**3,436**	**2,689**	**388**	**2,016**	**2,825**	**850**	**789**

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

Table 2 Vehicle Specifications for On-Road Diesel-Fueled Trucks Oakland Rail Yard				
Equipment Type	Equipment Owner	Make/Model	Model Year	Vehicle Class
Fuel Truck	Harbor Services	Ford 8000	1984	HHD
Auger Truck	UPRR	Ford K84	1985	HHD
Fuel Truck	LERI[1]	Mack M5200	1989	HHD
Tire Truck	UPRR	Ford 350 Econoline	1989	LHDT1
Boom Truck	UPRR	Ford F800	1992	HHD
Boom Truck	UPRR	Volvo WG64	2001	HHD
Notes: 1. Lift Equipment Rebuilders, Inc (LERI) is a contractor working at the Yard.				

C HHD Diesel-Fueled Trucks

A variety of HHD Diesel-fueled trucks operate at the Oakland Yard each day. The HHD trucks are used to pickup and deliver intermodal cargo containers. The trucks are owned and operated by many 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 trucks operating in Alameda County was used.

In addition to the intermodal operations discussed above, HHD Diesel-fueled trucks are also used to pick up and deliver cargo to the two PCC distribution centers. The trucks are owned and operated by many trucking companies and draymen. Therefore, a fleet distribution is not available. For emission calculations, the EMFAC-WD 2006 model default fleet distribution for HHD Diesel-fueled trucks operating in Alameda County was used.

D Cargo Handling Equipment (CHE)

A variety of heavy equipment is used to load, unload, and move cargo containers in the Yard. Table 3 provides the equipment specifications for CHE operating at the Yard.

Table 3 Equipment Specifications for Cargo Handling Equipment Oakland Rail Yard					
Equipment Type	Make/Model	Engine Make/Model	Model Year	Rating (hp)	No. of Units
Crane	Drott 2500	Case 504 BDT	1973	250	1
RTG[1]	Mi Jack 1000R	Detroit 6-71	1990	238	1
RTG[1]	Taylor	Detroit 50 Series	1999	238	1
RTG[1]	Mi Jack 850	Detroit 50 Series	1999	300	1
RTG[1]	Mi Jack 1200R	Detroit 50 Series	2004	300	1
RTG[1]	Mi Jack 1200R	Detroit 50 Series	2005	300	1
Chassis Stacker	Taylor TCS90	Cummins 6BT	1999	155	2
Chassis Stacker	Taylor THD 2500	Cummins 6BT	2003	155	1
Chassis Stacker	Taylor T300M	Cummins 6BT	2005	155	1
Yard Hostler	Ottawa	Cummins 5.9	2000	175	4
Yard Hostler	Ottawa	Cummins 5.9	2001	175	1
Yard Hostler	Ottawa	Cummins 5.9	2003	175	8
Yard Hostler	Ottawa	Cummins 5.9	2004	175	2
Yard Hostler	Ottawa	Cummins 5.9	2005	175	6

Notes:
1. Rubber Tire Gantry Crane.
2. There is an additional 1979 Detroit 800 AC RTG at the facility, but it was not operated in 2005.

E <u>Heavy Equipment</u>

In addition to the CHE discussed above, Diesel-fueled heavy equipment is used at Oakland to support Yard activities. 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 4 provides detailed information for the heavy equipment used at the Yard.

Table 4 **Equipment Specifications for Heavy Equipment** **Oakland Rail Yard**					
Equipment Type	Equipment Owner/Location	Make/Model	Model Year	Rating (hp)	No. of Units
Crane	One Spot	Lorain RT-250D	1975	*200*	1
Trackmobile	One Spot	Trackmobile TM2400	1994	147	1
Forklift	One Spot	Hyster	1987	225	1
Forklift	TTX	Caterpillar	Pre-1990	*90*	1
Forklift	TTX	Nissan	2005	114	1
Backhoe	Track Department	Case 580C	Pre-1983	62	1
Backhoe	Yard	Ford 555 Special	Pre-1983	55	1
Yard Hostler	IMS	Capacity	1986	125	1
Yard Hostler	Sid's Mobile Repair	Capacity	*1986*	*125*	1
Man Lift	Locomotive Shop	JLG 460SJ	2001	50	1
Notes: 1. Items in italics are engineering estimates.					

F. <u>Tanks</u>

The stationary emission sources at the Yard include storage tanks, a sand tower, a wastewater treatment plant, heaters, and emergency generators. Table 5 provides detailed information for all storage tanks located at the facility.

Table 5 Storage Tank Specifications Oakland Rail Yard			
Tank No.	Tank Location	Material Stored	Tank Capacity (gallons)
GENSET-1[1]	Intermodal Offices	Diesel	170
LER-1[1]	Intermodal Crane Pad	Used Oil	550
LER-2[1]	Intermodal Crane Pad	Hydraulic Oil	300
LER-3[1]	Intermodal Crane Pad	Motor Oil	300
LER-4[1]	Intermodal Crane Pad	Transmission Fluid	230
LER-5[1]	Intermodal Crane Pad	Motor Oil	230
TKND-0820[1]	Intermodal Crane Pad	Diesel	10,000
TKNO-0303[1]	Intermodal Crane Pad	Used Oil	550
TNKO-0304[1]	Car Shop	Used Oil	1,500
TNKW-0197	Car Shop	Wastewater	1,000
TNKD-0822[1]	Car Shop	Diesel	1,000
TNKG-0080	Car Shop	Gasoline	1,000
TNKW-0196	Car Shop	Wastewater	5,000
TNKO-0299[1]	Locomotive Service Track	Lube Oil	15,000
TNKO-0300[1]	Locomotive Service Track	Used Oil	10,000
TNKO-0301[1]	WWTP	Used Oil	12,000
TNKW-0145	WWTP	Wastewater	50,000
TNKO-0302[1]	WWTP	Sludge	10,000
1450[1]	Locomotive Service Track	Water Treatments	12,500
Notes: 1. Exempt from permitting requirements per BAAQMD Rule 2-1-123.			

As shown in Table 5, all storage tanks at the facility, except TNKW-0197, TNKG-0800, TNKW-0196, and TNKW-0145, are exempt from Bay Area Air Quality Management District (BAAQMD) permitting requirements per Rule 2-1-123. Since these storage tanks are exempt from local air district rules, the emissions from these tanks will not be included in this inventory nor in the dispersion modeling analysis consistent with the UPRR inventory protocol.

G. Sand Tower

Locomotives use sand for traction and braking. The sand tower system consists of a storage system and a transfer system to dispense sand into locomotives. The storage system includes a pneumatic delivery system and a storage silo. The transfer system includes a pneumatic transfer system, an elevated receiving silo, and a moving hopper and gantry system.

H Wastewater Treatment Plant

The Oakland Yard also has a wastewater treatment plant (WWTP). Equipment at the WWTP includes an oil/water separator, dissolved air flotation (DAF) unit, pumps, and storage tanks. Air emission sources at the WWTP are from the oil/water separator and the DAF.

I Heaters

There are a number of space heaters operated at the Yard. Table 6 lists the equipment specifications for the heaters.

Table 6
Equipment Specifications for Heaters
Oakland Rail Yard

Location	Fuel Type	Rating (MMBtu/hr)
Administrative Building	Natural Gas	0.06
Administrative Building	Natural Gas	0.06
Administrative Building	Natural Gas	0.06
Administrative Building	Natural Gas	0.06
Administrative Building	Propane	0.06
Administrative Building	Natural Gas	0.06
Car Shop	Natural Gas	0.10
Car Shop	Natural Gas	0.10
Car Shop	Natural Gas	0.10
Car Shop	Natural Gas	0.10
Car Shop	Natural Gas	0.10
Car Shop	Natural Gas	0.10

Notes:
1. Heaters with a rated capacity of less than 1 MMBtu/hr are exempt from BAAQMD permitting requirements per Rule 2-1-114-1.1

Heaters with a rated capacity of less than 1 MMBtu/hr are exempt from BAAQMD permitting requirements per Rule 2-1-114-1.1. As shown in Table 6, the rated capacity of each heater at the Oakland Yard is less than 1 MMBtu/hr. Therefore, the heaters are exempt from BAAQMD permitting requirements. Since the heaters are exempt from local air district rules, the emissions from the heaters will not be included in this inventory nor in the dispersion modeling analysis consistent with the UPRR inventory protocol.

J Emergency Generators

There are six (6) emergency generators located at the Yard, to provide emergency power when electrical service from the local power provider is disrupted. Table 7 lists the equipment specifications for the emergency generators.

Table 7
Equipment Specifications for Emergency Generators
Oakland Rail Yard

Location	Fuel Type	Rating (hp)
Intermodal Yard	Diesel	587
WWTP[1]	Gasoline	3
WWTP[1]	Gasoline	10
Microwave Tower[1]	Natural Gas	40
Telephone Exchange[1]	Natural Gas	20
1851-B 5th Street[1]	Natural Gas	27

Notes:
1. Internal combustion engines with a rated capacity of 50 hp or less are exempt from BAAQMD permitting requirements per Rule 2-1-114-2.1.

Internal combustion engines with a rated capacity of 50 brake horsepower or less are exempt from permitting requirements by BAAQMD Rule 2-1-114-2.1. As shown in Table 7, five of the generators are rated at less then 50 hp. Therefore, these units are exempt from BAAQMD permitting requirements. Since the generators are exempt from local air district rules, the emissions from the generators will not be included in this inventory nor in the dispersion modeling analysis consistent with the UPRR inventory protocol.

K TRUs and Reefer Cars

TRUs and reefer cars are transferred in and out of the Yard and are temporarily stored in the intermodal Yard and the Desert 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 remained constant, with individual units cycling in and out of the Yard.

In addition to the intermodal operations discussed above, TRUs and reefer cars are used to pick up and deliver perishable cargo from the PCC distribution centers. 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 remained constant, with individual units cycling in and out of the distribution centers.

L Portable Equipment and Steam Cleaners

Portable equipment operating at the Yard includes welders, an air compressor, steam cleaners, a pressure washer, and a hydraulic lift. Equipment specifications for the welders and miscellaneous portable equipment are shown in Table 8.

Table 8 Portable Equipment Specifications Oakland Rail Yard				
Equipment Location	Equipment Type	Number of Units	Fuel Type	Rating (hp)
Car Shop	Welder	8	Gasoline	16
Locomotive Shop	Welder	1	Gasoline	12.5
Locomotive Shop	Welder	1	Gasoline	16
Crane Shop	Welder	2	Gasoline	<50
Crane Shop Service Trucks	Welder	2	Gasoline	<50
IMS	Welder	1	Gasoline	15
TTX	Welder	4	Gasoline	18
WWTP	Pressure Washer	1	Gasoline	16
Crane Shop	Air Compressor	1	Gasoline	45
TTX	Hydraulic Lift	1	Diesel	11

Notes:

1. Internal combustion engines with a rated capacity of 50 hp or less are exempt from BAAQMD permitting requirements per Rule 2-1-114-2.1.

Internal combustion engines with a rated capacity of 50 brake horsepower or less are exempt from permitting requirements by BAAQMD Rule 2-1-114-2.1. As shown in Table 8, all of the welders and miscellaneous portable equipment operated at the Oakland Yard have a rated capacity of less than 50 hp, and therefore are exempt from permitting requirements. Since these units are exempt from local air district rules, the emissions from these units will not be included in this inventory nor in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

Equipment specifications for the steam cleaners operated at the Oakland Yard are shown in Table 9.

Table 9 **Equipment Specifications for Steam Cleaners** **Oakland Rail Yard**				
Equipment Location	Emission Unit	Fuel Type	Rating	
			(MMBtu/hr)	(hp)
Car Shop	Pump	Gasoline	NA	11
	Heater	Diesel	0.05	NA
Locomotive Shop	Pump	Gasoline	NA	11
	Heater	Diesel	0.05	NA

Notes:

1. Heaters with a rated capacity of less than 1 MMBtu/hr are exempt from permitting requirements per Rule 2-1-114-1.1.
2. Internal combustion engines with a rated capacity of 50 hp or less are exempt from permitting requirements per Rule 2-1-114-2.1.

BAAQMD Rule 2-1-114-1.1 exempts from permitting requirements heaters with a maximum heat input rate of 1 MMBtu/hr or less. Internal combustion engines with a rated capacity of 50 brake horsepower or less are exempt from permitting requirements by BAAQMD Rule 2-1-114-2.1. As shown in Table 9, the internal combustion engines for both of the steam cleaners have a rated capacity of less than 50 horsepower and are therefore, exempt from permitting requirements per Rule 2-1-114-2.1. The heaters in the steam cleaners qualify for the permit exemption of Rule 2-1-114-1.1. Since these units are exempt from local air district rules, the emissions from these units will not be included in this inventory nor 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, the default load factors from the OFFROAD 2006 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 10 summarizes the activity data for locomotives operating on trains at the Oakland Yard, including the number of trains and number of operating locomotives per consist, as well as their idle and operating 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 have been detached, the locomotives move to the service area for refueling. On departure, locomotive consists are moved by switchers from the service area 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 Oakland Yard. These trains are counted separately, as the idling period is shorter prior to departure, and the locomotive consist is not disconnected nor moved to the service track.

Power moves are groups of locomotives that are moved between yards to provide road power for departing trains. Although power moves may have as many as 10 or more locomotives, typically only one or two locomotives are actually operating. For emission calculations, power moves were assumed to have 1.5 operating locomotives (except for power moves involving just one locomotive).[1] In addition to road power, four yard switchers 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. They are also used to move road power from service to departing trains. All four of these locomotives operate three 8-hour shifts. Three of the four are remote control locomotives that operate exclusively in the Yard. The fourth operates in the yard for approximately three hours per shift, and outside the Yard the remainder of its working time.

A separate database provided information on each locomotive handled by the service area at the Yard. Based on detailed information on the reason and type of service or maintenance performed, separate counts of service and maintenance activities were developed, as detailed in Table 11. Routine service of locomotives involves idling and short movements in the service area associated with sanding, refueling, oiling, and other service activities prior to their movement to the ready track area where locomotives are consisted for outbound trains. All locomotives are assumed to idle for two hours during refueling. Two additional one-hour idling periods are assumed to occur (before and after service). ZTR/AESS-equipped locomotives are assumed to idle for only ½ hour in each of these periods. Depending on the type of maintenance, load testing prior to and after maintenance may be performed, although this is rare at Oakland (less than one percent of locomotives serviced in 2005), as the locomotive repair shop at this Yard is no longer staffed. The number of these test events was determined based on the service codes for each locomotive maintenance event in the database. The specific nature (duration and throttle setting) of such load testing events is described in Table 11.

[1] 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 10
Train Activity Summary
Oakland Rail Yard

Train Type	East Bound No. of Trains	East Bound Locomotives per Consist	West Bound No. of Trains	West Bound Locomotives per Consist	Arrival/Departing Speed (mph)	Idle Time (hrs)
Through Trains	6,114	1.35	7,051	1.41	5	0.0
Intermodal Train Arrivals	149	2.13	1,300	2.28	10	2.0
Intermodal Train Departures	924	2.14	396	1.79	10	2.0
Intermodal Arr & Dep Arriving	126	2.41	21	2.29	10	1.0
Intermodal Arr & Dep Departing	126	2.17	21	1.57	10	0.0
Other Arrivals	319	2.81	461	2.36	10	2.0
Other Departures	904	2.84	22	2.09	10	2.0
Other Arr & Dep Arriving	141	3.15	121	2.61	10	1.0
Other Arr & Dep Departing	141	2.99	121	2.71	10	0.0
Power Moves Through	148	1.93	98	2.66	5	0.0
Power Moves Arriving	13	2.85	13	3.46	10	0.0
Power Moves Departing	26	2.62	24	2.38	10	0.0

Notes:
1. In addition to the activities described above, four switchers operate in the Yard. All four of these locomotives operate three 8-hour shifts.

Table 11 Locomotive Service and Shop Releases and Load Tests Oakland Rail Yard				
Activity	Number of Events	Idling per event (min)	N1 time (min)	N8 time (min)
Locomotive Service	4,120	240	0	0
Planned Maintenance Pre-Test	7	2	0	8
Planned Maintenance Post-Test	7	2	0	8
Quarterly Maintenance Test	17	2	0	8
Unscheduled Maintenance Diagnostic	0	2	0	8
Unscheduled Maintenance Post-Test	13	1	0	5

B On-Road Diesel-Fueled Trucks

Emissions from the on-road Diesel-fueled truck are based on the engine model year, annual vehicle miles traveled (VMT), and the amount of time spent idling. Table 12 summarizes the activity data for the on-road Diesel-fueled truck operating at the Yard.

Table 12
Activity Data for On-Road Diesel-Fueled Trucks
Oakland Rail Yard

Vehicle Type	Equipment Owner	Make/Model	Model Year	Vehicle Class	Annual VMT[1]	Idling Time[2]	
						(min/day)	(hr/yr)
Fuel Truck	Harbor Services	Ford 8000	1984	HHD	120	15	91
Auger Truck	UPRR	Ford K84	1985	HHD	100	15	91
Fuel Truck	LERI	Mack M5200	1989	HHD	520	15	91
Tire Truck	UPRR	Ford 350 Econoline	1989	LHDT1	400	15	91
Boom Truck	UPRR	Ford F800	1992	HHD	200	15	91
Boom Truck	UPRR	Volvo WG64	2001	HHD	730	15	91

Notes:
1. Annual VMT and idling time provided by UPRR personnel.
2. Idling time (min/day) is an engineering estimate based on personal observation.

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 used for intermodal operations at Oakland 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 Manager at Oakland, 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 13.

Table 13
Summary of Gate Count Data
Oakland Rail Yard

Month	In-Gate Total[1]	Out-Gate Total[1]	Bobtails[2]	Total
January	8,941	15,430	6,093	30,464
February	8,962	15,295	6,064	30,321
March	10,276	15,821	6,524	32,621
April	9,557	15,932	6,372	31,861
May	10,545	14,227	6,193	30,965
June	11,291	15,688	6,745	33,724
July	10,728	13,055	5,946	29,729
August	8,731	13,574	5,576	27,881
September	8,528	12,569	5,274	26,371
October	9,669	11,832	5,375	26,876
November	7,640	12,536	5,044	25,220
December	8,419	10,422	4,710	23,551
Totals	**113,287**	**166,381**	**69,917**	**349,585**

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

Table 14 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 0 minutes per HHD truck trip was assumed to account for emissions during truck queuing, staging, loading and/or unloading. Based on discussions with the Intermodal Operations Manager, the average queuing time at the gate at Oakland 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.

Table 14
Summary of HHD Diesel Truck Data for Intermodal Activities
Oakland Rail Yard

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)
349,585	1.5	524,378	0	174,792.5

Notes:
1. Provided by UPRR. See Table 13.
2. Engineering estimate based on observation and interviews with UPRR personnel.

Emissions from HHD Diesel-fueled trucks operating at the PCC distribution centers were estimated based on the number of truck trips, the length of each trip, and the amount of time spent idling. The number of truck trips was based on information provided by PCC personnel. The same idling assumptions that were used for the intermodal truck operations were used for the trucks operating at the distribution centers. Table 15 summarizes activity data, such as annual VMT and idling time, for HHD Diesel-fueled trucks operating at the distribution centers.

Table 15
Summary of HHD Diesel Truck Data for Distribution Center Activities
Oakland Rail Yard

Center Name	Address	No. of Truck Bays[1]	Number of HHD Truck Trips[1]	VMT per HHD Truck Trip (mi/trip)[2]	Annual VMT (mi/yr)	Idling Time	
						(min/trip)[3]	(hr/yr)
Pacific Coast Containers	2099 7th St.	42	40,150	0.20	8,030	30	20,075
Pacific Transload System	737 Bay St.	42	36,500	0.25	9,125	30	18,250

Notes:
1. From Pacific Coast Containers, Inc.
2. Engineering estimate based on satellite photos of the Yard.
3. Assumes 10 minutes during queuing and staging at the gate, 15 minutes to drop off/pick up a container, and 5 minutes for any additional delays.

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 16.

Table 16
Activity Data for Cargo Handling Equipment
Oakland Rail Yard

Equipment Type	Make/Model	Model Year	Rating (hp)	No. of Units	Hours of Operation (hr/yr per unit)
Crane	Drott 2500	1973	250	1	36
RTG	Mi Jack 1000R	1990	238	1	3,500
RTG	Taylor	1999	238	1	3,600
RTG	Mi Jack 850	1999	300	1	2,800
RTG	Mi Jack 1200R	2004	300	1	1,700
RTG	Mi Jack 1200R	2005	300	1	1,500
Chassis Stacker	Taylor TCS90	1999	155	1	300
Chassis Stacker	Taylor TCS90	1999	155	1	255
Chassis Stacker	Taylor THD 2500	2003	155	1	1,650
Chassis Stacker	Taylor T300M	2005	155	1	3,700
Yard Hostler	Ottawa	2000	175	1	2,777
Yard Hostler	Ottawa	2000	175	1	2,292
Yard Hostler	Ottawa	2000	175	1	1,823
Yard Hostler	Ottawa	2000	175	1	1,856
Yard Hostler	Ottawa	2001	175	1	2,047
Yard Hostler	Ottawa	2003	175	1	2,358
Yard Hostler	Ottawa	2003	175	1	3,564
Yard Hostler	Ottawa	2003	175	1	4,038
Yard Hostler	Ottawa	2003	175	1	3,828
Yard Hostler	Ottawa	2003	175	1	3,426
Yard Hostler	Ottawa	2003	175	1	1,123
Yard Hostler	Ottawa	2003	175	1	3,505
Yard Hostler	Ottawa	2003	175	1	3,389
Yard Hostler	Ottawa	2004	175	1	2,874
Yard Hostler	Ottawa	2004	175	1	2,510
Yard Hostler	Ottawa	2005	175	1	2,410
Yard Hostler	Ottawa	2005	175	1	2,109
Yard Hostler	Ottawa	2005	175	1	814
Yard Hostler	Ottawa	2005	175	1	1,758
Yard Hostler	Ottawa	2005	175	1	1,434
Yard Hostler	Ottawa	2005	175	1	2,063

Notes:
1. Information based on operator interviews.

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 1?.

Table 17
Activity Data for Heavy Equipment
Oakland Rail Yard

Equipment Type	Make/Model	Model Year	Rating (hp)	No. of Units	Hours of Operation (hr/yr per unit)
Crane	Lorain RT-250D	1975	*200*	1	60
Trackmobile	Trackmobile TM2400	1994	147	1	520
Forklift	Hyster	1987	225	1	548
Forklift	Caterpillar	Pre-1990	*90*	1	730
Forklift	Nissan	2005	114	1	416
Backhoe	Case 580C	Pre-1983	62	1	75
Backhoe	Ford 555 Special	Pre-1983	55	1	150
Yard Hostler	Capacity	1986	125	1	*25*
Yard Hostler	Capacity	*1986*	*125*	1	*365*
Man Lift	JLG 460SJ	2001	50	1	*250*

Notes:
1. Items in italics are engineering estimates based on operator interviews.

F Tanks

Emissions from the non-exempt storage tanks located at the Oakland Yard are based on the size of the tank, material stored, and annual throughput. Activity data for the non-exempt tanks are shown in Table 18.

Table 18 Activity Data for Storage Tanks Oakland Rail Yard					
Tank No.	Tank Location	Material Stored	Tank Capacity (gal)	Tank Dimensions (ft)	Annual Throughput (gal/yr)[1]
TNKW-0197	Car Shop	Wastewater	1,000	11 x 4	3,740,000
TNKW-0196	Car Shop	Wastewater	5,000	8 x 15	3,740,000
TNKW-0145	WWTP	Wastewater	50,000	20 x 50	3,740,000
TNKG-0080	Car Shop	Gasoline	1,000	11 x 3.6	5,510

Notes:
1. Information provided by UPRR personnel.

G. Sand Tower

Emissions from the sand tower are based on the annual sand throughput. The 2005 sand throughput for the Oakland Yard was 270 tons.

H. Wastewater Treatment Plant

Emissions from the WWTP are based on the annual wastewater flow rate. In 2005 the wastewater flow rate at Oakland was 3,740,000 gallons.

I. Emergency Generators

Emissions from the non-exempt emergency generator are based on equipment size and the annual hours of operation. The emergency generator is equipped with a 587 hp internal combustion engine and it was operated 30 hours in 2005.

J. 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 operating in the intermodal Yard are summarized in Table 19.

Table 19 **Activity Data for TRUs and Reefer Cars Operating in the Intermodal Yard** **Oakland Rail Yard**				
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	70	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 6-35 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.

Activity data for the TRUs and reefer cars operating at the PCC distribution centers are summarized in Table 20. The number of container-type TRUs is assumed to be equal to the total number of truck bays minus the number of bays with a reefer plug. Number of reefer cars per day was provided by PCC.

Table 20 **Activity Data for TRUs and Reefer Cars Operating at Distribution Centers** **Oakland Rail Yard**					
Center Name	Equipment Type	Average Rating (hp)[3]	Average No. of Units in Yard[4]	Hours of Operation	
				(hr/day)[5]	(hr/yr)[6]
Pacific Coast Containers[1]	Container	28.56	38	4	1,460
	Railcar	34	18	4	1,460
Pacific Transload System[2]	Container	28.56	27	4	1,460
	Railcar	34	8	4	1,460

Notes:

1 Located at 2099 7th Street.
2. Located at 737 Bay Street.
3. Based on the average horsepower distribution in the OFFROAD2006 model.
4. Number of container-type TRUs is assumed to be equal to the total number of truck bays minus the number of bays with a reefer plug. Number of reefer cars was provided by PCC. (See *www.pcc-cts.com*)
5. 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.
6. 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 Distribution Center.

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[2] operating in the rail yard, and through trains on the main line. Procedures for calculating emissions followed the methods described in Ireson et al. (2005).[3] 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[4]. A separate calculation was performed for each type of locomotive activity, including line-haul or switcher locomotive operations, consist movements, locomotive refueling, and pre- and post-locomotive service and maintenance testing. Speed, movement duration, and throttle notch values were obtained from UPRR personnel for the Oakland Yard for different types of activities, and movement durations were calculated from distance traveled and speed. 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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[2] 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.

[3] Ireson, R.G., M.J. Germer, L.A. Schmid (2005). "Development of Detailed Rail yard 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.

[4] Emission estimates are based on the total number of working locomotives. Therefore, the total number of locomotives used in the emission calculations will be slightly lower than the total number of locomotives 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 operating, model distribution, locomotive tier distribution, fraction equipped with auto start/stop technology[5]) 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, intermodal train arrivals and departures, non-intermodal arrivals and departures, local trains, and power moves.

Four "captive" switcher locomotives (i.e., dedicated to moving sections of rail cars within the Yard) operated within the facility boundaries. These units include three remote control locomotives operating 24 hours per day in the Yard and one additional switcher operating approximately 9 hours per day in the Yard. 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 assumed nominal fuel sulfur content of 3,000 ppm) were adjusted based on the

[5] 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 to 30 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.

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 railyards (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[6]. This value is assumed to be

[6] Personal communication from Theron Hinckley of Chevron Products Company to Jon Germer of UPRR and Rob Ireson, December 13, 2006.

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 DPM 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 17 and 18. Sample emission calculations are shown in Appendix A-3 and A-4. The calculations of sulfur adjustments and the Wong Technical Memo are shown in Appendix A-7.

Table 21
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 221 PPM
Oakland Rail Yard

Model Group	Tier	Throttle Setting Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	Source[1]
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 (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
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 (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 (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 22
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 2,639 PPM
Oakland Rail Yard

Model Group	Tier	Throttle Setting Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	Source[1]
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-?0 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. <u>On-Road Diesel-Fueled Trucks</u>

Emission estimates for the on-road Diesel-fueled trucks are based on the vehicle model year, annual VMT within the Yard, and amount of time the vehicles spend idling. 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 vehicle-specific emission factor traveling emissions was calculated, using the EMFAC-WD 2006 model with the BURDEN output option. Vehicle-specific idling emission factors were calculated using the EMFAC-WD 2006 model with the EMFAC output option. The emission factors for the on-road Diesel-fueled trucks are shown in Table 23. Detailed emission factor derivation calculations and EMFAC-WD 2006 output are contained in Appendix B.

Table 23
Emission Factors for On-Road Diesel-Fueled Trucks
Oakland Rail Yard

Equipment Type	Equipment Owner/ID	Make/ Model	Model Year	Vehicle Class	Traveling Emission Factors (g/mi)[1]					Idling Emission Factors (g/hr)[2]				
					ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Fuel Truck	Harbor Services	Ford 8000 Series	1984	HHD	9.07	30.24	27.22	5.04	0.00	33.61	74.81	58.65	7.10	0.58
Auger Truck	MoW	Ford K84	1985	HHD	9.07	30.51	28.04	4.95	0.00	33.61	74.81	58.65	7.10	0.58
Fuel Truck	LERI	Mack M5200	1989	HHD	9.07	30.91	28.90	4.37	0.34	19.68	61.68	100.70	2.65	0.58
Tire Truck	50033	Ford 350 Econoline	1989	LHDT1	0.60	2.42	4.84	0.60	0.00	3.17	26.30	75.05	2.38	0.37
Boom Truck	Track Dept.	Ford F800	1992	HHD	6.05	30.24	30.24	3.02	0.38	15.71	56.75	100.70	2.65	0.58
Boom Truck	1915-72762	Volvo WG64	2001	HHD	3.60	8.81	27.88	1.47	0.27	9.43	46.94	118.24	1.38	0.58

Notes:
1. Traveling exhaust emission factors were calculated from EMFAC-WD 2006 with the BURDEN output option. Emission factor calculations assume an average speed of 15 mph.
2. Idling emission factors were calculated from EMFAC-WD 2006 with the EMFAC output option.

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 for trucks operating at the intermodal yard or the PCC distribution centers, the EMFAC-WD 2006 default distribution for Alameda 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 24. Detailed emission factor derivation calculations and the EMFAC-WD 2006 output, are contained in Appendix C.

Table 24
Emission Factors for HHD Diesel-Fueled Trucks[1]
Oakland Rail Yard

Operating Mode	Fleet Average Emission Factors				
	ROG	CO	NOx	DPM	SOx
Traveling (g/mi)	4.81	12.92	26.71	1.99	0.26
Idling (g/hr)	16.35	55.87	99.69	2.93	0.58

Notes:
1. Since a fleet distribution was not known, the same emission factors apply to HHD trucks operating in the intermodal Yard and to HHD trucks operating at the PCC distribution centers.
2. Traveling exhaust emission factors were calculated using the EMFAC-WD 2006 model with the BURDEN output option. The default fleet distribution for Alameda County was used.
3. Idling emission factors were calculated using the EMFAC-WD 2006 model with the EMFAC output option. The default fleet distribution for Alameda County was used.
4. See Part V for vehicle specifications.
5. Diesel PM_{10} (DPM) is a TAC.

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 25. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix D.

Table 25
Emission Factors for Cargo Handling Equipment
Oakland Rail Yard

Equipment Type	Make/Model	Model Year	Emission Factors (g/bhp-hr)[1]				
			VOC	CO	NOx	DPM	SOx
Crane	Drott 2500	1973	1.301	6.417	15.457	0.919	0.060
RTG	Mi Jack 1000R	1990	0.681	3.300	9.016	0.455	0.060
RTG	Taylor	1999	0.270	1.009	6.409	0.155	0.060
RTG	Mi Jack 850	1999	0.270	1.009	6.409	0.155	0.060
RTG	Mi Jack 1200R	2004	0.091	0.946	4.162	0.097	0.052
RTG	Mi Jack 1200R	2005	0.074	0.933	3.836	0.094	0.052
Chassis Stacker	Taylor TCS90	1999	0.538	2.851	6.862	0.360	0.060
Chassis Stacker	Taylor THD 2500	2003	0.248	2.765	5.091	0.210	0.060
Chassis Stacker	Taylor T300M	2005	0.117	2.722	4.239	0.134	0.060
Yard Hostler	Ottawa	2000	0.541	2.862	6.885	0.364	0.060
Yard Hostler	Ottawa	2001	0.532	2.835	6.827	0.355	0.060
Yard Hostler	Ottawa	2003	0.250	2.781	5.117	0.214	0.060
Yard Hostler	Ottawa	2004	0.164	2.754	4.553	0.165	0.060
Yard Hostler	Ottawa	2005	0.117	2.727	4.246	0.135	0.060

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

5. Heavy Equipment

Emission estimates for the heavy equipment are based on the number and type of equipment, the equipment model, and the hours of operation. Emission factors were calculated using OFFROAD2006 model. The emission factors for heavy equipment are shown in Table 26. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix E.

Table 26 Emission Factors for Heavy Equipment Oakland Rail Yard							
Equipment Type	Make/Model	Model Year	Emission Factors (g/bhp-hr)[1]				
			ROG	CO	NOx	DPM	SOx
Crane	Lorain RT-250D	1975	1.648	4.264	11.449	0.739	0.059
Trackmobile	Trackmobile TM2400	1994	1.439	3.870	10.478	0.624	0.059
Forklift	Hyster	1997	2.689	7.896	18.096	1.411	0.059
Forklift	Caterpillar	Pre-1990	3.776	7.897	18.180	1.983	0.061
Forklift	Nissan	2005	0.368	3.215	5.020	0.254	0.061
Backhoe	Case 580C	Pre-1983	3.632	7.812	18.728	1.717	0.061
Backhoe	Ford 555 Special	Pre-1983	3.632	7.812	18.728	1.717	0.061
Yard Hostler	Capacity	1986	2.928	8.438	19.249	1.558	0.059
Yard Hostler	Capacity	*1986*	2.928	8.438	19.249	1.558	0.059
Man Lift	JLG 460SJ	2001	2.245	5.045	5.481	0.579	0.068

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 TNKG-0080. All TACs listed in the most recent version of the Emission Inventory Criteria and Guidelines Report for the Air Toxics "Hot Spots" Program are included. The TAC emission factors for gasoline storage are shown in Table 27. The TANKS output and the relevant sections of CARB's speciation database are included in Appendix F.

Table 27
TAC Emission Factors for the Gasoline Storage Tank
Oakland Rail Yard

CAS	Chemical Name	Organic Fraction of VOC (by weight)
540841	2,2,4-trimethylpentane	0.0129
71432	Benzene	0.0036
11082?	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	0.01?0
Total		**0.44**

Notes:

1. The organic fraction information is from CARB's speciation 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 CARB's speciation database and the AB2588 list.

7. Sand Tower

Emission estimates for the sand tower are based on annual sand throughput and emission factors from EPA's AP-42 document. The sand transfer system consists of two parts: pneumatic transfer and gravity transfer. The pneumatic transfer system is similar to those used to unload cement at concrete batch plants. The gravity feed system is similar to the sand and aggregate transfer operations at concrete batch plants. Therefore, emissions will be calculated using the AP-42 emission factors for concrete batch plants. These emission factors are shown in Table 28.

Table 28
Emission Factors for Sand Tower Operations
Oakland Rail Yard

Pollutant	Emission Factors (lb/ton)	
	Pneumatic Transfer[1]	Gravity Transfer[2]
PM_{10}	0.00034	0.00099

Notes:

1. Emission factor from AP-42, Table 11.12-5, 6/06. Factor for controlled pneumatic cement unloading to elevated storage silo was used. The unit is equipped with a fabric filter.
2. Emission factor from AP-42, Table 11.12-5, 6/06. Factor for sand transfer was used.
3. There are no TAC emissions from this source.

8. Wastewater Treatment Plant

Emission estimates for the WWTP are based on emission rates from the *Union Pacific Rialroad, Oakland Yard, Title V/New Source Review/Emission Inventory - Applicability Analysis* (Trinity Consultants, July 17, 2000) and the annual wastewater flow rate. Emission rates were calculated by Trinity Consultants using EPA's WATER program. The emission rates are shown in Table 29.

Table 29 **Emission Factors for the Wastewater Treatment Plant** **Oakland Rail Yard**			
	Emission Rate (g/sec)		
Pollutant	Oil/Water Separator	DAF Unit	Total
Benzene	4.93×10^{-9}	6.62×10^{-6}	6.62×10^{-6}
Bis (2-ethylhexyl) Phthalate	6.92×10^{-9}	1.27×10^{-10}	7.05×10^{-9}
Bromomethane	1.00×10^{-8}	1.17×10^{-5}	1.17×10^{-5}
Chloroform	6.14×10^{-9}	8.18×10^{-6}	8.19×10^{-6}
Ethylbenzene	2.51×10^{-8}	3.75×10^{-5}	3.75×10^{-5}
Methylene Chloride	7.79×10^{-8}	1.40×10^{-4}	1.40×10^{-4}
Toluene	3.08×10^{-8}	4.46×10^{-5}	4.46×10^{-5}
Xylene	5.16×10^{-8}	4.19×10^{-5}	7.50×10^{-5}
Total	$\mathbf{2.13 \times 10^{-7}}$	$\mathbf{3.24 \times 10^{-4}}$	$\mathbf{3.24 \times 10^{-4}}$

Notes:

1. Emission rates from *Union Pacific Railroad, Oakland Yard, Title V/New Source Review/Emission Inventory - Applicability Analysis*, Trinity Consultants, July 17, 2000.

9. Emergency Generator

Emission estimates for the non-exempt Diesel-fueled emergency generator are based on the size of the unit and the hours of operation. Emission factors are from AP-42, Table 3.3.-1 (10/96). The emission factors are shown in Table 30.

Table 30 **Emission Factors for the Diesel-Fueled Emergency Generator** **Oakland Rail Yard**				
Emission Factors (g/hp-hr)				
ROG	CO	NOx	DPM	SOx
1.14	3.03	14.06	1.00	0.93

Notes:

1. Emission factors from AP-42, Table 3.3-1, 10/96.
2. Diesel PM_{10} (DPM) is a TAC.

10. 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 31. Detailed emission factor derivation calculations and the OFFROAD2006 output are contained in Appendix G.

Table 31 Emission Factors for TRUs and Reefer Cars Oakland Rail Yard					
Equipment Type	Emissions (g/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. VOC evaporative emissions are negligible.
3. Emission factor based on a Diesel fuel sulfur content of 130 ppm.
4. The same emission factors apply to TRUs and reefer cars operating at the intermodal Yard and the PCC distribution centers.

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 Tables 21 and 22, the number of events, the number of locomotives per consist, duration, and duty cycle of different types of activity. Table shows the duty cycles assumed for different types of activities.

Table 32 Locomotive Duty Cycles Oakland Rail Yard	
Activity	Duty Cycle
Through Train Movement	N - 100%
Movements within the Yard	N1 50%, N - 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 six types of activity: through trains (including through power moves); intermodal trains; other trains including arriving and departing power moves; yard switchers; locomotives in service; and locomotives load tests. Table 33 shows the DPM emission estimates for the different types of activities.

Table 33 DPM Emissions from Locomotives Oakland Rail Yard	
Activity	DPM Emissions (tpy)
Through trains	0.460
Intermodal trains	0.624
Other trains	0.464
Power moves	0.011
Yard operations	1.875
Service and Shop Idling	0.476
Load tests	0.004
Total	**3.914**

Notes:

1. See Table 1 for equipment specifications.
2. See Tables 10 and 11 for activity data.
3. See Tables 21 and 22 for emission factors.
4. Emissions from yard operations are based on four switcher locomotives operating 3 8-hour shifts each, the EPA Switch Duty Cycle, and the emission factors shown in Tables 21 and 22.
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 on-road Diesel-fueled trucks are shown in Table 34. DPM emissions from HHD Diesel-fueled trucks and CHE are shown in Tables 35 and 36, respectively. DPM emissions from heavy equipment are shown in Table 37. Table 38 summarizes the TAC emissions from the gasoline storage tank. TAC emissions from the WWTP are summarized in Table 39. DPM emissions from the emergency generator and the Diesel-fueled TRUs and reefer cars are shown in Table 40 and Table 41, respectively.

As discussed above, there are no TAC emissions from the sand tower. Detailed emission calculations for each source group are contained in Appendix H.

Table 34 **DPM Emissions from On-Road Diesel-Fueled Trucks** **Oakland Rail Yard**			
	Emissions (tpy)		
Pollutant	Traveling Mode	Idling Mode	Total
DPM	0.006	0.002	0.008

Notes:
1. See Table 2 for equipment specifications.
2. See Table 12 for activity data.
3. See Table 23 for emission factors.

Table 35 **DPM Emissions from HHD Diesel-Fueled Trucks** **Oakland Rail Yard**			
	Emissions (tpy)		
Source	Traveling Mode	Idling Mode	Total
Intermodal Trucks	1.15	0.56	1.716
Distribution Centers	0.04	0.12	0.162
Total	**1.19**	**0.68**	**1.878**

Notes:
1. See Part V for equipment specifications.
2. See Tables 13 through 15 for activity data.
3. See Table 24 for emission factors.

Table 36 DPM Emissions from Cargo Handling Equipment Oakland Rail Yard				
Equipment Type	Make/Model	Model Year	No of Units	DPM Emissions (tpy)
Crane	Drott 2500	1973	1	0.004
RTG	Mi Jack 1000R	1990	1	0.180
RTG	Taylor	1999	1	0.063
RTG	Mi Jack 850	1999	1	0.062
RTG	Mi Jack 1200R	2004	1	0.023
RTG	Mi Jack 1200R	2005	1	0.020
Chassis Stacker	Taylor TCS90	1999	1	0.006
Chassis Stacker	Taylor TCS90	1999	1	0.005
Chassis Stacker	Taylor THD 2500	2003	1	0.018
Chassis Stacker	Taylor T300M	2005	1	0.025
Yard Hostler	Ottawa	2000	1	0.107
Yard Hostler	Ottawa	2000	1	0.088
Yard Hostler	Ottawa	2000	1	0.070
Yard Hostler	Ottawa	2000	1	0.072
Yard Hostler	Ottawa	2001	1	0.077
Yard Hostler	Ottawa	2003	1	0.053
Yard Hostler	Ottawa	2003	1	0.081
Yard Hostler	Ottawa	2003	1	0.091
Yard Hostler	Ottawa	2003	1	0.087
Yard Hostler	Ottawa	2003	1	0.078
Yard Hostler	Ottawa	2003	1	0.025
Yard Hostler	Ottawa	2003	1	0.079
Yard Hostler	Ottawa	2003	1	0.077
Yard Hostler	Ottawa	2004	1	0.050
Yard Hostler	Ottawa	2004	1	0.044
Yard Hostler	Ottawa	2005	1	0.035
Yard Hostler	Ottawa	2005	1	0.030
Yard Hostler	Ottawa	2005	1	0.012
Yard Hostler	Ottawa	2005	1	0.025
Yard Hostler	Ottawa	2005	1	0.021
Yard Hostler	Ottawa	2005	1	0.030
Total			**31**	**1.638**

Notes:
1. See Table 3 for equipment specifications.
2. See Table 16 for activity data.
3. See Table 25 for emission factors.

Table 37 **DPM Emissions from Heavy Equipment** **Oakland Rail Yard**				
Equipment Type	Make/Model	Model Year	No of Units	DPM Emissions tpy)
Crane	Lorain RT-250D	1975	1	0.004
Trackmobile	Trackmobile TM2400	1994	1	0.027
Forklift	Hyster	1997	1	0.058
Forklift	Caterpillar	Pre-1990	1	0.043
Forklift	Nissan	2005	1	0.004
Backhoe	Case 580C	Pre-1983	1	0.005
Backhoe	Ford 555 Special	Pre-1983	1	0.009
Yard Hostler	Capacity	1986	1	0.003
Yard Hostler	Capacity	*1986*	1	0.045
Man Lift	JLG 460SJ	2001	1	0.004
Total			**10**	**0.202**

Notes:
1. See Table 4 for equipment specifications.
2. See Table 17 for activity data.
3. See Table 26 for emission factors.

Table 38 **TAC Emissions from the Gasoline Storage Tank** **Oakland Rail Yard**		
CAS	Chemical Name	Emissions (tpy)
540841	2,2,4-trimethylpentane	0.0028
71432	Benzene	0.0008
110827	Cyclohexane	0.0022
100414	Ethylbenzene	0.0003
78784	Isopentane	0.0793
98828	Isopropylbenzene (cumene)	0.0000
108383	m-Xylene	0.0007
110543	n-Hexane	0.0033
95476	o-Xylene	0.0003
106423	p-Xylene	0.0002
108883	Toluene	0.0036
Total		**0.0935**

Notes:
1. See Table 5 for equipment specifications.
2. See Table 18 for activity data.
3. See Table 27 for emission factors.

Table 39 TAC Emissions from the Wastewater Treatment Plant Oakland Rail Yard	
Pollutant	Emissions (tpy)
Benzene	8.85×10^{-5}
Bis (2-ethylhexyl) Phthalate	9.41×10^{-8}
Bromomethane	1.56×10^{-4}
Chloroform	1.09×10^{-4}
Ethylbenzene	5.01×10^{-4}
Methylene Chloride	1.8? $\times 10^{-3}$
Toluene	5.96×10^{-4}
Xylene	1.00×10^{-3}
Total	**4.32×10^{-3}**

Notes:
1. See Part V for equipment description.
2. See Part VI for activity data.
3. See Table 29 for emission factors.

Table 40 DPM Emissions from the Emergency Generator Oakland Rail Yard	
Equipment Type/Location	DPM Emissions (tpy/yr)
Emergency Generator - Intermodal Yard	0.019

Notes:
1. See Table 7 for equipment specifications.
2. See Part VI for activity data.
3. See Table 30 for emission factors.

Table 41 DPM Emissions from TRUs and Reefer Cars Oakland Rail Yard		
Source	Equipment Type	DPM Emissions (tpy)
Intermodal Operations	TRU	1.28
	Railcar	0.09
Distribution Centers	TRU	1.19
	Railcar	0.59
Total		**3.15**

Notes:
1. See Part V for equipment specifications.
2. See Tables 19 and 20 for activity data.
3. See Table 31 for emission factors.

C Facility Total Emissions

Facility-wide DPM emissions are shown in Table 42. Facility-wide TAC emissions are shown in Table 43.

Table 42
Facility-Wide Diesel Particulate Emissions
Oakland Rail Yard

Source	Emissions (tpy)
Locomotives[1]	3.914
On-Road Diesel-Fueled Trucks	0.008
HHD Diesel-Fueled Trucks	1.878
Cargo Handling Equipment[4]	1.638
Heavy Equipment[5]	0.200
Emergency Generator[6]	0.019
TRUs and Reefer Cars[7]	3.154
Total	**10.811**

Notes:
1. See Table 33.
2. See Table 34.
3. See Table 35.
4. See Table 36.
5. See Table 37
6. See Table 40.
7. See Table 41.

Table 43 Facility-Wide TAC Emissions (Excluding DMP) Oakland Rail Yard				
		Emissions (tpy)		
CAS	Chemical Name	Gasoline Tank[1]	WWTP[2]	Total
540841	2,2,4-trimethylpentane	0.0028	-	0.0028
71432	Benzene	0.0008	0.0001	0.0009
	Bis (2-ethylhexyl) Phthalate	-	0.0000	0.0000
	Bromomethane	-	0.0002	0.0002
67663	Chloroform	-	0.0001	0.0001
110827	Cyclohexane	0.0022	-	0.0022
100414	Ethylbenzene	0.0003	0.0005	0.0008
78784	Isopentane	0.0793	-	0.0793
98828	Isopropylbenzene (cumene)	0.0000	-	0.0000
	Methylene Chloride	-	0.0019	0.0019
108383	m-Xylene	0.0007	-	0.0007
110543	n-Hexane	0.0033	-	0.0033
95476	o-Xylene	0.0003	-	0.0003
106423	p-Xylene	0.0002	-	0.0002
108883	Toluene	0.0036	0.0006	0.0042
1330207	Xylene (total)	-	0.0010	0.0010
Total		**0.0934**	**0.0043**	**0.0978**

Notes:
1. See Table 38.
2. See Table 39.

PART VIII: RISK SCREENING CALCULATIONS

As discussed in Part IV of this report, de minimis sources, based on weighted health risk, will be identified in the inventory but will not be further discussed or 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 will 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 is summarized in Table 44. Detailed cancer risk and non-cancer health hazard index calculations are in Appendix I.

Table 44 Summary of Weighted Risk by Source Category Oakland Rail Yard				
Source	Cancer Risk		Non-Cancer Chronic Health Hazard	
	Risk Index Value	Percent of Total Risk	Health Hazard Index Value	Percent of Total Hazard
Locomotives	1.17×10^{-3}	36.20	1.96×10^{1}	23.53
On-Road Diesel-Fueled Trucks	2.45×10^{-6}	0.08	4.08×10^{-2}	0.05
HHD Diesel-Fueled Trucks - Intermodal	5.15×10^{-4}	15.87	8.58	10.31
HHD Diesel-Fueled Trucks - Distribution Centers	4.85×10^{-5}	1.49	8.08×10^{-1}	0.97
Cargo Handling Equipment	4.91×10^{-4}	15.15	8.19	9.85
Heavy Equipment	6.01×10^{-5}	1.85	1.00	1.20
Gasoline Storage Tank	2.22×10^{-8}	0.00	2.54×10^{1}	30.56
WWTP	3.14×10^{-9}	0.00	1.92	2.31
Emergency Generator	5.81×10^{-6}	0.18	9.69×10^{-2}	0.12
TRUs and Reefer Cars - Intermodal	4.12×10^{-4}	12.69	6.86	8.25
TRUs and Reefer Cars - Distribution Centers	5.35×10^{-4}	16.48	1.07×10^{1}	12.86
Total	$\mathbf{3.24 \times 10^{-3}}$	**100**	$\mathbf{8.32 \times 10^{1}}$	**100**

Sources that represent less than 3 percent each of the facility-total weighted-average cancer risk and non-cancer chronic risk, as shown in Table 44 are de minimis.
De minimis sources will not be included in the dispersion modeling analysis. Table 45 lists the de minimis sources for the Oakland Yard.

Table 45 Summary of De Minimis Sources Oakland Rail Yard	
De Minimis Sources for Cancer Risk	De Minimis Sources for Non-Cancer Chronic Health Hazard
On-Road Diesel-Fueled Trucks Heavy Equipment HHD Diesel-Fueled Trucks - Distribution Centers Gasoline Storage Tank WWTP Emergency Generator	On-Road Diesel-Fueled Trucks Heavy Equipment HHD Diesel-Fueled Trucks - Distribution Centers WWTP Emergency Generator

Sources that are de minimis for both cancer risk and non-cancer chronic health hazard (i.e., on-road Diesel-fueled trucks, WWTP, and the emergency generator) will not be included in the dispersion modeling analysis. At the request of CARB, emissions from the HHD Diesel-fueled trucks operating at the PCC distribution centers and 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 the Oakland Yard. The purpose of the analysis was to estimate ground-level concentrations of DPM, and other TACs, emitted from Yard operations, at receptor locations surrounding 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, HHD Diesel-fueled trucks operating at the PCC distribution centers and 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 of 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 46 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 46 Source Treatment for Air Dispersion Modeling Oakland Rail Yard	
Source[1]	Source Treatment
Gasoline Storage Tank	Point
HHD Diesel-Fueled Trucks (idling)[2]	Volume
HHD Diesel-Fueled Trucks (traveling)[2]	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.
2. Applies to HHD trucks operating in and around the intermodal yard as well as HHD trucks operating at the PCC distribution centers.

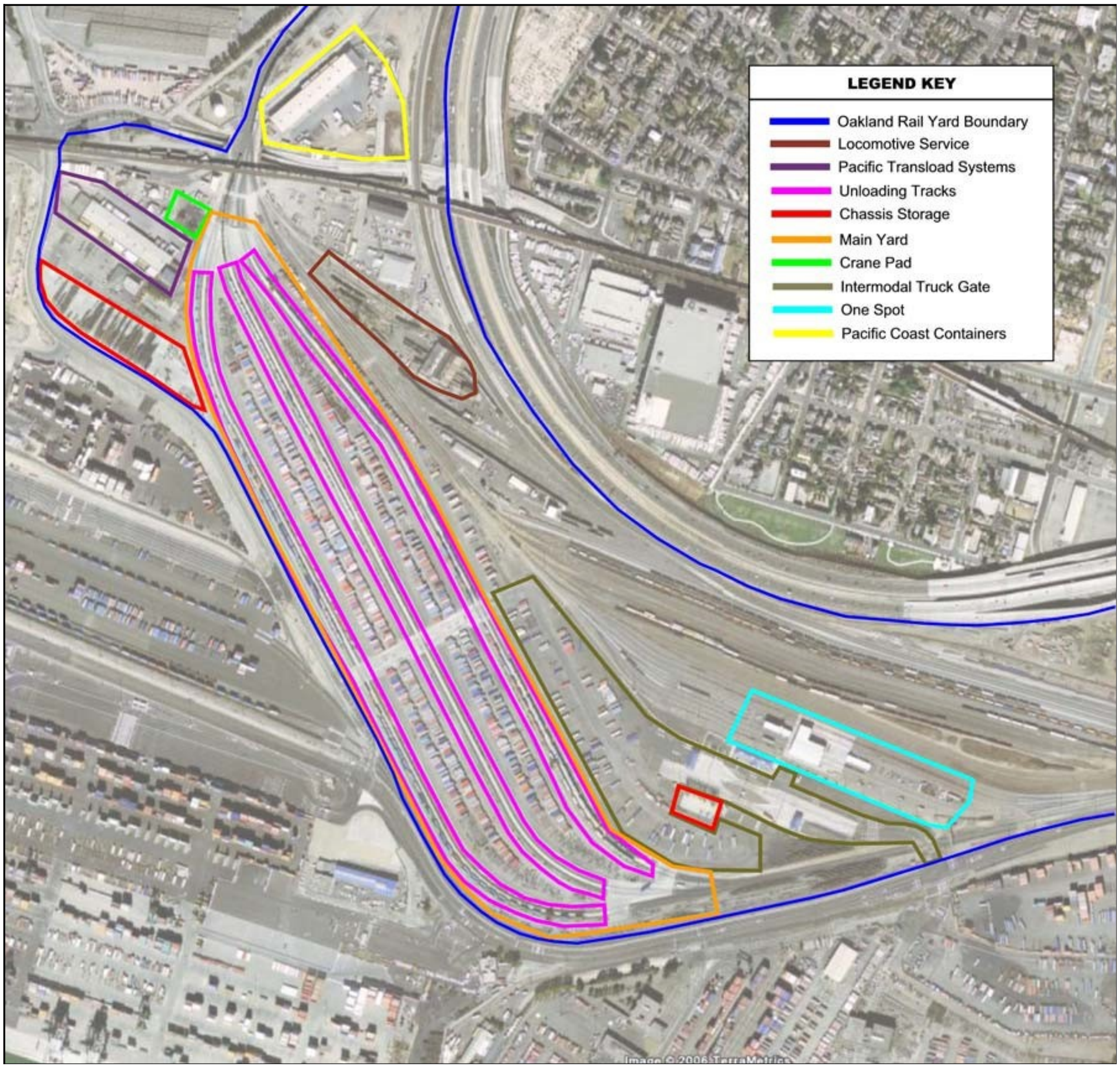
2. Model Selection

Selection of air dispersion models depends on many factors, including the type of emissions source (point, line, area, 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,[7] multiple-source, Gaussian dispersion model designed for use with emission sources situated in terrain where ground elevations can exceed the release heights of the emission sources (i.e., complex terrain).[8] AERMOD was used with hourly wind speed and direction, temperature and cloud cover data from the Oakland International Airport. AERMOD used these parameters to select the appropriate dispersion coefficients.

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

Figure 3
Source Locations



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

Two AERMET preprocessors (Stages 1 and 2, and Stage 3) were used to prepare meteorological data for use in AERMOD. Surface roughness was estimated in four wind direction sectors surrounding the meteorological monitoring site at the Oakland International Airport, while albedo and Bowen ratio[9] were estimated in four similar wind direction sectors surrounding the Yard. 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 the 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[10] 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*.[11]

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[9] 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, the albedo for snow and ice varies from 80% to 85% and the albedo for 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.

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

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

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.

- Two seasonal/diurnal activity profiles were calculated for train activity (excluding through trains)—one for arrivals and one for departures. The profile for arrivals represents idling occurring during the two hours following train arrival. The profile for departures represents idling occurring during the two hours prior to train departure. The same profiles were applied to train movements within the Yard.
- A diurnal profile was used for switching operations and pre-maintenance load testing.
- A seasonal but not diurnal profile was applied to locomotive emissions occurring during service activities, except for pre-maintenance load testing, as discussed above.
- The seasonal distributions for arriving and departing trains were averaged and the average profile 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 47. Table 48 summarizes the modeling inputs used to create the AERMOD input file for each non-locomotive source at the Yard.

Table 47 Locomotive Modeling Inputs Oakland Rail Yard							
	Point/Idling Source Parameters				Volume Source Parameters		
Source	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	-	-	-
Load tests N1[3]	4.6	0.625	8.0	420	-	-	-
Load tests N8[3]	4.6	0.625	36.6	589	-	-	-
Yard locomotives OA-SW	4.6	0.305	5.6	341	-	-	-
Locomotives (traveling)[4]					-	-	-
Day[5]	-	-	-	-	2.6	0-50	5.6
Night[5]	-	-	-	-	6.79	0-50	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. Load test stack parameters are those of the most prevalent locomotive model (SD-7x).
4. All locomotive movements for road power and yard locomotives while not idling are the day and night volume source parameters for moving locomotives from the CARB Roseville modeling.
5. Lateral dispersion coefficient (σ_y) for moving locomotive volume sources was set to values between 0 and 50 m, depending on the spacing of sources in different areas of the yard and proximity to yard boundaries.

Table 48 Non-Locomotive Modeling Inputs Oakland Rail Yard							
	Point/Idling Source Parameters				Volume Source Parameters		
Source	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	-	-	-
Forklifts[2]	-	-	-	-	1.39	20-50	4.15
Yard Hostlers[2]	-	-	-	-	1.39	20-50	4.15
Chassis Stackers[2]	-	-	-	-	1.39	20-50	4.15
Trackmobile[2]	-	-	-	-	1.39	20-50	4.15
Backhoes[2]	-	-	-	-	1.39	20-50	4.15
Man Lift[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.

4 Meteorological Data Selection

The Yard does not monitor meteorological variables on site. Surface data and upper air data from the Oakland International Airport, operated by the National Weather Service and located approximately 7.5 miles to the southeast, were used for this project. Missing surface data were replaced according to USEPA guidance[12]. The completed dataset was processed in AERMET, the meteorological preprocessor for AERMOD.

Ten years, 1996 through 2005, of meteorological data 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 to subject the full set of receptors to only one year of meteorological data. For air dispersion modeling of emissions from the Oakland Yard, the meteorological data from 2004 were selected, the year having the most complete data recovery.

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 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. Due to the generally flat terrain throughout the modeling domain and the proximity of the surface wind station to the Yard, the meteorological data used should be reasonable representative of conditions at

[12] USEPA "Meteorological Monitoring Guidance for Regulatory Modeling Applications" Section 6.8; Atkinson & Lee "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models"

the Yard, barring the possibility of an unknown bias in the wind data due to an obstruction near the anemometer.

5 Model Domain and Receptor Grids

A domain size of 20 km by 20 km and coarse receptor grid of 500 m x 500 m was used for the modeling analysis. A fine grid of 50 m x 50 m surrounding the Yard was used for modeling within 300 m of the fence line. A medium-fine grid of 100 m x 100 m was used for receptors between 300 and 600 m of the fence line around the fine grid network, and a medium grid of 200 m x 200 m was used for receptor distances between 600 and 1000 m.

All receptors were identified by UTM coordinates. United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEM) data were 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 49 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 49.

Table 49 Sensitive Receptor Locations Oakland Rail Yard				
Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
4 C's Child Development Center	756 21st St, Oakland, CA 94612	6	563720	4185213
Alameda Science & Technology Institute	555 Atlantic Ave., Alameda, CA 94501	3	563331	4181719
Anna Yates Elementary School	1070 41st St., Emeryville, CA 94608	14	563461	4187449
Antassia Child Care	3426 Adeline St, Emeryville, CA 94608	8	563357	4186735
Audra's Child Care	1905 Chestnut St, Oakland, CA 94607	4	563032	4185297
Barbara E. Shaw Infant & Toddler Center	274 12 th St, Oakland, CA 94607	11	564457	4184037
Bay Area School of Enterprise	2750 Todd St., Alameda, CA 94501	1	561611	4182480
Bay Area Technology School	1920 Telegraph Ave, Oakland, CA 94612	8	564284	4184816
Caregivers Childcare Placement	449 15th St # 201, Oakland, CA 94612	11	564249	4184428
CCUMC Nursery School	321 8th St, Oakland, CA 94607	10	564204	4183749
Children of the Future	2906 Magnolia St, Oakland, CA 94608	4	563114	4186243
Cleo's Day Care	1942 Chestnut St, Oakland, CA 94607	4	563060	4185315
Cole Middle School	1011 Union St, Oakland, CA 94607	5	562482	4184683
Crissy's Daycare	160 Maple Way, Alameda, CA 94501	3	562580	4181589
Damien's Day Care	1469 34th St, Emeryville, CA 94608	4	562870	4186689
Denise Childcare	867 Milton St, Oakland, CA 94607	6	563639	4185732
Early Birds Kindergarten Preparatory School	934 Chester St, Oakland, CA 94607	5	562053	4184716
East Bay Conservation Corps Charter School	1021 Third St., Oakland, CA 94607	3	562761	4183877
East Bay Endoscopy Center	5858 Horton St # 100, Emeryville, CA 94608	4	562373	4188331
Emery High School	1100 47th St., Emeryville, CA 94608	10	563042	4187786
Emery Middle School	1275 61st St., Emeryville, CA 94608	6	562637	4188584
Emeryville Recreation Center	4300 San Pablo Ave, Emeryville, CA 94608	13	563322	4187547
Families That Care	1404 8th St, Oakland, CA 94607	4	562199	4184552
Foster Elementary School	2850 West St., Oakland, CA 94608	9	563919	4185943
Gwen Jackson's Day Care	801 Campbell St, Oakland, CA 94607	4	561710	4184690
Hey Diddle Diddle	1055 43rd St, Emeryville, CA 94608	15	563508	4187566
Home Sweet Home	2750 Todd Street, Alameda, CA 94501	1	561597	4182549
Hoover Elementary School	890 Brockhurst St., Oakland, CA 94608	10	563748	4186457
Kipp Bridge College Preparatory School	991 14th St., Oakland, CA 94607	6	563110	4184811
Lafayette Elementary School	1700 Market St, Oakland, CA 94607	8	563382	4185025
Lake Merritt Childcare Center	301 12th St, Oakland, CA 94607	11	564385	4184039

Table 49 Sensitive Receptor Locations Oakland Rail Yard				
Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
Lake Park Retirement Residence	1850 Alice St, Oakland, CA 94612	9	564755	4184485
Laney Middle School	900 Fallon St., Oakland, CA 94609	7	564825	4183567
Lighthouse Community Charter School	345 12th St., Oakland, CA 94607	12	564301	4184081
Lincoln Elementary School	225 11th St., Oakland, CA 94607	11	564458	4183864
Little Stars Pre-School	169 14th St, Oakland, CA 94612	9	564742	4184053
Longfellow Elementary School	3877 Lusk St., Oakland, CA 94608	16	563871	4187103
Lowell Middle School	991 14th St, Oakland, CA 94607	6	563074	4184738
Marina Center	4727 San Pablo Ave, Emeryville, CA 94608	12	563220	4187840
Marjorie's Day Care	788 14th St, Oakland, CA 94612	9	563442	4184716
Martin Luther King Jr Elementary School	960 10th St, Oakland, CA 94607	7	563042	4184530
Mayari's Playhouse	875 19th St, Oakland, CA 94607	7	563457	4185135
McClymonds High School	2607 Myrtle St., Oakland, CA 94607	5	563391	4185880
Miller Elementary School	250 Singleton Ave, Alameda, CA 94501	3	562815	4182388
Millsmont Academy	426 17th St, Oakland, CA 94612	9	564285	4184615
Mimi Daycare	1321 Peralta St, Oakland, CA 94607	4	562107	4185074
Monicca's Daycare	1004 Chester St, Oakland, CA 94607	5	562068	4184776
Ms T's Daycare	1411 10th St, Oakland, CA 94607	5	562236	4184726
Oakland Military Institute	2405 W 14th St., Bldg. 796, Oakland, CA 94607	3	561400	4185472
Oakland School for the Arts	1800 San Pablo Ave., Oakland, CA 94612	10	564065	4184739
Pam's Child Care	699 30th St, Oakland, CA 94609	11	564086	4186056
Parent Child Development Center	836 31st St, Oakland, CA 94608	9	563771	4186255
Parent Child Development Center	1094 56th St, Emeryville, CA 94608	12	563164	4188210
Pentacostal Way of Truth Academy	1575 Seventh St., Oakland, CA 94607	3	561792	4184505
Prescott Elementary School	920 Campbell St, Oakland, CA 94607	4	561793	4184775
Ralph Bunche Academy	1240 18th St., Oakland, CA 94607	3	562667	4185342
Rose's Day Care	1407 West St A, Oakland, CA 94612	9	563420	4184730
Santa Fe Elementary School	915 54th St., Oakland, CA 94608	19	563720	4188008
Sheila's Childcare	1206 30th St, Emeryville, CA 94608	4	563112	4186359
Sophia Project	820 19th St, Oakland, CA 94607	7	563560	4185115
St Martin De Porres	1630 10th St, Oakland, CA 94607	5	561880	4184847
St. Vincent's Day Home	1086 Eighth St., Oakland, CA 94607	6	562813	4184382

Table 49 **Sensitive Receptor Locations** **Oakland Rail Yard**				
Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
Starlite Child Development Center	246 14th St, Oakland, CA 94612	11	564598	4184158
Sugar & Spice Center for Children	2238 Mariner Square Dr, Alameda, CA 94501	2	563723	4182474
Sunshine Daycare	5223 Market St, Emeryville, CA 94608	21	563923	4187953
Supporting Future Growth Child Care	860 30th St, Emeryville, CA 94608	9	563783	4186143
Supporting Future Growth Child Care	3208 San Pablo Ave, Emeryville, CA 94608	9	563625	4186400
Susan s Day Care	2536 Filbert St, Oakland, CA 94607	5	563397	4185803
Thomas Childcare	1055 8th St, Oakland, CA 94607	6	562864	4184337
Thurgood Marshall Early Head Start	1117 10th St, Oakland, CA 94607	6	562806	4184570
Tiny Tots Daycare II	690 15th St, Oakland, CA 94612	10	563698	4184690
Tracy Childcare Center	787 22nd St, Oakland, CA 94612	6	563722	4185271
V's Child Care	1166 8th St, Oakland, CA 94607	6	562657	4184427
West Oakland Community Charter School	959 12th St, Oakland, CA 94607	7	563144	4184617
Woodstock Elementary School	1900 Third St., Alameda, CA 94501	3	562717	4181597
Notes: 1. UTM Coordinates are in Zone 11, NAD 83.				

Figure 4
Coarse Modeling Grid
Oakland Rail Yard

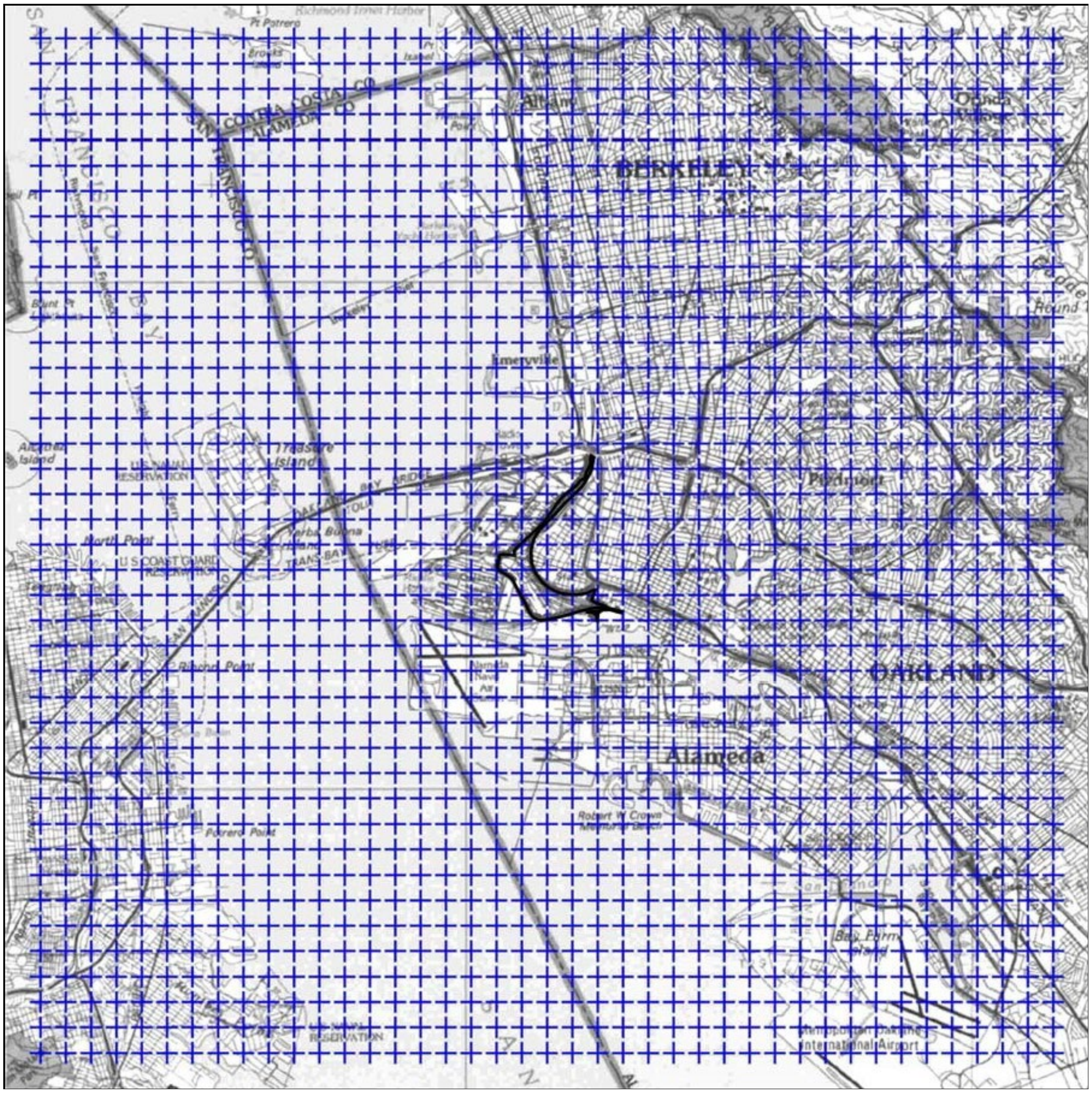


Figure 5
Fine Modeling Grid
Oakland Rail Yard

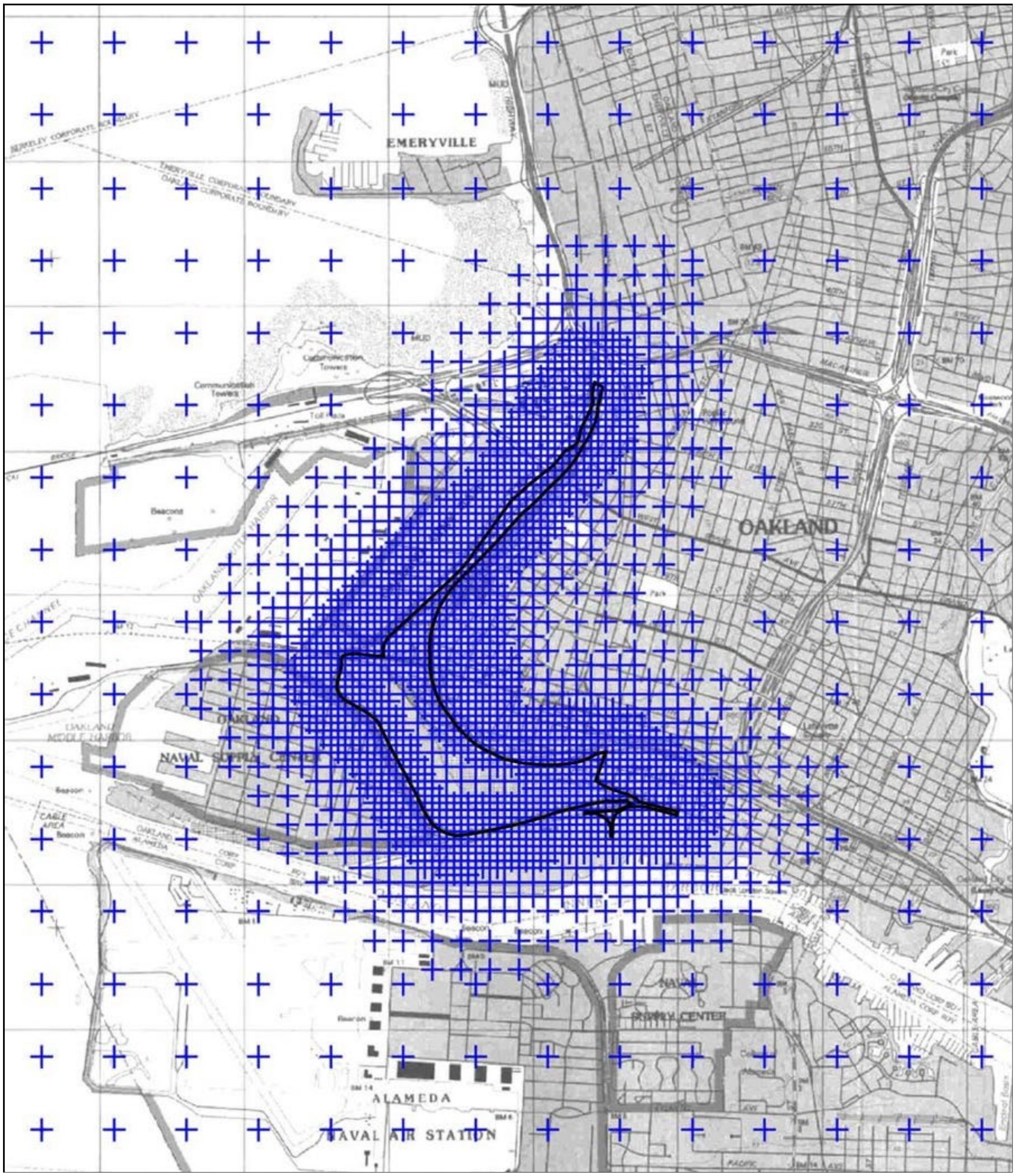
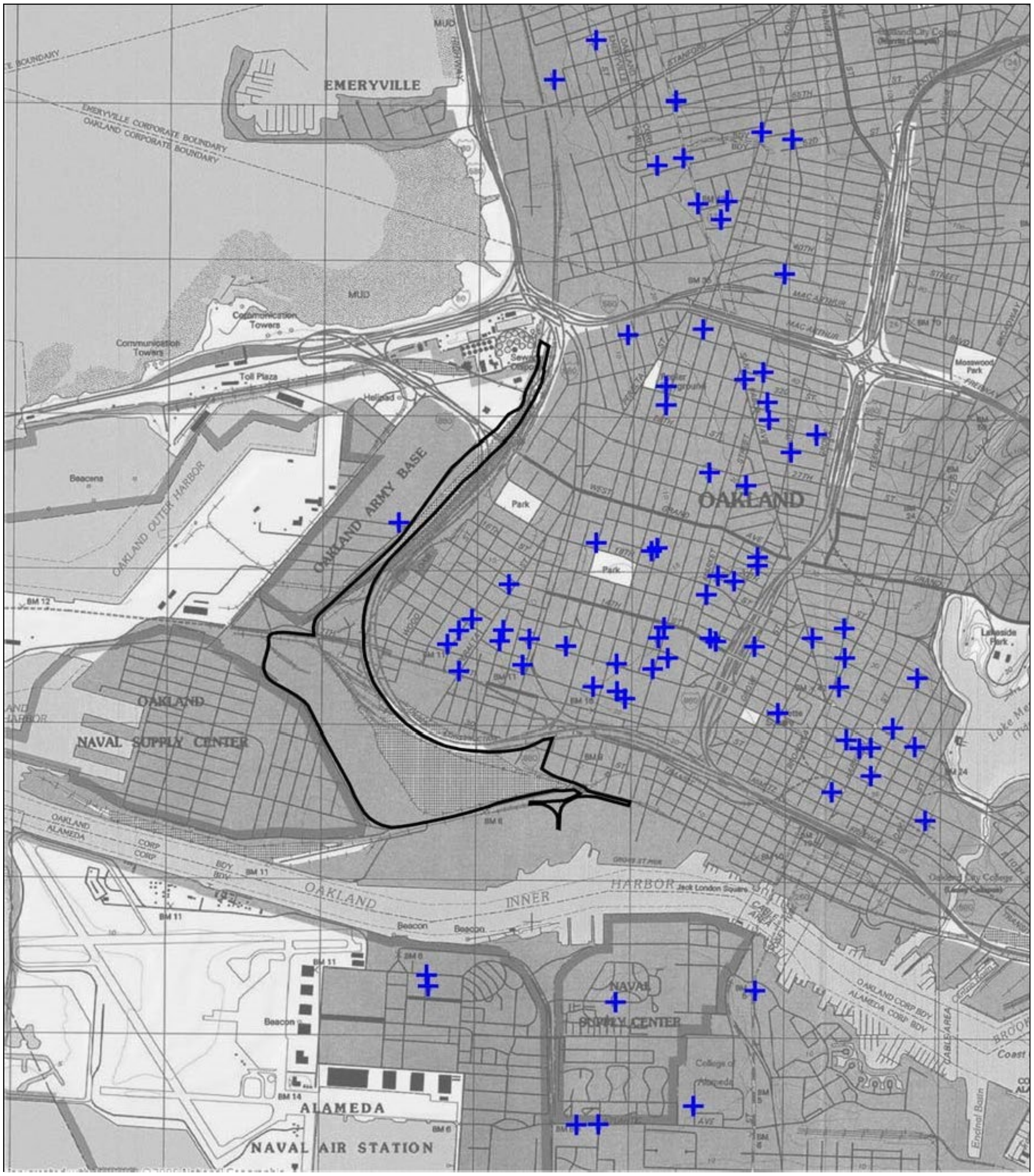


Figure 6
Sensitive Receptors
Oakland Rail Yard



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 Oakland International Airport was divided into four sectors to characterize the surface roughness, and the area surrounding the Oakland Rail Yard was divided into four similar sectors to characterize the 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 (not to be confused with the surface roughness parameters already specified for sectors around the meteorological monitoring station and input to AERMET), AERMOD assigns a default "urban" surface roughness of 1 meter. For the Oakland Yard, 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 cities of Oakland, Alameda, Berkeley, Emeryville and Piedmont was considered to determine the urban heat island effect on the nocturnal convective boundary layer height. The population of these cities is approximately 560,000 (see reference list), 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.

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

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.

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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http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=oakland&_cityTown=oakland&_state=04000US06&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010

Piedmont:

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APPENDIX A

LOCOMOTIVE DATA

APPENDIX A-1

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

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

Through Trains

EB Arrivals 6114

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	9	5738	16	92	14	22	3	227	215	1	28
Pre Tier 0	Yes	3	14	3	0	1	0	0	0	0	22	0	0
Tier 0	No	0	0	13	2	27	512	11	0	39	173	11	0
Tier 0	Yes	1	1	0	0	0	7	0	0	0	110	0	0
Tier 1	No	0	0	0	0	0	86	0	0	0	4	0	0
Tier 1	Yes	0	0	0	0	0	385	0	0	0	357	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	41	0	0	0	83	0	0

EB Departures 6114

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	9	5736	16	92	14	22	3	227	215	1	28
Pre Tier 0	Yes	3	14	3	0	1	0	0	0	0	22	0	0
Tier 0	No	0	0	13	2	27	512	11	0	39	173	11	0
Tier 0	Yes	1	1	0	0	0	7	0	0	0	110	0	0
Tier 1	No	0	0	0	0	0	86	0	0	0	4	0	0
Tier 1	Yes	0	0	0	0	0	385	0	0	0	359	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	41	0	0	0	83	0	0

WB Arrivals 7051

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	1	165	6873	16	116	15	27	56	400	598	1	137
Pre Tier 0	Yes	4	10	3	0	0	0	0	0	0	13	0	0
Tier 0	No	0	0	13	0	22	387	10	0	31	148	5	0
Tier 0	Yes	0	2	0	0	0	4	0	0	0	72	0	0
Tier 1	No	0	0	0	0	0	81	0	0	0	7	0	0
Tier 1	Yes	0	0	0	0	0	343	0	0	0	290	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	45	0	0	0	66	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Departures		7051										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	1	166	6873	16	116	15	27	56	399	597	1	137
Pre Tier 0	**Yes**	4	10	3	0	0	0	0	0	0	13	0	0
Tier 0	**No**	0	0	13	0	21	386	10	0	31	147	6	0
Tier 0	**Yes**	0	2	0	0	0	4	0	0	0	72	0	0
Tier 1	**No**	0	0	0	0	0	81	0	0	0	7	0	0
Tier 1	**Yes**	0	0	0	0	0	345	0	0	0	290	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	45	0	0	0	67	0	0

	Arriving IM Trains												
	EB Arrivals		149										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	42	6	18	0	0	0	47	25	0	1
Pre Tier 0	**Yes**	0	0	2	0	0	0	0	0	0	4	0	0
Tier 0	**No**	0	0	1	0	2	66	0	0	7	10	2	0
Tier 0	**Yes**	0	0	0	0	1	1	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	15	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	47	0	0	0	5	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	6	0	0	0	9	0	0

	EB Departures		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Arrivals		1300										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	1	101	26	47	17	3	7	212	258	1	21
Pre Tier 0	**Yes**	2	0	0	0	0	0	0	0	0	22	0	0
Tier 0	**No**	0	0	2	1	11	845	2	0	38	84	13	0
Tier 0	**Yes**	0	0	0	0	0	4	0	0	0	8	0	0
Tier 1	**No**	0	0	0	0	0	142	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	713	0	0	0	27	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	99	0	0	0	256	0	0

	WB Departures		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

	Departing IM Trains												
	EB Arrivals		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	EB Departures		924										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	50	17	28	10	6	0	139	164	0	6
Pre Tier 0	**Yes**	3	1	0	0	0	0	0	0	0	16	0	0
Tier 0	**No**	0	0	2	0	4	571	3	0	25	60	10	0
Tier 0	**Yes**	0	0	0	0	0	4	0	0	0	4	0	0
Tier 1	**No**	0	0	0	0	0	103	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	478	0	0	0	20	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	75	0	0	0	174	0	0

	WB Arrivals		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

	WB Departures		396										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	57	7	25	0	0	0	72	37	0	7
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	4	0	0
Tier 0	**No**	0	0	2	0	3	188	0	0	9	20	3	0
Tier 0	**Yes**	0	0	0	0	1	0	0	0	0	2	0	0
Tier 1	**No**	0	0	0	0	0	30	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	170	0	0	0	5	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	16	0	0	0	51	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

Arriving and Departing IM Trains

EB Arrivals 126

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	6	2	16	2	1	0	14	19	0	1
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	1	0	0
Tier 0	No	0	0	0	0	1	101	0	0	2	7	1	0
Tier 0	Yes	0	0	0	0	0	3	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	10	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	72	0	0	0	1	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	16	0	0	0	28	0	0

EB Departures 126

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	6	2	15	3	0	0	11	15	0	1
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	1	0	0
Tier 0	No	0	0	0	0	1	92	0	0	2	5	1	0
Tier 0	Yes	0	0	0	0	0	3	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	9	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	63	0	0	0	1	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	17	0	0	0	25	0	0

WB Arrivals 21

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	2	0	2	1	0	0	6	2	0	0
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	0	10	0	0	1	3	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	2	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	15	0	0	0	1	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	1	0	0	0	2	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Departures		21										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	2	0	1	1	0	0	2	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	8	0	0	1	1	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	2	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	13	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	2	0	0

Other Arriving Trains

	EB Arrivals		319										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	772	1	40	0	0	0	5	0	0	6
Pre Tier 0	**Yes**	0	1	2	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	19	0	6	13	1	0	1	1	1	0
Tier 0	**Yes**	0	0	0	0	4	0	0	0	0	1	0	0
Tier 1	**No**	0	0	0	0	0	4	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	10	0	0	0	3	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	3	0	0	0	1	0	0

	EB Departures		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Arrivals		461										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	9	661	4	38	0	4	1	45	18	0	11
Pre Tier 0	**Yes**	10	12	5	0	0	0	0	0	0	3	0	0
Tier 0	**No**	0	0	26	0	12	84	1	0	7	16	1	0
Tier 0	**Yes**	0	3	0	0	0	0	0	0	0	12	0	0
Tier 1	**No**	0	0	0	0	0	11	0	0	0	1	0	0
Tier 1	**Yes**	0	0	0	0	0	64	0	0	0	25	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	3	0	0	0	3	0	0

	WB Departures		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

Other Departing Trains

	EB Arrivals		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPS0**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	EB Departures		904										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	8	1452	14	98	2	4	0	99	58	0	19
Pre Tier 0	**Yes**	11	24	9	0	0	0	0	0	0	7	0	0
Tier 0	**No**	0	1	45	1	26	260	0	0	16	46	5	0
Tier 0	**Yes**	1	4	0	0	4	0	0	0	0	17	0	0
Tier 1	**No**	0	0	0	0	0	40	0	0	0	1	0	0
Tier 1	**Yes**	0	0	0	0	0	185	0	0	0	52	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	16	0	0	0	40	0	0

	WB Arrivals		0										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

	WB Departures		22										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	11	0	2	0	0	0	9	3	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	1	10	0	0	2	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	3	0	0	0	3	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	1	0	0	0	1	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

Other Arriving and Departing Trains

EB Arrivals 141

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPS0	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	31	2	14	1	2	1	34	22	0	0
Pre Tier 0	Yes	0	0	1	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	1	0	3	74	0	0	10	36	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	36	0	0
Tier 1	No	0	0	0	0	0	12	0	0	0	3	0	0
Tier 1	Yes	0	0	0	0	0	63	0	0	0	76	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	4	0	0	0	18	0	0

EB Departures 141

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPS0	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	31	3	3	1	1	1	35	21	0	0
Pre Tier 0	Yes	0	0	1	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	1	69	0	0	11	36	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	36	0	0
Tier 1	No	0	0	0	0	0	10	0	0	0	2	0	0
Tier 1	Yes	0	0	0	0	0	64	0	0	0	74	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	5	0	0	0	16	0	0

WB Arrivals 121

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPS0	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	17	29	2	14	1	0	0	17	23	0	8
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	1	0	0
Tier 0	No	0	0	1	1	2	67	0	0	1	15	0	0
Tier 0	Yes	0	0	0	0	0	2	0	0	0	8	0	0
Tier 1	No	0	0	0	0	0	16	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	51	0	0	0	28	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	6	0	0	0	6	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Departures		121										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	15	29	1	17	1	0	4	17	36	0	9
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	1	0	0
Tier 0	**No**	0	0	1	1	4	66	0	0	1	12	0	0
Tier 0	**Yes**	0	0	0	0	0	2	0	0	0	8	0	0
Tier 1	**No**	0	0	0	0	0	14	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	52	0	0	0	26	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	6	0	0	0	5	0	0

Power Moves Through

	EB Arrivals		148										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	2	116	0	3	0	1	0	10	15	0	1
Pre Tier 0	**Yes**	0	3	0	0	0	0	0	0	0	1	0	0
Tier 0	**No**	0	1	0	0	1	51	0	0	1	9	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	3	0	0
Tier 1	**No**	0	0	0	0	0	9	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	36	0	0	0	2	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	7	0	0	0	13	0	0

	EB Departures		148										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	2	116	0	3	0	1	0	9	15	0	1
Pre Tier 0	**Yes**	0	3	0	0	0	0	0	0	0	1	0	0
Tier 0	**No**	0	1	0	0	1	51	0	0	1	9	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	3	0	0
Tier 1	**No**	0	0	0	0	0	9	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	35	0	0	0	2	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	7	0	0	0	13	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Arrivals		98										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	45	94	1	5	0	1	2	8	14	0	3
Pre Tier 0	**Yes**	16	43	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	2	1	0	1	2	0	0	0	0	0	0
Tier 0	**Yes**	7	5	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	3	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	5	0	0	0	3	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

	WB Departures		98										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	44	99	1	5	0	1	2	8	14	0	3
Pre Tier 0	**Yes**	16	44	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	1	1	0	1	2	0	0	0	0	0	0
Tier 0	**Yes**	7	5	0	0	0	0	0	0	0	0	0	0
Tier 1	**No**	0	0	0	0	0	3	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	5	0	0	0	3	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0

	Power Moves Arriving												
	EB Arrivals		13										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	4	0	2	0	1	0	2	5	0	0
Pre Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	0	0	0	8	1	0	0	2	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	2	0	0
Tier 1	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	**Yes**	0	0	0	0	0	4	0	0	0	5	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	0	0	0	0	1	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	EB Departures		0										
Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	0	0	0	0	0	0	0

	WB Arrivals		13										
Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	1	9	0	1	0	0	0	2	2	0	0
Pre Tier 0	Yes	4	8	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	1	0	0	1	5	0	0	1	2	0	0
Tier 0	Yes	0	1	0	0	1	0	0	0	0	2	0	0
Tier 1	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	3	0	0	0	1	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	0	0	0	0	0	0	0

	WB Departures		0										
Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

Power Moves Departing

EB Arrivals 0

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	0	0	0	0	0	0	0

EB Departures 26

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	10	0	7	0	0	0	6	6	0	0
Pre Tier 0	Yes	1	0	0	0	0	0	0	0	0	1	0	0
Tier 0	No	0	0	0	0	1	16	0	0	0	0	0	0
Tier 0	Yes	0	0	0	0	0	1	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	6	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	8	0	0	0	2	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	2	0	0	0	1	0	0

WB Arrivals 0

Technology	ZTR/AESS	Switch	GP3x	GP4x	GPSO	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
Pre Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Pre Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 0	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 1	Yes	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	No	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	Yes	0	0	0	0	0	0	0	0	0	0	0	0

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-1

Locomotive Model, Tier, and Auto Start/Stop Technology Frequency by Train Type

	WB Departures		24										
Technology	**ZTR/AESS**	**Switch**	**GP3x**	**GP4x**	**GPSO**	**GP60**	**SD7x**	**SD90**	**Dash7**	**Dash8**	**Dash9**	**C60A**	**Unknown**
Pre Tier 0	**No**	0	0	9	1	2	0	0	0	2	5	1	0
Pre Tier 0	**Yes**	1	2	0	0	0	0	0	0	0	0	0	0
Tier 0	**No**	0	0	1	0	1	14	0	0	0	0	0	0
Tier 0	**Yes**	0	0	0	0	0	0	0	0	0	1	0	0
Tier 1	**No**	0	0	0	0	0	2	0	0	0	1	0	0
Tier 1	**Yes**	0	0	0	0	0	7	0	0	0	5	0	0
Tier 2	**No**	0	0	0	0	0	0	0	0	0	0	0	0
Tier 2	**Yes**	0	0	0	0	0	1	0	0	0	1	0	0

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 tum off the Diesel engine after 15 to 30 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-2

LOCOMOTIVE MODEL DISTRIBUTION BY TRAIN TYPE GROUPS

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A2
Locomotive Model Distribution by Train Type Groups

·u Trains and Power Moves

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	0.0000	0.0856	0.3913	0.0018	0.0147	0.0000	0.0037	0.0037	0.0322	0.0534	0.0000
Pre Tier 0	Yes	0.0295	0.0856	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0018	0.0000
Tier 0	No	0.0000	0.0046	0.0018	0.0000	0.0037	0.0976	0.0000	0.0000	0.0018	0.0166	0.0000
Tier 0	Yes	0.0129	0.0092	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0055	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0221	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0746	0.0000	0.0000	0.0000	0.0092	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	0.0129	0.0000	0.0000	0.0000	0.0239	0.0000

Intermodal 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	0.0001	0.0082	0.5966	0.0029	0.0133	0.0022	0.0025	0.0029	0.0411	0.0502	0.0001
Pre Tier 0	Yes	0.0004	0.0012	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0028	0.0000
Tier 0	No	0.0000	0.0000	0.0014	0.0001	0.0028	0.0861	0.0011	0.0000	0.0053	0.0195	0.0015
Tier 0	Yes	0.0001	0.0001	0.0000	0.0000	0.0001	0.0009	0.0000	0.0000	0.0000	0.0089	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0152	0.0000	0.0000	0.0000	0.0005	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0709	0.0000	0.0000	0.0000	0.0317	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	0.0094	0.0000	0.0000	0.0000	0.0198	0.0000

Other Trains and Power Moves

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	0.0000	0.0080	0.4870	0.0045	0.0380	0.0010	0.0019	0.0011	0.0436	0.0318	0.0002
Pre Tier 0	Yes	0.0043	0.0075	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0021	0.0000
Tier 0	No	0.0000	0.0003	0.0150	0.0005	0.0093	0.1096	0.0005	0.0000	0.0080	0.0265	0.0011
Tier 0	Yes	0.0002	0.0013	0.0000	0.0000	0.0014	0.0008	0.0000	0.0000	0.0000	0.0197	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0184	0.0000	0.0000	0.0000	0.0013	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0821	0.0000	0.0000	0.0000	0.0479	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	0.0075	0.0000	0.0000	0.0000	0.0149	0.0000

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Appendix A2
Locomotive Model Distribution by Train Type Groups

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
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

Locomotives Serviced

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	0.0000	0.0119	0.1052	0.0083	0.0241	0.0029	0.0017	0.0002	0.0714	0.0620	0.0002
Pre Tier 0	Yes	0.0119	0.0136	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0061	0.0000
Tier 0	No	0.0002	0.0002	0.0041	0.0002	0.0058	0.2529	0.0012	0.0000	0.0141	0.0318	0.0041
Tier 0	Yes	0.0000	0.0036	0.0000	0.0000	0.0005	0.0012	0.0000	0.0000	0.0000	0.0056	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0313	0.0000	0.0000	0.0000	0.0002	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.2167	0.0000	0.0000	0.0000	0.0143	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0270	0.0000	0.0000	0.0000	0.0641	0.0000

Locomotives Load Tested

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	0.0000	0.0556	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0556	0.0556	0.0000
Pre Tier 0	Yes	0.0000	0.1111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0556	0.0000	0.0000	0.0000	0.4444	0.0000	0.0000	0.0000	0.0556	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	0.1111	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
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0556	0.0000

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 EB Arriving	1	6114	1.353	1	1.353	0.50
Thru EB Departing	2	6114	1.353	1	1.353	0.50
Thru WB Arriving	3	7051	1.413	1	1.413	0.50
Thru WB Departing	4	7051	1.413	1	1.413	0.50
Intermodal Train EB Arrivals	5	149	2.128	2	2.128	0.00
Intermodal Train WB Arrivals	6	1300	2.279	2	2.279	0.00
Intermodal Train EB Departures	7	924	2.135	2	2.135	0.90
Intermodal Train WB Departures	8	396	1.790	2	1.790	0.90
Intermodal EB Arriving and Departing Arrivals	9	126	2.413	2	2.413	0.00
Intermodal EB Arriving and Departing Departures	10	126	2.167	2	2.167	0.00
Intermodal WB Arriving and Departing Arrivals	11	21	2.286	2	2.286	0.00
Intermodal WB Arriving and Departing Departures	12	21	1.571	2	1.571	0.00
Other Train EB Arrivals	13	319	2.806	3	2.806	0.00
Other Train WB Arrivals	14	461	2.364	3	2.364	0.00
Other Train EB Departures	15	904	2.837	3	2.837	0.90
Other Train WB Departures	16	22	2.091	3	2.091	0.90
Other EB Arriving and Departing Arrivals	17	141	3.149	3	3.149	0.00
Other EB Arriving and Departing Departures	18	141	2.986	3	2.986	0.00
Other WB Arriving and Departing Arrivals	19	121	2.612	3	2.612	0.00
Other WB Arriving and Departing Departures	20	121	2.711	3	2.711	0.00
Power Moves Thru EB Arriving	21	148	1.926	1	1.500	0.50
Power Moves Thru EB Departing	22	148	1.912	1	1.500	0.50
Power Moves Thru WB Arriving	23	98	2.663	1	1.500	0.50
Power Moves Thru WB Departing	24	98	2.704	1	1.500	0.50
Power Moves EB Arrivals	25	13	2.846	3	1.500	0.00

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
Power Moves EB Departures	26	13	3.462	3	1.500	0.00
Power Moves WB Arrivals	27	26	2.615	3	1.500	0.90
Power Moves WB Departures	28	24	2.375	3	1.500	0.90
Yard Switchers -- Desert Yard	29	365	1.688	4	1.688	1.00
Yard Switchers -- Main Yard	30	365	1.688	4	1.688	1.00

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	Nl	N2	N3	N4	NS	N6	N7	N8
California Fuel (221 ppm S)												
Thru Trains and Power Moves	1	29.21	37.60	66.16	39.35	111.65	204.27	239.38	304.61	482.93	560.85	688.53
Intermodal Trains	2	36.05	39.81	70.68	41.85	119.73	215.38	251.09	321.11	505.51	587.39	724.93
Other Trains and Power Moves	3	32.89	38.01	68.87	42.57	116.51	217.06	255.89	330.79	517.92	601.08	731.66
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	1	29.21	37.60	66.16	39.35	111.65	219.34	266.26	344.88	539.50	618.82	762.03
Intennodal Trains	2	36.05	39.81	70.68	41.85	119.73	231.92	279.20	363.13	565.19	650.68	805.77
Other Trains and Power Moves	3	32.89	38.01	68.87	42.57	116.51	234.02	284.52	373.79	579.32	667.15	814.64
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

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**	0.0000	0.0856	0.3913	0.0018	0.0147	0.0000	0.0037	0.0037	0.0322	0.0534	0.0000
Pre Tier 0	**Yes**	0.0295	0.0856	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0018	0.0000
Tier 0	**No**	0.0000	0.0046	0.0018	0.0000	0.0037	0.0976	0.0000	0.0000	0.0018	0.0166	0.0000
Tier 0	**Yes**	0.0129	0.0092	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0055	0.0000
Tier 1	**No**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0221	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0746	0.0000	0.0000	0.0000	0.0092	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	0.0129	0.0000	0.0000	0.0000	0.0239	0.0000

Intermodal 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	0.0001	0.0082	0.5966	0.0029	0.0133	0.0022	0.0025	0.0029	0.0411	0.0502	0.0001
Pre Tier 0	Yes	0.0004	0.0012	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0028	0.0000
Tier 0	No	0.0000	0.0000	0.0014	0.0001	0.0028	0.0861	0.0011	0.0000	0.0053	0.0195	0.0015
Tier 0	Yes	0.0001	0.0001	0.0000	0.0000	0.0001	0.0009	0.0000	0.0000	0.0000	0.0089	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0152	0.0000	0.0000	0.0000	0.0005	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0709	0.0000	0.0000	0.0000	0.0317	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	0.0094	0.0000	0.0000	0.0000	0.0198	0.0000

Other Trains and Power Moves

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	0.0000	0.0080	0.4870	0.0045	0.0380	0.0010	0.0019	0.0011	0.0436	0.0318	0.0002
Pre Tier 0	Yes	0.0043	0.0075	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0021	0.0000
Tier 0	No	0.0000	0.0003	0.0150	0.0005	0.0093	0.1096	0.0005	0.0000	0.0080	0.0265	0.0011
Tier 0	Yes	0.0002	0.0013	0.0000	0.0000	0.0014	0.0008	0.0000	0.0000	0.0000	0.0197	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0184	0.0000	0.0000	0.0000	0.0013	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0821	0.0000	0.0000	0.0000	0.0479	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	0.0075	0.0000	0.0000	0.0000	0.0149	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
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)
Main Line 1	1	0.149
Main Line 2	2	0.192
Main Line 3	3	0.480
From Main Line to North End of Main Yard	4	0.221
Main Line 5	5	0.146
Main Line 6	6	0.115
Main Line 7	7	0.115
Main Line 8	8	0.147
Main Line 9	9	0.172
Main Line 10	10	0.225
Main Line 11	11	0.547
Main Line 12	12	0.194
North End to Desert Yard North End	13	0.018
North End of Desert Yard #1	14	0.236
North End of Desert Yard #2	15	0.007
North Center of Desert Yard	16	0.457
Center of Desert Yard	17	0.111
South Center of Desert Yard	18	0.161
South End of Desert Yard	19	0.243
Desert Yard to IM Yard North End Split	20	0.193
IM Yard North End Split to West IM Yard	21	0.170
North End of West IM Yard	22	0.116
Center of West IM Yard	23	0.346
South End of West IM Yard	24	0.116
IM Yard South End Split to West IM Yard #2	25	0.070
IM Yard South End Split to West IM Yard #1	26	0.245
IM Yard South End Split to South End Split	27	0.517
South End Split to South End	28	0.194
IM Yard North End Split to Center IM Yard	29	0.141
North End of Center IM Yard	30	0.133
Center of Center IM Yard	31	0.399
South End of Center IM Yard	32	0.133
IM Yard South End Split to Center IM Yard	33	0.226
IM Yard North End Split to East IM Yard	34	0.132
North End of East IM Yard	35	0.132
Center of East IM Yard #1	36	0.105
Center of East IM Yard #2	37	0.292
South End of East IM Yard	38	0.132
IM Yard South End Split to East IM Yard	39	0.181

Appendix A-3
Sample Calculations

Track Segment	Segment Number	Length (mi)
IM Yard North End Split to Service	40	0.131
Service and Ready Tracks	41	0.115
IM Yard North End Split to Manifest Yard North End #1	42	0.125
IM Yard North End Split to Manifest Yard North End #2	43	0.333
Manifest Yard North End Split to Manifest Yard	44	0.089
Manifest Yard North End	45	0.119
Manifest Yard Center	46	0.357
Manifest Yard South End	47	0.119
Manifest Yard South End to Manifest Yard South End Spl	48	0.104
Manifest Yard South End Split to South End Split	49	0.044
South End Split to "Wye"	50	0.116
"Wye" Inlet	51	0.134
"Wye" Leg# 1	52	0.118
"Wye" Leg#2	53	0.050
"Wye" Leg# 3	54	0.051
"Wye" Leg#4	55	0.050
"Wye" Leg# 5	56	0.078
"Wye" Leg# 6	57	0.036
Main Line Split to Yard North End Split	58	0.382
Yard Switching - Desert Yard	59	1.204
Yard Switching - Main Yard	60	1.172

* Note: Approximately 5% of consists for south bound trains use the "Y" to tum to be facing south

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 EB	1 or 2	1	25	1	0.000	0.000	1.000
	1 or 2	2	25	1	0.000	0.000	1.000
	1 or 2	3	25	1	0.000	0.000	1.000
	1 or 2	4	25	1	0.000	0.000	1.000
	1 or 2	5	25	1	0.000	0.000	1.000
	1 or 2	6	25	1	0.000	0.000	1.000
	1 or 2	7	25	1	0.000	0.000	1.000
	1 or 2	8	25	1	0.000	0.000	1.000
	1 or 2	9	25	1	0.000	0.000	1.000
	1 or 2	10	25	1	0.000	0.000	1.000
	1 or 2	**11**	25	1	0.000	0.000	1.000
	1 or 2	12	25	1	0.000	0.000	1.000
Thru WB	3 or4	1	25	1	0.000	0.000	1.000
	3 or4	2	25	1	0.000	0.000	1.000
	3 or 4	3	25	1	0.000	0.000	1.000
	3 or 4	4	25	1	0.000	0.000	1.000
	3 or4	5	25	1	0.000	0.000	1.000
	3 or4	6	25	1	0.000	0.000	1.000
	3 or 4	7	25	1	0.000	0.000	1.000
	3 or4	8	25	1	0.000	0.000	1.000
	3 or4	9	25	1	0.000	0.000	1.000
	3 or4	10	25	1	0.000	0.000	1.000
	3 or4	**11**	25	1	0.000	0.000	1.000
	3 or4	12	25	1	0.000	0.000	1.000
Intermodal Train EB Arrivals	5	28	10	2	0.000	0.000	1.000
	5	27	10	2	0.000	0.000	1.000
	5	26	10	2	0.000	0.000	0.333
	5	25	10	2	0.000	0.000	0.333
	5	24	10	2	0.000	0.000	0.333
	5	23	10	2	0.000	0.000	0.333
	5	22	10	2	0.500	0.167	0.000
	5	-22	10	2	0.000	0.000	0.333

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
	5	-21	10	2	0.000	0.000	0.333
	5	33	10	2	0.000	0.000	0.333
	5	32	10	2	0.000	0.000	0.333
	5	**31**	10	2	0.000	0.000	0.333
	5	30	10	2	0.500	0.167	0.000
	5	-30	10	2	0.000	0.000	0.333
	5	-29	10	2	0.000	0.000	0.333
	5	39	10	2	0.000	0.000	0.333
	5	38	10	2	0.000	0.000	0.333
	5	37	10	2	0.000	0.000	0.333
	5	36	10	2	0.000	0.000	0.333
	5	35	10	2	0.500	0.167	0.000
	5	-35	10	2	0.000	0.000	0.333
	5	-34	10	2	0.000	0.000	0.333
	5	-40	10	2	0.000	0.000	1.000
Intermodal Train WB Arrivals	6	1	10	2	0.000	0.000	1.000
	6	2	10	2	0.000	0.000	1.000
	6	3	10	2	0.000	0.000	1.000
	6	4	10	2	0.000	0.000	1.000
	6	58	10	2	0.000	0.000	1.000
	6	**21**	10	2	0.000	0.000	0.333
	6	22	10	2	0.000	0.000	0.333
	6	23	10	2	0.000	0.000	0.333
	6	24	10	2	0.500	0.167	0.000
	6	-24	10	2	0.000	0.000	0.333
	6	-25	10	2	0.000	0.000	0.333
	6	-26	10	2	0.000	0.000	0.333
	6	-26	10	2	0.000	0.000	1.000
	6	-25	10	2	0.000	0.000	1.000
	6	-24	10	2	0.000	0.000	1.000
	6	-23	10	2	0.000	0.000	1.000
	6	-22	10	2	0.000	0.000	1.000

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
	6	-21	10	2	0.000	0.000	1.000
	6	-40	10	2	0.000	0.000	1.000
	6	29	10	2	0.000	0.000	0.333
	6	30	10	2	0.000	0.000	0.333
	6	**31**	10	2	0.000	0.000	0.333
	6	32	10	2	0.500	0.167	0.000
	6	-32	10	2	0.000	0.000	0.333
	6	-33	10	2	0.000	0.000	0.333
	6	34	10	2	0.000	0.000	0.333
	6	35	10	2	0.000	0.000	0.333
	6	36	10	2	0.000	0.000	0.333
	6	37	10	2	0.000	0.000	0.333
	6	38	10	2	0.500	0.167	0.000
	6	-38	10	2	0.000	0.000	0.333
	6	-39	10	2	0.000	0.000	0.333
Intermodal Train EB Departures	7	22	10	2	0.250	0.083	0.167
	7	**21**	10	2	0.000	0.000	0.167
	7	58	10	2	0.000	0.000	0.500
	7	4	10	2	0.000	0.000	0.500
	7	3	10	2	0.000	0.000	0.500
	7	2	10	2	0.000	0.000	0.500
	7	1	10	2	0.000	0.000	0.500
	7	30	10	2	0.250	0.083	0.167
	7	29	10	2	0.000	0.000	0.167
	7	35	10	2	0.250	0.083	0.167
	7	34	10	2	0.000	0.000	0.167
	7	**14**	10	2	0.750	0.250	0.500
	7	13	10	2	0.000	0.000	0.500
Intermodal Train WB Departures	8	24	10	2	0.250	0.083	0.167
	8	25	10	2	0.000	0.000	0.167
	8	26	10	2	0.000	0.000	0.167
	8	27	10	2	0.000	0.000	0.500

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
	8	28	10	2	0.000	0.000	1.000
	8	32	10	2	0.250	0.083	0.167
	8	33	10	2	0.000	0.000	0.167
	8	38	10	2	0.250	0.083	0.167
	8	39	10	2	0.000	0.000	0.167
	8	19	10	2	0.750	0.250	0.500
	8	20	10	2	0.000	0.000	0.500
	8	42	10	2	0.000	0.000	0.500
	8	43	10	2	0.000	0.000	0.500
	8	44	10	2	0.000	0.000	0.500
	8	45	10	2	0.000	0.000	0.500
	8	46	10	2	0.000	0.000	0.500
	8	47	10	2	0.000	0.000	0.500
	8	48	10	2	0.000	0.000	0.500
	8	49	10	2	0.000	0.000	0.500
Intermodal EB Arriving and Departing Arrivals	9	28	10	2	0.000	0.000	1.000
	9	27	10	2	0.000	0.000	1.000
	9	26	10	2	0.000	0.000	0.333
	9	25	10	2	0.000	0.000	0.333
	9	24	10	2	0.000	0.000	0.333
	9	23	10	2	0.000	0.000	0.333
	9	22	10	2	0.167	0.167	0.000
	9	33	10	2	0.000	0.000	0.333
	9	32	10	2	0.000	0.000	0.333
	9	31	10	2	0.000	0.000	0.333
	9	30	10	2	0.167	0.167	0.000
	9	39	10	2	0.000	0.000	0.333
	9	38	10	2	0.000	0.000	0.333
	9	37	10	2	0.000	0.000	0.333
	9	36	10	2	0.000	0.000	0.333
	9	35	10	2	0.167	0.167	0.000
Intermodal EB Arriving and Departing Departures	10	22	10	2	0.000	0.000	0.333

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
	10	21	10	2	0.000	0.000	0.333
	10	58	10	2	0.000	0.000	1.000
	10	4	10	2	0.000	0.000	1.000
	10	3	10	2	0.000	0.000	1.000
	10	2	10	2	0.000	0.000	1.000
	10	1	10	2	0.000	0.000	1.000
	10	30	10	2	0.000	0.000	0.333
	10	29	10	2	0.000	0.000	0.333
	10	35	10	2	0.000	0.000	0.333
	10	34	10	2	0.000	0.000	0.333
Intermodal WB Arriving and Departing Arrivals	11	1	10	2	0.000	0.000	1.000
	11	2	10	2	0.000	0.000	1.000
	11	3	10	2	0.000	0.000	1.000
	11	4	10	2	0.000	0.000	1.000
	11	58	10	2	0.000	0.000	1.000
	11	21	10	2	0.000	0.000	0.333
	11	22	10	2	0.000	0.000	0.333
	11	23	10	2	0.000	0.000	0.333
	11	24	10	2	0.167	0.167	0.000
	11	29	10	2	0.000	0.000	0.333
	11	30	10	2	0.000	0.000	0.333
	11	31	10	2	0.000	0.000	0.333
	11	32	10	2	0.167	0.167	0.000
	11	34	10	2	0.000	0.000	0.333
	11	35	10	2	0.000	0.000	0.333
	11	36	10	2	0.000	0.000	0.333
	11	37	10	2	0.000	0.000	0.333
	11	38	10	2	0.167	0.167	0.000
Intermodal WB Arriving and Departing Departures	12	24	10	2	0.000	0.000	0.333
	12	25	10	2	0.000	0.000	0.333
	12	26	10	2	0.000	0.000	0.333
	12	27	10	2	0.000	0.000	1.000

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
	12	28	10	2	0.000	0.000	1.000
	12	32	10	2	0.000	0.000	0.333
	12	33	10	2	0.000	0.000	0.333
	12	38	10	2	0.000	0.000	0.333
	12	39	10	2	0.000	0.000	0.333
Other Train EB Arrivals	13	28	10	2	0.000	0.000	1.000
	13	49	10	2	0.000	0.000	1.000
	13	48	10	2	0.000	0.000	1.000
	13	47	10	2	0.000	0.000	1.000
	13	46	10	2	0.000	0.000	1.000
	13	45	10	2	0.750	0.250	0.000
	13	-45	10	2	0.000	0.000	0.500
	13	-44	10	2	0.000	0.000	0.500
	13	-43	10	2	0.000	0.000	0.500
	13	-42	10	2	0.000	0.000	0.500
	13	-40	10	2	0.000	0.000	0.500
	13	45	10	2	0.000	0.000	0.500
	13	44	10	2	0.000	0.000	0.500
	13	43	10	2	0.000	0.000	0.500
	13	42	10	2	0.000	0.000	0.500
	13	20	10	2	0.000	0.000	0.500
	13	19	10	2	0.000	0.000	0.500
	13	18	10	2	0.000	0.000	0.500
	13	17	10	2	0.000	0.000	0.500
	13	16	10	2	0.000	0.000	0.500
	13	15	10	2	0.000	0.000	0.500
	13	**14**	10	2	0.750	0.250	0.000
	13	-14	10	2	0.000	0.000	0.500
	13	-14	10	2	0.000	0.000	0.500
	13	-15	10	2	0.000	0.000	0.500
	13	-16	10	2	0.000	0.000	0.500
	13	-17	10	2	0.000	0.000	0.500

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	-18	10	2	0.000	0.000	0.500
	13	-19	10	2	0.000	0.000	0.500
	13	-20	10	2	0.000	0.000	0.500
	13	-40	10	2	0.000	0.000	0.500
Other Train WB Arrivals	14	13	10	2	0.000	0.000	0.500
	14	14	10	2	0.000	0.000	0.500
	14	15	10	2	0.000	0.000	0.500
	14	16	10	2	0.000	0.000	0.500
	14	17	10	2	0.000	0.000	0.500
	14	18	10	2	0.000	0.000	0.500
	14	19	10	2	0.750	0.250	0.000
	14	-19	10	2	0.000	0.000	0.500
	14	-20	10	2	0.000	0.000	0.500
	14	-40	10	2	0.000	0.000	1.000
	14	1	10	2	0.000	0.000	0.500
	14	2	10	2	0.000	0.000	0.500
	14	3	10	2	0.000	0.000	0.500
	14	4	10	2	0.000	0.000	0.500
	14	58	10	2	0.000	0.000	0.500
	14	42	10	2	0.000	0.000	0.500
	14	43	10	2	0.000	0.000	0.500
	14	44	10	2	0.000	0.000	0.500
	14	45	10	2	0.000	0.000	0.500
	14	46	10	2	0.000	0.000	0.500
	14	47	10	2	0.750	0.250	0.000
	14	-47	10	2	0.000	0.000	0.500
	14	-48	10	2	0.000	0.000	0.500
	14	-48	10	2	0.000	0.000	0.500
	14	-47	10	2	0.000	0.000	0.500
	14	-46	10	2	0.000	0.000	0.500
	14	-45	10	2	0.000	0.000	0.500
	14	-44	10	2	0.000	0.000	0.500

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
	14	-43	10	2	0.000	0.000	0.500
	14	-42	10	2	0.000	0.000	0.500
Other Train EB Departures	15	**14**	10	2	0.750	0.250	0.500
	15	13	10	2	0.000	0.000	0.500
	15	45	10	2	0.750	0.250	0.500
	15	44	10	2	0.000	0.000	0.500
	15	43	10	2	0.000	0.000	0.500
	15	42	10	2	0.000	0.000	0.500
	15	58	10	2	0.000	0.000	0.500
	15	4	10	2	0.000	0.000	0.500
	15	3	10	2	0.000	0.000	0.500
	15	2	10	2	0.000	0.000	0.500
	15	1	10	2	0.000	0.000	0.500
Other Train WB Departures	16	19	10	2	0.750	0.250	0.500
	16	20	10	2	0.000	0.000	0.500
	16	42	10	2	0.000	0.000	0.500
	16	43	10	2	0.000	0.000	0.500
	16	44	10	2	0.000	0.000	0.500
	16	45	10	2	0.000	0.000	0.500
	16	46	10	2	0.000	0.000	0.500
	16	47	10	2	0.000	0.000	0.500
	16	48	10	2	0.000	0.000	0.500
	16	49	10	2	0.000	0.000	0.500
	16	28	10	2	0.000	0.000	1.000
	16	47	10	2	0.750	0.250	0.500
	16	48	10	2	0.000	0.000	0.500
	16	49	10	2	0.000	0.000	0.500
Other EB Arriving and Departing Arrivals	17	28	10	2	0.000	0.000	1.000
	17	49	10	2	0.000	0.000	1.000
	17	48	10	2	0.000	0.000	1.000
	17	47	10	2	0.000	0.000	1.000
	17	46	10	2	0.000	0.000	1.000

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
	17	45	10	2	0.500	0.500	0.000
Other EB Arriving and Departing Departures	18	45	10	2	0.000	0.000	1.000
	18	44	10	2	0.000	0.000	1.000
	18	43	10	2	0.000	0.000	1.000
	18	42	10	2	0.000	0.000	1.000
	18	58	10	2	0.000	0.000	1.000
	18	4	10	2	0.000	0.000	1.000
	18	3	10	2	0.000	0.000	1.000
	18	2	10	2	0.000	0.000	1.000
	18	1	10	2	0.000	0.000	1.000
Other WB Arriving and Departing Arrivals	19	1	10	2	0.000	0.000	1.000
	19	2	10	2	0.000	0.000	1.000
	19	3	10	2	0.000	0.000	1.000
	19	4	10	2	0.000	0.000	1.000
	19	58	10	2	0.000	0.000	1.000
	19	42	10	2	0.000	0.000	1.000
	19	43	10	2	0.000	0.000	1.000
	19	44	10	2	0.000	0.000	1.000
	19	45	10	2	0.000	0.000	1.000
	19	46	10	2	0.000	0.000	1.000
	19	47	10	2	0.500	0.500	0.000
Other WB Arriving and Departing Departures	20	47	10	2	0.000	0.000	1.000
	20	48	10	2	0.000	0.000	1.000
	20	49	10	2	0.000	0.000	1.000
	20	28	10	2	0.000	0.000	1.000
Power Moves Thru EB	21 or 22	12	25	1	0.000	0.000	1.000
	21 or 22	11	25	1	0.000	0.000	1.000
	21 or 22	10	25	1	0.000	0.000	1.000
	21 or 22	9	25	1	0.000	0.000	1.000
	21 or 22	8	25	1	0.000	0.000	1.000
	21 or 22	7	25	1	0.000	0.000	1.000
	21 or 22	6	25	1	0.000	0.000	1.000

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
	21 or 22	5	25	1	0.000	0.000	1.000
	21 or 22	4	25	1	0.000	0.000	1.000
	21 or 22	3	25	1	0.000	0.000	1.000
	21 or 22	2	25	1	0.000	0.000	1.000
	21 or 22	1	25	1	0.000	0.000	1.000
Power Moves Thru WB Arriving	23 or 24	1	25	1	0.000	0.000	1.000
	23 or 24	2	25	1	0.000	0.000	1.000
	23 or 24	3	25	1	0.000	0.000	1.000
	23 or 24	4	25	1	0.000	0.000	1.000
	23 or 24	5	25	1	0.000	0.000	1.000
	23 or 24	6	25	1	0.000	0.000	1.000
	23 or 24	7	25	1	0.000	0.000	1.000
	23 or 24	8	25	1	0.000	0.000	1.000
	23 or 24	9	25	1	0.000	0.000	1.000
	23 or 24	10	25	1	0.000	0.000	1.000
	23 or 24	11	25	1	0.000	0.000	1.000
	23 or 24	12	25	1	0.000	0.000	1.000
Power Moves EB Arrivals	25	28	10	2	0.000	0.000	1.000
	25	49	10	2	0.000	0.000	1.000
	25	48	10	2	0.000	0.000	1.000
	25	47	10	2	0.000	0.000	1.000
	25	46	10	2	0.000	0.000	1.000
	25	45	10	2	0.000	0.000	1.000
	25	44	10	2	0.000	0.000	1.000
	25	43	10	2	0.000	0.000	1.000
	25	42	10	2	0.000	0.000	1.000
	25	40	10	2	0.000	0.000	1.000
Power Moves EB Departures	26	1	10	2	0.000	0.000	1.000
	26	2	10	2	0.000	0.000	1.000
	26	3	10	2	0.000	0.000	1.000
	26	4	10	2	0.000	0.000	1.000
	26	58	10	2	0.000	0.000	1.000

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
	26	40	10	2	0.000	0.000	1.000
Power Moves WB Arrivals	27	40	10	2	0.000	0.000	1.000
	27	58	10	2	0.000	0.000	1.000
	27	4	10	2	0.000	0.000	1.000
	27	3	10	2	0.000	0.000	1.000
	27	2	10	2	0.000	0.000	1.000
	27	I	10	2	0.000	0.000	1.000
Power Moves WB Departures	28	40	10	2	0.000	0.000	1.000
	28	42	10	2	0.000	0.000	1.000
	28	43	10	2	0.000	0.000	1.000
	28	44	10	2	0.000	0.000	1.000
	28	45	10	2	0.000	0.000	1.000
	28	46	10	2	0.000	0.000	1.000
	28	47	10	2	0.000	0.000	1.000
	28	48	10	2	0.000	0.000	1.000
	28	49	10	2	0.000	0.000	1.000
	28	28	10	2	0.000	0.000	1.000

Notes

(I) 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)
(5) All intermodal arriving trains, including those arriving and departing, are assumed to be distributed evenly between the three parts of the intermodal yard (west, center, and east)
(6) 50% of departing intermodal trains are assumed to depart from the Desert Yard, and the other 50% from the three parts of the intermodal yard
(7) 50% of other trains arriving or departing are assumed to use the Desert Yard, and the other 50% use the manifest yard (both arrivals and departures)
(8) All other trains both arriving and departing are assumed to use the manifest yard

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)
Desert Yard	29	13	3	0	0	0.308032
"	29	14	3	0	0	3.969727
"	29	15	3	0	0	0.1179
"	29	16	3	0	0	7.689406
"	29	17	3	0	0	1.864698
"	29	18	3	0	0	2.708776
"	29	19	3	0	0	4.087627
"	29	20	3	0	0	3.253836
Main Yard	30	21	3	0	0	0.685084
"	30	22	3	0	0	0.465883
"	30	23	3	0	0	1.397648
"	30	24	3	0	0	0.465883
"	30	25	3	0	0	0.281196
"	30	26	3	0	0	0.988835
"	30	27	3	0	0	2.085741
"	30	28	3	0	0	0.781185
"	30	29	3	0	0	0.570299
"	30	30	3	0	0	0.536808
"	30	31	3	0	0	1.610423
"	30	32	3	0	0	0.536808
"	30	33	3	0	0	0.910498
"	30	34	3	0	0	0.531774
"	30	35	3	0	0	0.534255
"	30	36	3	0	0	0.423648
"	30	37	3	0	0	1.179116
"	30	38	3	0	0	0.534255
"	30	39	3	0	0	0.731867
"	30	40	3	0	0	0.528516
"	30	41	3	0	0	0.46395
"	30	42	3	0	0	0.502819
"	30	43	3	0	0	1.345005
"	30	44	3	0	0	0.360698
"	30	45	3	0	0	0.479812
"	30	46	3	0	0	1.439435
"	30	47	3	0	0	0.479812
"	30	48	3	0	0	0.42112

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)
"	30	49	3	0	0	0.177878
"	30	50	3	0	0	0.467931
"	30	51	3	0	0	0.541144
"	30	52	3	0	0	0.474237
"	30	53	3	0	0	0.200614
"	30	54	3	0	0	0.204891
"	30	55	3	0	0	0.200889
"	30	56	3	0	0	0.31515
"	30	57	3	0	0	0.144901

Appendix A-3
Sample Calculations

Duty Cycles (Percent of Time by Notch)	Duty Cycle Number	Idle	DB	Nl	N2	N3	N4	NS	N6	N7	NS
Through Trains and Power Moves	1	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
In Yard Movement	2	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yard Switchers	3	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

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

Locomotive Model Group	**Group** ID	**Idle-NonZTR**	**Idle-All**	**DB**	**Nl**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
California Fuel (221 ppm S)												
Service	l	18.68	28.71	50.93	45.66	94.77	216.93	277.89	354.94	558.78	644.29	736.71
LoadTest	2	16.51	24.4	42.6	42.13	86.98	206.92	280.08	351.41	578.43	673.34	759.63
47-State Fuel (2639 ppm S)												
Service	l	18.68	28.71	50.93	45.66	94.77	235.46	308.84	400.44	625.62	719.56	827.65
LoadTest	2	16.51	24.4	42.6	42.13	86.98	223.65	311.42	396.93	646.88	747.2	846.4

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

Service and Shop Activity

			Duration of Activity per Locomotive (minutes)											
Activity	**Number of Locomotives**	**Fraction of Calif. Fuel**	**Idle-NonZTR**	**Idle-All**	**DB**	**Nl**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
Service - Inbound & Service	4120	0.00	90	30	0	0	0	0	0	0	0	0	0
Service - Post Service	4120	0.90	90	30	0	0	0	0	0	0	0	0	0
Pre-Maintenance Load Test	7	0.90	0	2	0	0	0	0	0	0	0	0	8
Post-Maintenance Load Test	7	0.90	0	2	0	0	0	0	0	0	0	0	8
Quarterly Maintenance Load Tes	17	0.90	0	2	0	0	0	0	0	0	0	0	8
Unscheduled Mtc Post Test	13	0.90	0	l	0	0	0	0	0	0	0	0	5

Appendix A-3
Sample Calculations

Locomotive Model Distributions

Locomotives Serviced

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	0.0000	0.0119	0.1052	0.0083	0.0241	0.0029	0.0017	0.0002	0.0714	0.0620	0.0002
Pre Tier 0	Yes	0.0119	0.0136	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0061	0.0000
Tier0	No	0.0002	0.0002	0.0041	0.0002	0.0058	0.2529	0.0012	0.0000	0.0141	0.0318	0.0041
Tier0	Yes	0.0000	0.0036	0.0000	0.0000	0.0005	0.0012	0.0000	0.0000	0.0000	0.0056	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0313	0.0000	0.0000	0.0000	0.0002	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.2167	0.0000	0.0000	0.0000	0.0143	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0270	0.0000	0.0000	0.0000	0.0641	0.0000

Locomotives Load Tested

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	0.0000	0.0556	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0556	0.0556	0.0000
Pre Tier 0	Yes	0.0000	0.1111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier0	No	0.0000	0.0556	0.0000	0.0000	0.0000	0.4444	0.0000	0.0000	0.0000	0.0556	0.0000
Tier0	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	0.1111	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
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0556	0.0000

Appendix A-3
Sample Calculations

Example I -- WB Arriving Intermodal Trains

Parameter	Value
Activity Code	6
Number of Events	1 300
Locomotives per Consist on Train	2.279
Locomotives per Consist Working During Power	1.5
Moves 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)**	Fraction of Segment Moving	Locomotive Hours Moving	Locomotive Hours **NonZTR Idle**	Locomotive **Hours ZTR Idle**
Main Line I	1	0.149	10	**N**	0.000	0.000	1.000	44.00	0.00	0.00
Main Line 2	2	0.192	10	**N**	0.000	0.000	1.000	56.74	0.00	0.00
Main Line 3	3	0.480	1 0	**N**	0.000	0.000	1.000	142.18	0.00	0.00
From Main Line to North End of Main Yard	4	0.221	10	**N**	0.000	0.000	1.000	65.53	0.00	0.00
Main Line Split to Yard North End Split	58	0.382	1 0	**N**	0.000	0.000	1.000	113.23	0.00	0.00
IM Yard North End Split to West IM Yard	21	0.170	10	**N**	0.000	0.000	0.333	16.77	0.00	0.00
North End of West IM Yard	22	0.116	1 0	**N**	0.000	0.000	0.333	11.41	0.00	0.00
Center of West IM Yard	23	0.346	10	N	0.000	0.000	0.333	34.21	0.00	0.00
South End of West IM Yard	24	0.116	10	**N**	0.500	0.167	0.000	0.00	1481.35	493.78
South End of West IM Yard	24	0.116	10	y	0.000	0.000	0.333	7.51	0.00	0.00
IM Yard South End Split to West IM Yard #2	25	0.070	10	y	0.000	0.000	0.333	4.53	0.00	0.00
IM Yard South End Split to West IM Yard # I	26	0.245	10	y	0.000	0.000	0.333	15.92	0.00	0.00
IM Yard South End Split to West IM Yard # I	26	0.245	10	y	0.000	0.000	1 .000	47.78	0.00	0.00
IM Yard South End Split to West IM Yard #2	25	0.070	10	y	0.000	0.000	1.000	13.59	0.00	0.00
South End of West IM Yard	24	0.116	1 0	y	0.000	0.000	1.000	22.52	0.00	0.00
Center of West IM Yard	23	0.346	10	y	0.000	0.000	1.000	67.55	0.00	0.00
North End of West IM Yard	22	0.116	1 0	y	0.000	0.000	1.000	22.52	0.00	0.00
IM Yard North End Split to West IM Yard	21	0.170	10	y	0.000	0.000	1.000	33.11	0.00	0.00
IM Yard North End Split to Service	40	0.131	1 0	y	0.000	0.000	1 .000	25.55	0.00	0.00
IM Yard North End Split to Center IM Yard	29	0.141	10	**N**	0.000	0.000	0.333	1 3.95	0.00	0.00
North End of Center IM Yard	30	0.133	10	**N**	0.000	0.000	0.333	1 3. 13	0.00	0.00
Center of Center IM Yard	31	0.399	10	N	0.000	0.000	0.333	39.41	0.00	0.00
South End of Center IM Yard	32	0.133	1 0	**N**	0.500	0.167	0.000	0.00	1481.35	493.78
South End of Center IM Yard	32	0.133	10	y	0.000	0.000	0.333	8.64	0.00	0.00
IM Yard South End Split to Center IM Yard	33	0.226	10	y	0.000	0.000	0.333	14.66	0.00	0.00
IM Yard North End Split to East IM Yard	34	0.132	10	N	0.000	0.000	0.333	13.02	0.00	0.00
North End of East IM Yard	35	0.132	10	**N**	0.000	0.000	0.333	13.08	0.00	0.00
Center of East IM Yard # I	36	0.105	10	**N**	0.000	0.000	0.333	10.37	0.00	0.00
Center of East IM Yard #2	37	0.292	10	**N**	0.000	0.000	0.333	28.86	0.00	0.00
South End of East IM Yard	38	0.132	10	N	0.500	0.167	0.000	0.00	1481.35	493.78
South End of East IM Yard	38	0.132	1 0	y	0.000	0.000	0.333	8.61	0.00	0.00
IM Yard South End Split to East IM Yard	39	0.181	10	y	0.000	0.000	0.333	11.79	0.00	0.00

Note: Each of the three IM Yards are assumed to handle one third of the arriving IM trains.

Total								*920.17*	*4444.05*	*1481.35*

Appendix A-3

Sample Calculations

Emission Factors	**Group** ID	**Idle-NonZTR**	**Idle - All**	**DB**	**NI**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
Arriving IM Trains - CA Fuel	2	36.05	39.81	70.68	41.85	119.73	215.38	251.09	321.11	505.5 1	587.39	724.93
Arriving IM Trains - 47-State Fuel	2	36.05	39.81	70.68	41.85	11 9.73	231.92	279.2	363.13	565.19	650.68	805.77
CA Fuel Fraction Adjusted Rates		*36.05*	*39.81*	*70.68*	*41.8 5*	*119.73*	*231.92*	*279.2*	*363./3*	*565./9*	*650.68*	*805.77*
Duty Cycle Moving	2	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
Weighted g/hr emissions		0.00	0.00	0.00	20.93	59.87	0.00	0.00	0.00	0.00	0.00	0.00

	Moving	**Idle-NonZTR**	**Idl e- All**
Emission Rate (g/hr)	80.79	36.05	39.81
Locomotive Hours	920.17	4444.05	1481.35
Total Emissions (g/yr)	**74341**	**160208**	**58973**

Example 2 -- Quarterly Maintenance Load Testing

Number of Quarterly Maintenance Load Tests	1 7
Fraction of Calif. Fuel	0. 9

Emission Factors (g/hr)	**Group** ID	**Idle-NonZTR**	**Idle-All**	**DB**	**NI**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
Load Test - CA Fuel	2	1 6.51	24.40	42.60	42.13	86.98	206.92	280.08	351.41	578.43	673.34	759.63
Load Test - 47-State Fuel	2	16.51	24.4	42.6	42.13	86.98	223.65	311.42	396.93	646.88	747.2	846.4
CA Fuel Fraction Adjusted Rates		*16.51*	*24.40*	*42.60*	*42./3*	*86.98*	*208.59*	*283.21*	*355.96*	*585.28*	*680.73*	*768.31*

							Duration (minutes)					
Activity	Number of Locomot ives	**Idle- NonZTR**	**Idle-All**	**DB**	**NI**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
Quarterly Maintenance Load Test	1 7	0	2	0	0	0	0	0	0	0	0	8
Emissions (g)												
Notch-Specific		0.0	13.8	0.0	0 .0	0 .0	0 .0	0.0	0 .0	0 .0	0 .0	1741.5

Total Emissions (g/yr)	**1755**

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 are prepared for both locomotive and non-locomotive sources are 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 include 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; and

[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 off 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; and
- Power moves.

Power moves are trains consisting only of locomotives that 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 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 that may involve both diagnostic load testing prior to maintenance and post-maintenance load testing. The duration of load test events in each throttle setting depends 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 oflocomotive 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,

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

for l corresponding to idle through N8, and

$$\bar{Q}(l^*) = \sum_{i=I}^{II}\sum_{J=I}^{4} F(i,j,1)\cdot Q(i,j,l^*)$$

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

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

where

> $\bar{Q}(l)$ = 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, NI, ... , NS)
>
> 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 $\mathbf{D}(i)$ (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

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

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, Nl, 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 oflocomotive 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 ofrecords for a typical locomotive's 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-5 - MOVEMENTS AT UPRR OAKLAND

EB Intermodal Arrivals (Yellow) and Power Moves (Light Blue)

WB Intermodal Arrivals (Yellow), Power Moves (Light Blue), and Main Line (Green)

APPENDIX A-5 - MOVEMENTS AT UPRR OAKLAND

Other Train EB Arrivals (Yellow) and Power Moves (Light Blue)

Other Train WB Arrivals (Yellow) and Power Moves (Light Blue)

APPENDIX A-5 - MOVEMENTS AT UPRR OAKLAND

Intermodal (Yellow and Green) and Other Train (Light Blue and Green) Departures

Intermodal (Yellow) and Other Train (Light Blue) Arriving and Departing

APPENDIX A-5 - MOVEMENTS AT UPRR OAKLAND

Power Moves Arriving and Departing

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 modem 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**	**Nl**	**N2**	**N3**	**N4**	**NS**	**N6**	**N7**	**NS**
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		

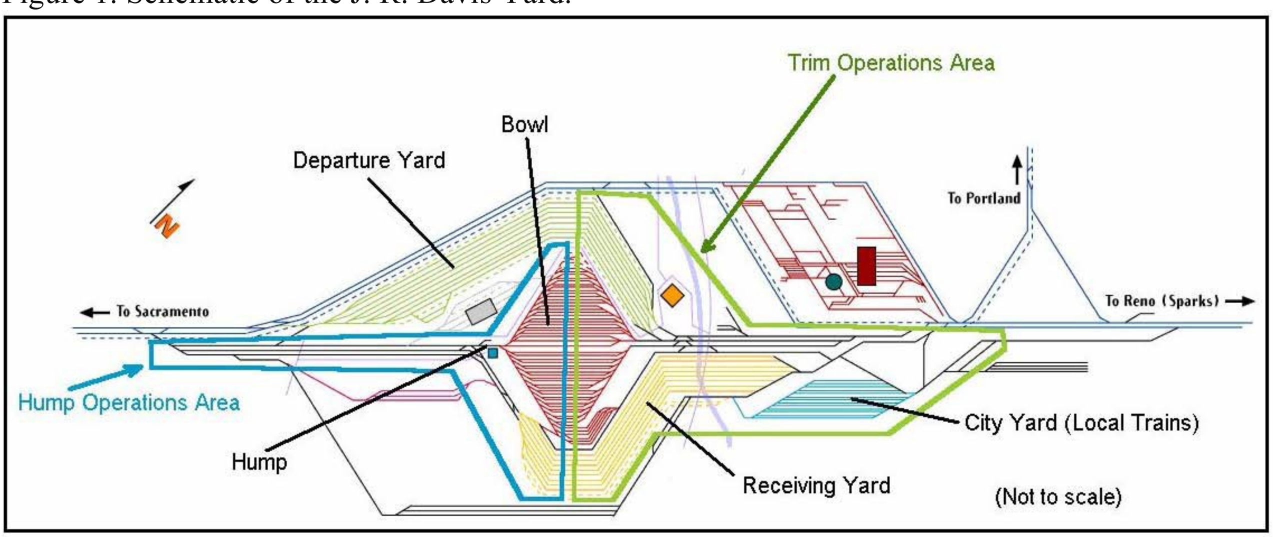
The parameters listed in Table 2 were used to calculate the number of trains by time of day arriving or departing from each area of the yard, as well as average composition of their consists (number of locomotives and distribution of locomotive models). The combination of train symbol, train segment, 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 shutdown.

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.

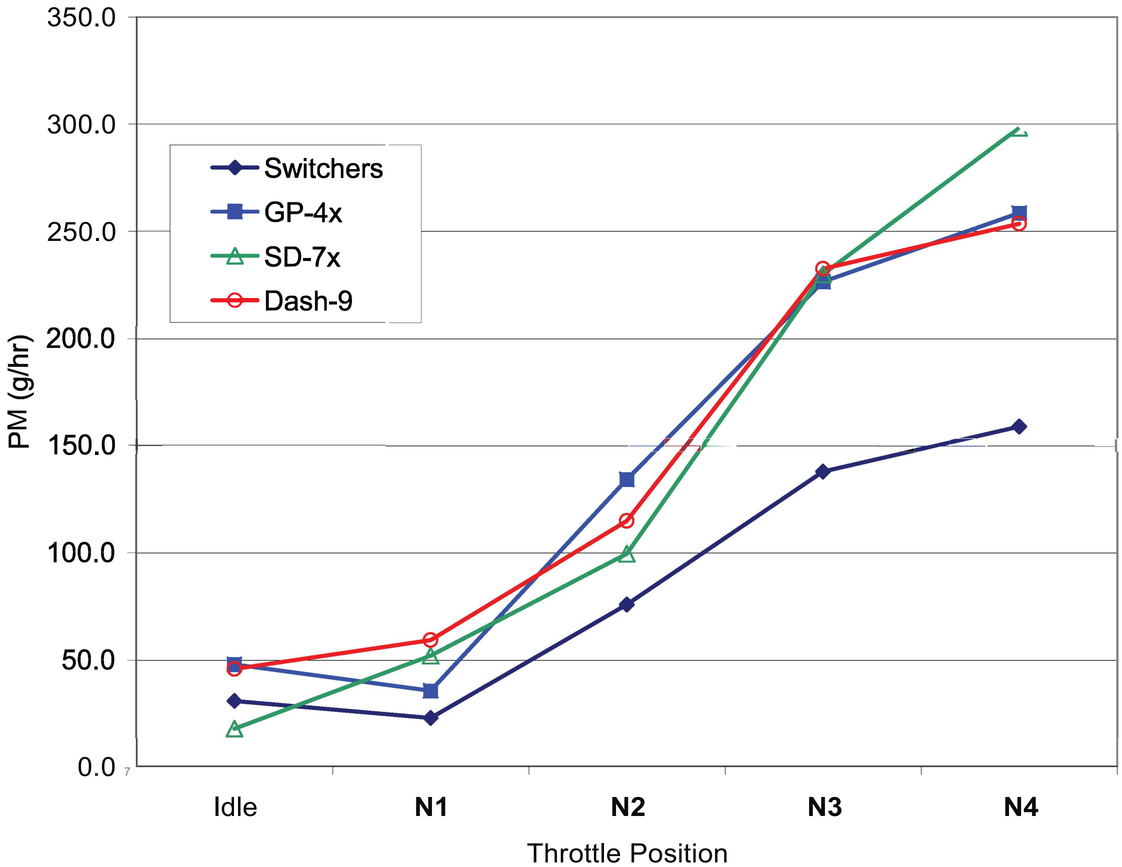
Table 3. Locomotive Model Groups

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).

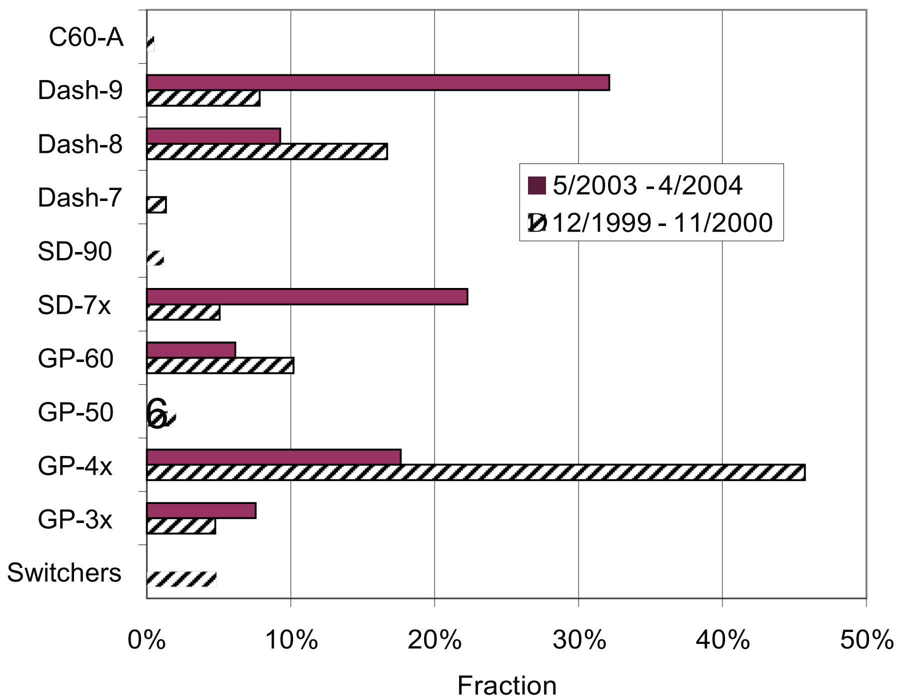


The emission factors used were based on tests using fuel typical of national off-road diesel. Initial emission estimates were derived by multiplying model-specific g/hr emission rates by the total hours of operation and locomotive model fraction for each activity within the yard. At the Davis Yard, over 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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KEYWORDS

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

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

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 colllllluunication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal colllllluunication 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 colllllluunication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRl 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 Boaz-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.

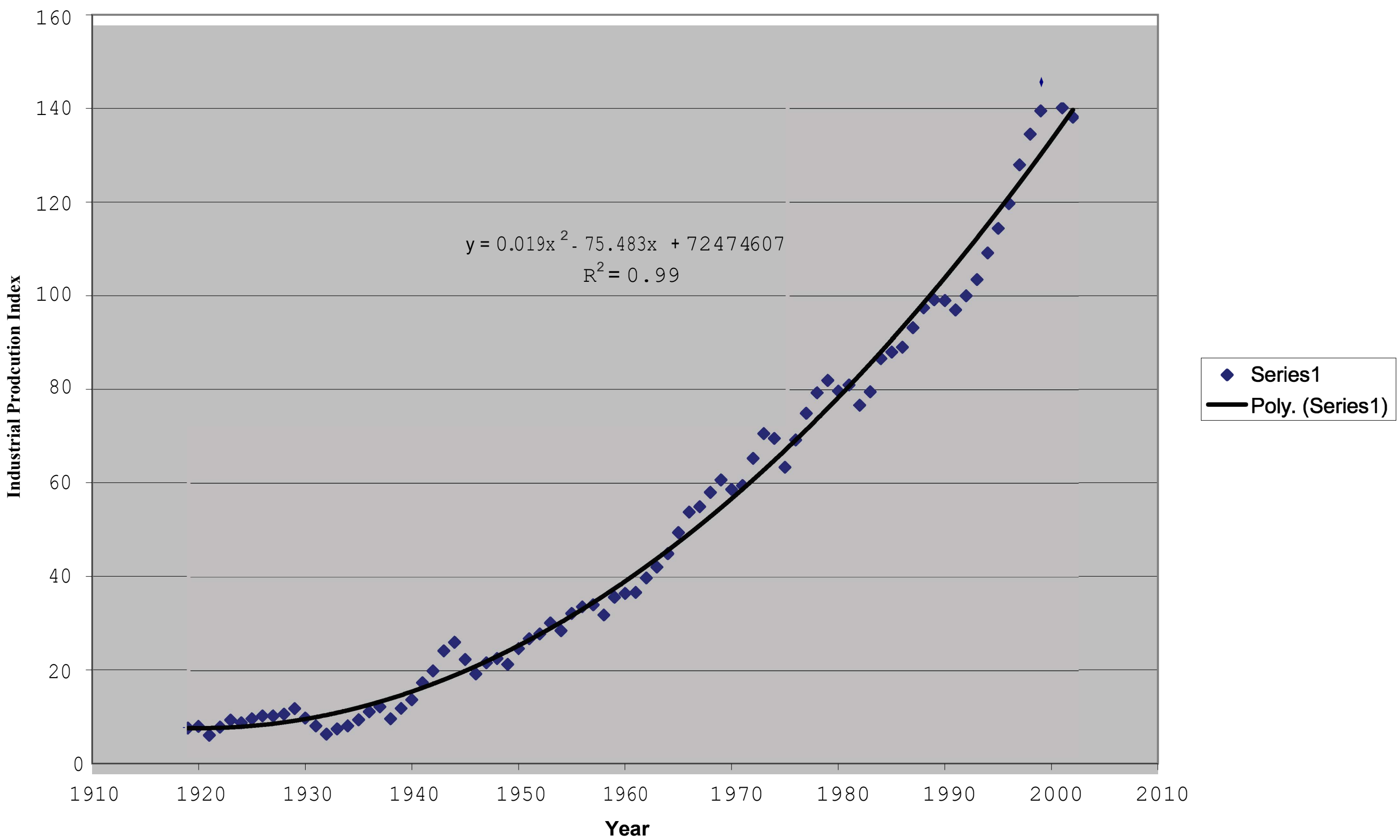
Revised Growth in Emissions

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/INDPR0/3/Max). Statistical analysis was used to derive a polynomial equation to fit the data.

Figure 1. Long-term Industrial Production



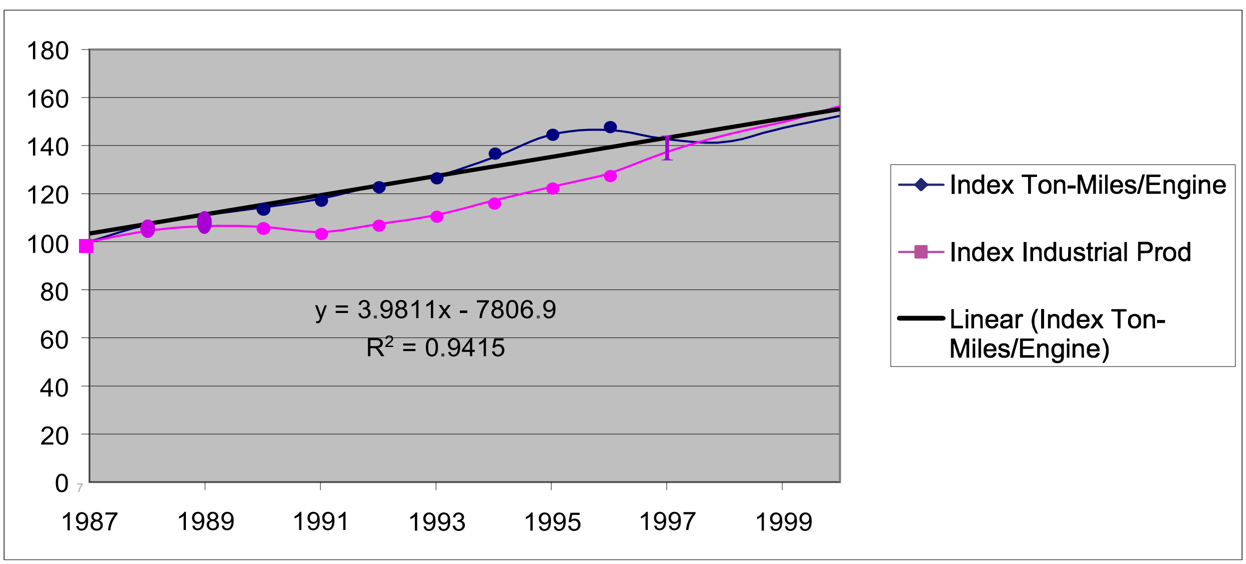
Another surrogate for growth is net ton-miles per engine. Consequently, staff analyzed railroad data from the AAR's Railroad Facts booklet (2001 edition). The booklet contains line-haul railroad statistics including financial status, operation and employment data, and usage profiles. Revenue ton-mile 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 toreduce 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/regacUcarb lohc/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

<u>Aromatics</u>

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
14 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 Volume Percent	EPA Aromatic Volume Percent	Nonroad Aromatic Volume Percent	Weighted Aromatic Volume Percent	PM Emission Reduction 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/regacUcarblohc/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, EPNSWRI)
MK 5000C	330/3150ppm	-0.71	-0.03	-0.03	-0.07	Fritz (1995, EPNSWRI)
EMD 16-710G3B, SD70MAC	330/3150ppm	-0.38	-0.08	-0.30	-0.01	Fritz (1995, EPNSWRI)
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 111 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 Boaz-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, SO39
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 f-	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
Class111 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

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 f-	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	0.94 0	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 111 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

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 f-	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 ON-ROAD DIESEL-FUELED TRUCKS

Emission Factors for On-Road Diesel-Fueled Trucks
Oakland Rail Yard, Oakland, CA

Running Exhaust Emissions

Equipment Type	Equipment Owner/ID	Vehicle Class	Make	Model	Model Year	Emission Factors (g/mi)				
						ROG	CO	NOx	DPM	SOx
Fuel Truck	Harbor Services	HHD	Ford	8000 series	1984	9.07	30.24	27.22	5.04	0.00
Auger Truck	MoW	HHD	Ford	K84	1985	9.07	30.51	28.04	4.95	0.00
Fuel Truck	LERI	HHD	Mack	M5200	1989	9.07	30.91	28.90	4.37	0.34
Tire Truck	50033	LHDTl	Ford	350 Econoline	1989	0.60	2.42	4.84	0.60	0.00
Boom Truck	Track Dept	HHD	Ford	F800	1992	6.05	30.24	30.24	3.02	0.38
Boom Truck	1915-72762	HHD	Volvo	WG64	2001	3.60	8.81	27.88	1.47	0.27
Total										

Idling Exhaust Emissions

Equipment Type	Equip. Owner/ID	Vehicle Class	Make	Model	Model Year	Emission Factors (g/hr)				
						ROG	CO	NOx	DPM	SOx
Fuel Truck[3]	Harbor Services	HHD	Ford	8000 series	1984	33.61	74.81	58.65	7.10	0.58
Auger Truck[3]	MoW	HHD	Ford	K84	1985	33.61	74.81	58.65	7.10	0.58
Fuel Truck[3]	LERI	HHD	Mack	M5200	1989	19.68	61.68	100.70	2.65	0.58
Tire Truck	50033	LHDTl	Ford	350 Econoline	1989	3.17	26.30	75.05	2.38	0.37
Boom Truck[3]	Track Dept	HHD	Ford	F800	1992	15.71	56.75	100.70	2.65	0.58
Boom Truck[3]	1915-72762	HHD	Volvo	WG64	2001	9.43	46.94	118.24	1.38	0.58
Total										

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Ac
Run Date: 2006/08/30 11:17:03
Seen Year : 2005 -- Model year 1984 selected
Season : Annual
Area : Alameda County
1/ M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	151
VMT/1000	9
Trips	765
Reactive Organic Gas Emissions	
Run Exh	0.09
Idle Exh	0.01
Start Ex	0
Total Ex	0.1
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.1
Carbon Monoxide Emissions	
Run Exh	0.3
Idle Exh	0.02
Start Ex	0
Total Ex	0.32
Oxides of Nitrogen Emissions	
Run Exh	0.27
Idle Exh	0.02
Start Ex	0
Total Ex	0.29
Carbon Dioxide Emissions (000)	
Run Exh	0.03
Idle Exh	0
Start Ex	0
Total Ex	0.03
PM10 Emissions	
Run Exh	0.05
Idle Exh	0
Start Ex	0
Total Ex	0.05
TireWear	0
BrakeWr	0
Total	0.05
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	2.62

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+PopC
Run Date: 2006/10/30 13:59:37
Seen Year: 2005 -- Model year 1984 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 1984 to 1984 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	33.611	33.059

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	74.81	73.582

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	58.647	57.684

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.573

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	7.099	6.982

Pollutant Name: PM10 -Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 -Break Wear Temperature: 57F Relative Humidity: 75%

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+E
Run Date: 2006/08/30 11:18:47
Seen Year : 2005 -- Model year 1985 selected
Season : Annual
Area : Alameda County
1/ M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	178
VMT/1000	11
Trips	900
Reactive Organic Gas Emissions	
Run Exh	0.11
Idle Exh	0.01
Start Ex	0
Total Ex	0.12
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.12
Carbon Monoxide Emissions	
Run Exh	0.37
Idle Exh	0.02
Start Ex	0
Total Ex	0.4
Oxides of Nitrogen Emissions	
Run Exh	0.34
Idle Exh	0.02
Start Ex	0
Total Ex	0.36
Carbon Dioxide Emissions (000)	
Run Exh	0.03
Idle Exh	0
Start Ex	0
Total Ex	0.04
PM10 Emissions	
Run Exh	0.06
Idle Exh	0
Start Ex	0
Total Ex	0.06
TireWear	0
BrakeWr	0
Total	0.06
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	3.3

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+PopC
Run Date: 2006/10/30 14:00:59
Seen Year: 2005 -- Model year 1985 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 1985 to 1985 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	33.611	31.237

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	74.81	69.526

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	58.647	54.505

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.542

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	7.099	6.597

Pollutant Name: PM10 -Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

Title : Statewide totals Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+B
Run Date: 2006/08/30 12:14:21
Seen Year : 2005 -- Model year 1989 selected
Season : Annual
Area : Statewide totals Average
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 59
Emissions: Tons Per Day

	LHDT1-DSL
Vehicles	490
VMT/1000	15
Trips	6170
Reactive Organic Gas Emissions	
Run Exh	0.01
Idle Exh	0
Start Ex	0
Total Ex	0.01
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.01
Carbon Monoxide Emissions	
Run Exh	0.04
Idle Exh	0
Start Ex	0
Total Ex	0.04
Oxides of Nitrogen Emissions	
Run Exh	0.08
Idle Exh	0
Start Ex	0
Total Ex	0.08
Carbon Dioxide Emissions (000)	
Run Exh	0.01
Idle Exh	0
Start Ex	0
Total Ex	0.01
PM10 Emissions	
Run Exh	0.01
Idle Exh	0
Start Ex	0
Total Ex	0.01
TireWear	0
BrakeWr	0
Total	0.01
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	0.95

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Poi
Run Date : 2006/10/26 13:17:26
Seen Year: 2005 -- Model year 1989 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 1989 to 1989 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	23.103	3.173	21.45

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	141.992	26.3	132.394

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	1.561	75.051	7.657

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0.049	0.365	0.075

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	2.381	0.197

Pollutant Name: PM10 - Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER
Run Date : 2006/08/30 11:21:39
Seen Year : 2005 -- Model year 1989 selected
Season : Annual
Area : Alameda County
1/ M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	327
VMT/1000	27
Trips	1657
Reactive Organic Gas Emissions	
Run Exh	0.27
Idle Exh	0.01
Start Ex	0
Total Ex	0.28
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.28
Carbon Monoxide Emissions	
Run Exh	0.92
Idle Exh	0.04
Start Ex	0
Total Ex	0.96
Oxides of Nitrogen Emissions	
Run Exh	0.86
Idle Exh	0.05
Start Ex	0
Total Ex	0.91
Carbon Dioxide Emissions (000)	
Run Exh	0.09
Idle Exh	0
Start Ex	0
Total Ex	0.09
PM10 Emissions	
Run Exh	0.13
Idle Exh	0
Start Ex	0
Total Ex	0.13
TireWear	0
BrakeWr	0
Total	0.13
Lead	0
SOx	0.01
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	8.09

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+PopC
Run Date: 2006/10/30 14:04:35
Seen Year: 2005 -- Model year 1989 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 1989 to 1989 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	19.683	19.037

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	61.676	59.653

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	84.929	82.142

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.564

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	3.54	3.424

Pollutant Name: PM10 -Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER,
Run Date: 2006/08/30 11:19:54
Seen Year : 2005 -- Model year 1992 selected
Season : Annual
Area : Alameda County
1/ M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	221
VMT/1000	24
Trips	1121
Reactive Organic Gas Emissions	
Run Exh	0.16
Idle Exh	0.01
Start Ex	0
Total Ex	0.17
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.17
Carbon Monoxide Emissions	
Run Exh	0.4
Idle Exh	0.02
Start Ex	0
Total Ex	0.42
Oxides of Nitrogen Emissions	
Run Exh	0.8
Idle Exh	0.04
Start Ex	0
Total Ex	0.84
Carbon Dioxide Emissions (000)	
Run Exh	0.08
Idle Exh	0
Start Ex	0
Total Ex	0.08
PM10 Emissions	
Run Exh	0.08
Idle Exh	0
Start Ex	0
Total Ex	0.08
TireWear	0
BrakeWr	0
Total	0.08
Lead	0
SOx	0.01
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	7.03

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Por
Run Date: 2006/10/30 14:05:47
Seen Year: 2005 -- Model year 1992 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 1992 to 1992 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg ·

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	15.705	14.65

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	56.747	52.935

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	100.699	93.936

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.544

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	2.648	2.47

Pollutant Name: PM10 -Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+i
Run Date : 2006/08/30 11:20:24
Seen Year : 2005 -- Model year 2001 selected
Season : Annual
Area : Alameda County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	308
VMT/1000	68
Trips	1556
Reactive Organic Gas Emissions	
Run Exh	0.27
Idle Exh	0.01
Start Ex	0
Total Ex	0.27
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0.27
Carbon Monoxide Emissions	
Run Exh	0.66
Idle Exh	0.03
Start Ex	0
Total Ex	0.68
Oxides of Nitrogen Emissions	
Run Exh	2.09
Idle Exh	0.07
Start Ex	0
Total Ex	2.16
Carbon Dioxide Emissions (000)	
Run Exh	0.22
Idle Exh	0
Start Ex	0
Total Ex	0.22
PM10 Emissions	
Run Exh	0.11
Idle Exh	0
Start Ex	0
Total Ex	0.11
TireWear	0
BrakeWr	0
Total	0.11
Lead	0
SOx	0.02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	19.81

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Por
Run Date: 2006/10/30 14:06:57
Seen Year: 2005 -- Model year 2001 selected
Season : Annual
Area : Alameda

Year: 2005 -- Model Years 2001 to 2001 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMD·lg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	9.426	8.222

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	46.943	40.947

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	118.235	103.133

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.508

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.375	1.2

Pollutant Name: PM10 - Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

APPENDIX C

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

Emission Factors for Intermodal HHD Diesel-Fueled Truck Traffic
Oakland Rail Yard, Oakland, CA

Running Exhaust Emissions

Emission Factors (g/mi)				
ROG	CO	NOx	DPM	SOx
4.81	12.92	26.71	1.99	0.26

Idling Exhaust Emissions

Emission Factors (g/hr)				
ROG	CO	NOx	DPM	SOx
16.35	55.87	99.69	2.93	0.5830

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

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IM[
Run Date : 2006/08/24 08:58:45
Seen Year: 2005 --All model years in the range 1965 to 2005 selected
Season : Annual
Area : Alameda County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day

	HHDT-DSL
Vehicles	7246
VMT/1000	1007
Trips	36666
Reactive Organic Gas Emissions	
Run Exh	5.34
Idle Exh	0.22
Start Ex	0
Total Ex	5.56
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	5.56
Carbon Monoxide Emissions	
Run Exh	14.34
Idle Exh	0.75
Start Ex	0
Total Ex	15.09
Oxides of Nitrogen Emissions	
Run Exh	29.65
Idle Exh	1.34
Start Ex	0
Total Ex	30.99
Carbon Dioxide Emissions (000)	
Run Exh	3.18
Idle Exh	0.09
Start Ex	0
Total Ex	3.27
PM10 Emissions	
Run Exh	2.21
Idle Exh	0.04
Start Ex	0
Total Ex	2.25
TireWear	0.04
BrakeWr	0.03
Total	2.32
Lead	0
SOx	0.29
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	294.28

Title : Alameda County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Por
Run Date: 2006/10/30 14:39:55
Seen Year: 2005 -- All model years in the range 1965 to 2005 selected
Season : Annual
Area : Alameda

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+IMD·lg

County Average Alameda

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

Pollutant Name: Reactive Org Gases Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	16.35	15.45

Pollutant Name: Carbon Monoxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	55.871	52.794

Pollutant Name: Oxides of Nitrogen Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	99.69	94.199

Pollutant Name: Sulfur Dioxide Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.551

Pollutant Name: PM10 Temperature: 57F Relative Humidity: 75%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	2.932	2.771

Pollutant Name: PM10 -Tire Wear Temperature: 57F Relative Humidity: 75%

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

Pollutant Name: PM10 - Break Wear Temperature: 57F Relative Humidity: 75%

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

Summary of Intermodal Traffic Gate Counts
Oakland Rail Yard, Oakland, CA

Month	In-Gate Total [1]	Out-Gate Total [1]	In & Out Bobtails	In & Out Total
Jan	8,941	15,430	6,093	30,464
Feb	8,962	15,295	6,064	30,321
Mar	10,276	15,821	6,524	32,621
Apr	9,557	15,932	6,372	31,861
May	10,545	14,227	6,193	30,965
June	11,291	15,688	6,745	33,724
July	10,728	13,055	5,946	29,729
Aug	8,731	13,574	5,576	27,881
Sept	8,528	12,569	5,274	26,371
Oct	9,669	11,832	5,375	26,876
Nov	7,640	12,536	5,044	25,220
Dec	8,419	10,422	4,710	23,551
Totals	113,287	166,381	69,917	**349,585**

Notes:
1. Provided by UPRR. (In&Out Gate Box Balance.pdf Reports).

Pacific Coast Container

2099 7th Street Oakland, California
Phone 510 763-8991 Fax 510 763-9002

Ports served	*Oakland, San Francisco, Richmond*
Facility, warehouse	*58,500 Sq. Ft.*
Yard Space	2.5 *Acre paved*
Storage Capacity (Frozen/Chilled)	*100,000 Cu.Ft frozen 6000 Sq.Ft chilled*
Truck Doors	54
Reefer Plugs	*16*
Railcar Capacity	*21*
USDA Inspection	Yes
Customs Bonded	Yes
Customs Examination	*CES & GET, CHL# 628*
Rail served by	*Union Pacific (Old SP) and BN Santa Fe reciprocal Primary Track 731*
Heavy weight access	*Oakland only*
In house Trucking Service	Yes

Home Page

Mail the Webmaster at Pacific Coast Container Inc.
http://www.pcc-cfs.com/pee.html

Pacific Transload System
737 Bay Street Oakland, California
Phone (510) 893-5420
Fax (510) 893-8351

Ports served	*Oakland, San Francisco, Richmond*
Facility, warehouse	58,500 *Sq. Ft.*
Yard Space	2.0 *Acre paved*
Storage Capacity (Frozen/Chilled)	*100,000 Cu.Ft frozen* 2500 *Sq.Ft chilled*
Truck Doors	*42*
Reefer Plugs	*15*
Railcar Capacity	*16*
USDA Inspection	*Yes*
Customs Bonded	*Yes*
Rail served by	*Union Pacific (Old SP) with BN Santa Fe RR reciprocal track 01745, 01746*
Heavy weight access	*Oakland only*
In house Trucking Service	*Yes*

Back to Home Page

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APPENDIX D

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR CARGO HANDLING EQUIPMENT

Emission Factors for Diesel-Fueled Cargo Handling Equipment
Oakland Rail Yard, Oakland, CA

Equipment Type	Equipment ID/Owner	Make	Model	Year	Rating (hp)	Load Factor	Emission Factors (g/bhp-hr)				
							HC	CO	NOx	DPM	SOx
RTG	99073	Mi Jack	I000R	1990	238	0.43	0.681	3.300	9.016	0.455	0.060
RTG	97924	Detroit	800AC	1979	238	0.43	NA	NA	NA	NA	NA
RTG	99951	Taylor	9040S	1999	238	0.43	0.270	1.009	6.409	0.155	0.060
RTG	99952	**Mi** Jack	850	1999	300	0.43	0.270	1.009	6.409	0.155	0.052
RTG	90412	**Mi** Jack	1200 R	2004	300	0.43	0.091	0.946	4.162	0.097	0.052
RTG	90510	**Mi** Jack	1200 R	2005	300	0.43	0.074	0.933	3.836	0.094	0.052
Crane	73316	Drott	2500	1973	250	0.43	1.301	6.417	15.457	0.919	0.060
Chassis Stacker	69916	Taylor	TCS 90	1999	155	0.30	0.538	2.851	6.862	0.360	0.060
Chassis Stacker	69917	Taylor	TCS 90	1999	155	0.30	0.538	2.851	6.862	0.360	0.060
Chassis Stacker	60302	Taylor	THD 2005	2003	155	0.30	0.248	2.765	5.091	0.210	0.060
Chassis Stacker	30505	Taylor	T300M	2005	155	0.30	0.117	2.722	4.239	0.134	0.060
Yard Hostler	10038	Ottawa	Ottawa	2000	175	0.55	0.541	2.862	6.885	0.364	0.060
Yard Hostler	10040	Ottawa	Ottawa	2000	175	0.55	0.541	2.862	6.885	0.364	0.060
Yard Hostler	10051	Ottawa	Ottawa	2000	175	0.55	0.541	2.862	6.885	0.364	0.060
Yard Hostler	10068	Ottawa	Ottawa	2000	175	0.55	0.541	2.862	6.885	0.364	0.060
Yard Hostler	10113	Ottawa	Ottawa	2001	175	0.55	0.532	2.835	6.827	0.355	0.060
Yard Hostler	10313	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10314	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10315	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10316	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10317	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10355	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10356	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10357	Ottawa	Ottawa	2003	175	0.55	0.250	2.781	5.117	0.214	0.060
Yard Hostler	10472	Ottawa	Ottawa	2004	175	0.55	0.164	2.754	4.553	0.165	0.060
Yard Hostler	10473	Ottawa	Ottawa	2004	175	0.55	0.164	2.754	4.553	0.165	0.060
Yard Hostler	10569	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Yard Hostler	10570	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Yard Hostler	10571	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Yard Hostler	10572	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Yard Hostler	10573	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Yard Hostler	10574	Ottawa	Ottawa	2005	175	0.55	0.117	2.727	4.246	0.135	0.060
Total											

Notes:
I. Emission factors from CARB's Cargo Handling Equipment Emission Calculation Spreadsheet.

If no emission control leave blan k

Cal Year	Yard	Equipment Type	Code	Useful Life (hours)	Model Year	Age (years)	Population	HP	HP Bin	Yearly Operational Hrs	Cummulative Hours	Emission Control Factor? (yin)	Emission Control	Load Factor	HPMY	HC EF	Emission Control HC EF	HC dr
2005	*(Example Calculation)*	*Yard Tractor onroad*		*8800*	*1985*	*21*		*500*	*500*	*1100*	*23100*	*n*		*0*	*5001985*	*1.30E+00*	*0.00E+00*	*0.000065*
2005	Oakland	**Crane**		63000	1990	16		238	250	3500	56000	n		0.43	2501990	6.80E-01	0.00E+00	0.000005
2005	Oakland	**Crane**		0	1979	27		238	250	0	0	n		0.43	2501979	1.00E+00	0.00E+00	#DIV/0!
2005	Oakland	**Crane**		64800	1999	7		238	250	3600	25200	n		0.43	2501999	3.20E-01	0.00E+00	0.000002
2005	Oakland	**Crane**		50400	1999	7		300	500	2800	19600	n		0.43	5001999	3.20E-01	0.00E+00	0.000003
2005	Oakland	**Crane**		30600	2004	2		300	500	1700	3400	n		0.43	5002004	1.20E-01	0.00E+00	0.000002
2005	Oakland	**Crane**		27000	2005	1		300	500	1500	1500	n		0.43	5002005	1.00E-01	0.00E+00	0.000002
2005	Oakland	**Crane**		648	1973	33		250	250	36	1188	n		0.43	2501973	1.00E+00	0.00E+00	0.000679
2005	Oakland	Forklift		6000	1999	7		155	175	300	2100	n		0.30	1751999	6.80E-01	0.00E+00	0.000032
2005	Oakland	Forklift		5100	1999	7		155	175	255	1785	n		0.30	1751999	6.80E-01	0.00E+00	0.000037
2005	Oakland	Forklift		33000	2003	3		155	175	1650	4950	n		0.30	1752003	3.30E-01	0.00E+00	0.000003
2005	Oakland	Forklift		74000	2005	1		155	175	3700	3700	n		0.30	1752005	1.60E-01	0.00E+00	0.000001
2005	Oakland	**Yard Tractor offroad**		44432	2000	6		175	175	2777	16662	n		0.55	1752000	6.80E-01	0.00E+00	0.000004
2005	Oakland	**Yard Tractor offroad**		36672	2000	6		175	175	2292	13752	n		0.55	1752000	6.80E-01	0.00E+00	0.000005
2005	Oakland	**Yard Tractor offroad**		29168	2000	6		175	175	1823	10938	n		0.55	1752000	6.80E-01	0.00E+00	0.000007
2005	Oakland	**Yard Tractor offroad**		29696	2000	6		175	175	1856	11136	n		0.55	1752000	6.80E-01	0.00E+00	0.000006
2005	Oakland	**Yard Tractor offroad**		32752	2001	5		175	175	2047	10235	n		0.55	1752001	6.80E-01	0.00E+00	0.000006
2005	Oakland	**Yard Tractor offroad**		37728	2003	3		175	175	2358	7074	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		57024	2003	3		175	175	3564	10692	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		64608	2003	3		175	175	4038	12114	n		0.55	1752003	3.30E-01	0.00E+00	0.000001
2005	Oakland	**Yard Tractor offroad**		61248	2003	3		175	175	3828	11484	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		54816	2003	3		175	175	3426	10278	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		17968	2003	3		175	175	1123	3369	n		0.55	1752003	3.30E-01	0.00E+00	0.000005
2005	Oakland	**Yard Tractor offroad**		56080	2003	3		175	175	3505	10515	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		54224	2003	3		175	175	3389	10167	n		0.55	1752003	3.30E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		45984	2004	2		175	175	2874	5748	n		0.55	1752004	2.20E-01	0.00E+00	0.000001
2005	Oakland	**Yard Tractor offroad**		40160	2004	2		175	175	2510	5020	n		0.55	1752004	2.20E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		38560	2005	1		175	175	2410	2410	n		0.55	1752005	1.60E-01	0.00E+00	0.000001
2005	Oakland	**Yard Tractor offroad**		33744	2005	1		175	175	2109	2109	n		0.55	1752005	1.60E-01	0.00E+00	0.000001
2005	Oakland	**Yard Tractor offroad**		13024	2005	1		175	175	814	814	n		0.55	1752005	1.60E-01	0.00E+00	0.000003
2005	Oakland	**Yard Tractor offroad**		28128	2005	1		175	175	1758	1758	n		0.55	1752005	1.60E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		22944	2005	1		175	175	1434	1434	n		0.55	1752005	1.60E-01	0.00E+00	0.000002
2005	Oakland	**Yard Tractor offroad**		33008	2005	1		175	175	2063	2063	n		0.55	1752005	1.60E-01	0.00E+00	0.000001

FCF HC	COEF	Emission Control CO EF	CO dr	NOX EF	Emission Control NOX EF	NOX dr	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
0.720000	***1.55E+01***	***0.00E+00***	***0.000440***	***6.00E+00***	***0.00E+00***	***0.000143***	***0.930000***	***6.00E-01***	*0.00E+00*	***0.000046***	***0.750000***	***5.97E-02***	***2.02E+00***	***2.57E+01***	***8.66E+00***	***5.97E-02***	***1.24E+00***	***2.29E+00***	***2.01E+00***
0.720000	2.70E+00	0.00E+00	0.0000 11	8.17E+00	0.00 E+00	0.000027	0.930000	3.80E-01	0.00 E +00	0.000004	0.750000	5.97E-02	6.81E-01	3.30 E+00	9.02E+00	5.97E-02	4.55E-01	3.87 E- 01	3.40 E-01
0.720000	4.40E+00	0.00E+00	#DIV/0!	1.20E+01	0.00 E+00	#DIV/0!	0.930000	5.50E-01	0.00 E +00	#DIV/0!	0.750000	5.97E-02	#DIV/0!	#DIV/0!	#DIV/0!	5.97E-02	#DIV/0!	0.00 E+00	0.00 E+00
0.720000	9.20E-01	0.00E+00	0.000004	6.25E+00	0.00 E+00	0.000020	0.948000	1.50E-01	0.00 E +00	0.000002	0.822000	5.97E-02	2.70E-01	1.01E+00	6.41E+00	5.97E-02	1.55E-01	1.58 E- 01	1.38E-01
0.720000	9.20E-01	0.00E+00	0.000005	6.25E+00	0.00 E+00	0.000026	0.948000	1.50E-01	0.00E+00	0.000002	0.822000	5.21E-02	2.70E-01	1.01E+00	6.41E+00	5.21E-02	1.55 E-01	1.55E-01	1.36E-01
0.720000	9.20E-01	0.00E+00	0.000008	4.29E+00	0.00 E+00	0.000029	0.948000	1.10E-01	0.00E+00	0.000002	0.822000	5.21E-02	9.06E-02	9.46E-01	4.16E+00	5.21E-02	9.72E-02	3.15E-02	2.77E-02
0.720000	9.20E-01	0.00E+00	0.000009	4.00E+00	0.00 E+00	0.000031	0.948000	1.10E-01	0.00E+00	0.000003	0.822000	5.21E-02	7.38E-02	9.33E-01	3.84E+00	5.21E-02	9.38E-02	2.26E-02	1.99E-02
0.720000	4.40E+00	0.00E+00	0.001698	1.20E+01	0.00 E+00	0.003889	0.930000	5.50E-01	0.00E+00	0.000569	0.750000	5.97E-02	1.30E+00	6.42E+00	1.55E+01	5.97E-02	9.19E-01	7.98E-03	7.01E-03
0.720000	2.70E+00	0.00E+00	0.000072	6.90E+00	0.00 E+00	0.000161	0.948000	3.80E-01	0.00E+00	0.000028	0.822000	5.97E-02	5.38E-01	2.85E+00	6.86E+00	5.97E-02	3.60E-01	1.19E-02	1.04E-02
0.720000	2.70E+00	0.00E+00	0.000085	6.90E+00	0.00 E+00	0.000189	0.948000	3.80E-01	0.00E+00	0.000033	0.822000	5.97E-02	5.38E-01	2.85E+00	6.86E+00	5.97E-02	3.60E-01	1.01E-02	8.88E-03
0.720000	2.70E+00	0.00E+00	0.000013	5.26E+00	0.00 E+00	0.000022	0.948000	2.40E-01	0.00E+00	0.000003	0.822000	5.97E-02	2.48E-01	2.76E+00	5.09E+00	5.97E-02	2.10E-01	3.01E-02	2.65E-02
0.720000	2.70E+00	0.00E+00	0.000006	4.44E+00	0.00 E+00	0.000008	0.948000	1.60E-01	0.00E+00	0.000001	0.822000	5.97E-02	1.17E-01	2.72E+00	4.24E+00	5.97E-02	1.34E-01	3.19E-02	2.80E-02
0.720000	2.70E+00	0.00E+00	0.000010	6.90E+00	0.00 E+00	0.000022	0.948000	3.80E-01	0.00E+00	0.000004	0.822000	5.97E-02	5.41E-01	2.86E+00	6.88E+00	5.97E-02	3.64E-01	2.29E-01	2.01E-01
0.720000	2.70E+00	0.00E+00	0.000012	6.90E+00	0.00 E+00	0.000026	0.948000	3.80E-01	0.00E+00	0.000005	0.822000	5.97E-02	5.41E-01	2.86E+00	6.88E+00	5.97E-02	3.64E-01	1.89E-01	1.66E-01
0.720000	2.70E+00	0.00E+00	0.000015	6.90E+00	0.00 E+00	0.000033	0.948000	3.80E-01	0.00E+00	0.000006	0.822000	5.97E-02	5.41E-01	2.86E+00	6.88E+00	5.97E-02	3.64E-01	1.51E-01	1.32E-01
0.720000	2.70E+00	0.00E+00	0.000015	6.90E+00	0.00 E+00	0.000033	0.948000	3.80E-01	0.00E+00	0.000006	0.822000	5.97E-02	5.41E-01	2.86E+00	6.88E+00	5.97E-02	3.64E-01	1.53E-01	1.35E-01
0.720000	2.70E+00	0.00E+00	0.000013	6.90E+00	0.00 E+00	0.000029	0.948000	3.80E-01	0.00E+00	0.000005	0.822000	5.97E-02	5.32E-01	2.84E+00	6.83E+00	5.97E-02	3.55E-01	1.66E-01	1.46E-01
0.720000	2.70E+00	0.00E+00	0.000011	5.26E+00	0.00 E+00	0.000020	0.948000	2.40E-01	0.00E+00	0.000003	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	9.00E-02	7.91E-02
0.720000	2.70E+00	0.00E+00	0.000008	5.26E+00	0.00 E+00	0.000013	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.36E-01	1.20E-01
0.720000	2.70E+00	0.00E+00	0.000007	5.26E+00	0.00 E+00	0.000011	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.54E-01	1.35E-01
0.720000	2.70E+00	0.00E+00	0.000007	5.26E+00	0.00 E+00	0.000012	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.46E-01	1.28E-01
0.720000	2.70E+00	0.00E+00	0.000008	5.26E+00	0.00 E+00	0.000013	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.31E-01	1.15E-01
0.720000	2.70E+00	0.00E+00	0.000024	5.26E+00	0.00 E+00	0.000041	0.948000	2.40E-01	0.00E+00	0.000006	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	4.29E-02	3.77E-02
0.720000	2.70E+00	0.00E+00	0.000008	5.26E+00	0.00 E+00	0.000013	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.34E-01	1.18E-01
0.720000	2.70E+00	0.00E+00	0.000008	5.26E+00	0.00 E+00	0.000014	0.948000	2.40E-01	0.00E+00	0.000002	0.822000	5.97E-02	2.50E-01	2.78E+00	5.12E+00	5.97E-02	2.14E-01	1.29E-01	1.14E-01
0.720000	2.70E+00	0.00E+00	0.000009	4.72E+00	0.00 E+00	0.000014	0.948000	1.90E-01	0.00E+00	0.000002	0.822000	5.97E-02	1.64E-01	2.75E+00	4.55E+00	5.97E-02	1.65E-01	7.19E-02	6.32E-02
0.720000	2.70E+00	0.00E+00	0.000011	4.72E+00	0.00 E+00	0.000016	0.948000	1.90E-01	0.00E+00	0.000002	0.822000	5.97E-02	1.64E-01	2.75E+00	4.55E+00	5.97E-02	1.65E-01	6.28E-02	5.52E-02
0.720000	2.70E+00	0.00E+00	0.000011	4.44E+00	0.00 E+00	0.000016	0.948000	1.60E-01	0.00E+00	0.000002	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	4.31E-02	3.79E-02
0.720000	2.70E+00	0.00E+00	0.000013	4.44E+00	0.00 E+00	0.000018	0.948000	1.60E-01	0.00E+00	0.000002	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	3.77E-02	3.31E-02
0.720000	2.70E+00	0.00E+00	0.000033	4.44E+00	0.00 E+00	0.000048	0.948000	1.60E-01	0.00E+00	0.000005	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	1.46E-02	1.28E-02
0.720000	2.70E+00	0.00E+00	0.000015	4.44E+00	0.00 E+00	0.000022	0.948000	1.60E-01	0.00E+00	0.000003	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	3.15E-02	2.76E-02
0.720000	2.70E+00	0.00E+00	0.000019	4.44E+00	0.00 E+00	0.000027	0.948000	1.60E-01	0.00E+00	0.000003	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	2.57E-02	2.25E-02
0.720000	2.70E+00	0.00E+00	0.000013	4.44E+00	0.00 E+00	0.000019	0.948000	1.60E-01	0.00E+00	0.000002	0.822000	5.97E-02	1.17E-01	2.73E+00	4.25E+00	5.97E-02	1.35E-01	3.69E-02	3.24E-02

Emissions (tons/year)						Emissions (tons/day)									
CO	NOX	SOX	PM	PM10	PM2.5	TOG	ROG		NOX	SOX	PM	PM10	PM2.5
2.02E+01	***6.82E+00***	***4.70E-02***	***9.78E-01***	***9.78E-01***	***8.99E-01***	***6.27E-03***	***5.50E-03***	***5.54E-02***	***1.87E-02***	***1.29E-04***	***2.68E-03***	***2.68E-03***	***2.46E-03***
1.30E+00	3.56E+00	2.36E-02	1.79E-01	1.79E-01	1.65E-01	1.06E-03	9.31E-04	3.57E-03	9.74E-03	6.46E-05	4.91E-04	4.91E-04	4.52E-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
4.10E-01	2.60E+00	2.42E-02	6.31E-02	6.31E-02	5.80E- 02	4.32E-04	3.79E-04	1.12E-03	7.12E-03	6.64E-05	1.73E-04	1.73E-04	1.59E-04
4.02 E-01	2.55 E+00	2.07E-02	6.18 E-02	6.18E-02	5.69 E-02	4.23 E-04	3.72 E-04	1.10 E-03	6.98 E-03	5.68 E-05	1.69E-04	1.69 E-04	1.56 E-04
2.28 E-01	1.01E+00	1.26 E-02	2.35E-02	2.35E-02	2.16E-02	8.64E-05	7.59E-05	6.26E-04	2.75E-03	3.45E-05	6.43E-05	6.43E-05	5.91E-05
1.99E-01	8.18E-01	1.11E-02	2.00E-02	2.00E-02	1.84E-02	6.20E-05	5.45E-05	5.45E-04	2.24E-03	3.04E-05	5.48E-05	5.48E-05	5.04E-05
2.73E-02	6.59E-02	2.55E-04	3.92E-03	3.92E-03	3.60E-03	2.19E-05	1.92E-05	7.49E-05	1.S0E-04	6.98 E-07	1.07 E-05	1.07E-05	9.87 E-06
4.38E-02	1.0SE- 01	9.18E-04	5.54 E-03	5.54E-03	5.09 E-03	3.26 E-05	2.86 E-05	1.20 E-04	2.89 E-04	2.51E-06	1.52E-05	1.52E-05	1.40E-05
3.72E-02	8.96E-02	7.S0E-04	4.71E-03	4.71E-03	4.33E-03	2.77E-05	2.43E-05	1.02E-04	2.45E-04	2.14E-06	1.29E-05	1.29E-05	1.19E-05
2.34E-01	4.30E-01	5.0SE-03	1.78E-02	1.78E-02	1.63E-02	8.25 E-05	7.25 E-05	6.40 E-04	1.18E-03	1.38E-05	4.87 E-05	4.87 E-05	4.48 E-05
5.16E-01	8.03E-01	1.13E-02	2.55E-02	2.55E-02	2.34E-02	8.73E-05	7.67E-05	1.41E-03	2.20E-03	3.10E-05	6.98E-05	6.98E-05	6.42E-05
8.42E-01	2.03E+00	1.76E-02	1.0?E-01	1.0?E-01	9.86E-02	6.28E-04	5.52E-04	2.31E-03	5.55E-03	4.82E-05	2.93E-04	2.93E-04	2.70E-04
6.95E-01	1.67E+00	1.45E-02	8.84E-02	8.84E-02	8.13E-02	5.19E-04	4.56E-04	1.91E-03	4.58E-03	3.98E-05	2.42E-04	2.42E-04	2.23E-04
5.53E-01	1.33E+00	1.15E-02	7.03E-02	7.03E-02	6.47E-02	4.12E-04	3.62E-04	1.52E-03	3.64E-03	3.16E-05	1.93E-04	1.93E-04	1.77E-04
5.63E-01	1.35E+00	1.18E-02	7.16E-02	7.16E-02	6.59E-02	4.20E-04	3.69E-04	1.54E-03	3.71E-03	3.22E-05	1.96E-04	1.96E-04	1.80E-04
6.15E-01	1.48E+00	1.30E-02	7.71E-02	7.71E-02	7.09E-02	4.56E-04	4.00E-04	1.69E-03	4.06E-03	3.55E-05	2.11E-04	2.11E-04	1.94E-04
6.95E-01	1.28E+00	1.49E-02	5.34E-02	5.34E-02	4.91E-02	2.47E-04	2.17E-04	1.90E-03	3.50E -03	4.09 E-05	1.46 E-04	1.46E-04	1.35E-04
1.05E+00	1.93E+00	2.26E-02	8.07E-02	8.0?E-02	7.42E-02	3.73E-04	3.27E-04	2.88E-03	5.30E-03	6.18E-05	2.21E-04	2.21E-04	2.03E-04
1.19E+00	2.19E+00	2.56E-02	9.14E-02	9.14E-02	8.41E-02	4.22E-04	3.71E-04	3.26E-03	6.00E-03	7.01E-05	2.50E-04	2.50 E-04	2.30E-04
1.13E+00	2.08E+00	2.42E-02	8.67E-02	8.67E-02	7.97E-02	4.00E-04	3.52E-04	3.09E-03	5.69E-03	6.64E-05	2.37E-04	2.37E-04	2.18E-04
1.01E+00	1.86E+00	2.17E-02	7.76E-02	7.76E-02	7.14E-02	3.58E-04	3.15E-04	2.77E-03	5.09E-03	5.94E-05	2.12E-04	2.12E-04	1.95E-04
3.31E-01	6.09E-01	7.11E-03	2.54E-02	2.54E-02	2.34E-02	1.17E-04	1.03E-04	9.07E-04	1.67E-03	1.95E-05	6.96E-05	6.96E-05	6.41E-05
1.03E+00	1.90E+00	2.22E-02	7.93E-02	7.93E-02	7.30E-02	3.67E-04	3.22E-04	2.83E-03	5.21E-03	6.08E-05	2.17 E- 04	2.17E-04	2.00E-04
9.99E-01	1.84E+00	2.15E-02	7.67E-02	7.67E-02	7.06E-02	3.54E-04	3.11E-04	2.74E-03	5.04E-03	5.88E-05	2.10E-04	2.10E-04	1.93E-04
8.39E-01	1.39E+00	1.82E-02	5.02E-02	5 02E-02	4.62E-02	1.97E-04	1.73E-04	2.30E-03	3.S0E -03	4.99 E-05	1.38 E- 04	1.38 E-04	1.27 E-04
7.33E-01	1.21E+00	1.59E-02	4.38 E-02	4.38E-02	4.03 E-02	1.72E-04	1.51E -04	2.01 E-03	3.32 E-03	4.36E-05	1.20E-04	1.20 E-04	1.10E-04
6.97E-01	1.08E+00	1.53E-02	3.45 E-02	3.45 E-02	3.18E-02	1.18E-04	1.04E-04	1.91 E-03	2.97 E-03	4.18E-05	9.46 E-05	9.46 E-05	8.70 E-05
6.10E-01	9.49 E- 01	1.34E-02	3.02 E-02	3.02 E-02	2.78 E-02	1.03 E-04	9.08E-05	1.67 E-03	2.60 E-03	3.66 E-05	8.28 E-05	8.28 E-05	7.61 E-05
2.35 E-01	3.66 E- 01	5.16 E-03	1.17E-02	1.17E-02	1.07 E-02	3.99 E-05	3.51 E-05	6.45 E-04	1.00 E -03	1.41E-05	3.19E-05	3.19E-05	2.94E-05
5.08E-01	7.91 E- 01	1.11 E-02	2.52 E-02	2.52E-02	2.32 E-02	8.62 E-05	7.57 E-05	1.39E-03	2.17E-03	3.0SE-05	6.90 E-05	6.90 E-05	6.35 E-05
4.15 E-01	6.45E-01	9.08E- 03	2.05E -02	2.05E-02	1.89 E-02	7.03 E-05	6.18 E-05	1.14E-03	1.77 E-03	2.49 E-05	5.63 E-05	5.63 E-05	5.18 E-05
5.96E-01	9.29E-01	.31E-02	2.96E-02	2.96E-02	2.72E-02	1.01E-04	8.88E-05	1.63E-03	2.54E-03	3.58E-05	8.10E-05	8.10E-05	7.45E-05

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		**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	
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

Summary of Cargo Handling Equipment Specifications
Union Pacific Railroad

Yard	Sierra Research Equipment Type	ARB Equivalent Equipment Type	Fuel Type	Make	Model	Engine Make	Engine Model	Year	Rating (hp)	No.of Units	Annual Hours of Operation	Controls?	Control Factors
Oakland	RTG	Crane	D	Mi Jack	I000R	Detroit	6-71	1990	238	I	3500	n	
Oakland	RTG	Crane	D	Detroit	800AC	Detroit	6-71	1979	238	I	0	n	
Oakland	RTG	Crane	D	Taylor	9040S	Detroit	Series 50	1999	238	I	3600	n	
Oakland	RTG	Crane	D	Mi Jack	Apr-02	Detroit	Series 50	1999	300	I	2800	n	
Oakland	RTG	Crane	D	Mi Jack	1200 R	Detroit	Series 50	2004	300	I	1700	n	
Oakland	RTG	Crane	D	Mi Jack	1200 R	Detroit	Series 50	2005	300	I	1500	n	
Oakland	Crane	Crane	D	Drott	Nov-06	Case	504 BDT	1973	250	I	36	n	
Oakland	Chassis Stacker	Forklift	D	Taylor	TCS90	Cummins	6BT	1999	155	I	300	n	
Oakland	Chassis Stacker	Forklift	D	Taylor	TCS90	Cummins	68T	1999	155	I	255	n	
Oakland	Chassis Stacker	Forklift	D	Taylor	THD 2005	Cummins	6BT	2003	155	I	1650	n	
Oakland	Chassis Stacker	Forklift	D	Taylor	T300M	Cummins	68T	2005	155	I	3700	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2000	175	I	2777	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2000	175	I	2292	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2000	175	I	1823	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2000	175	I	1856	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2001	175	1	2047	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	I	2358	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	1	3564	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	I	4038	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	1	3828	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	I	3426	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	1	1123	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	I	3505	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2003	175	1	3389	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2004	175	I	2874	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2004	175	1	2510	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	I	2410	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	1	2109	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	I	814	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	1	1758	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	I	1434	n	
Oakland	Yard Hostler	Yard Tractor offroad	D	Ottawa	Ottawa	Cummins	5.9	2005	175	1	2063	n	

APPENDIX E

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR HEAVY EQUIPMENT

Emission Factors for Diesel-Fueled Heavy Equipment
Oakland Rail Yard, Oakland, CA

Equipment Type	Location	Equipment ID/Owner	Make	Model	Year	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions	
							ROG	CO	NOx	DPM	SOx	Part 1 (g/hr)	Part 2 (g/yr)
Crane	One Spot	8900304	Lorain	LRT250D	1975	0.43	1.648	4.264	11.449	0.739	0.059	-	-
Trackmobile	One Spot	NA	Track Mobile	TM2400	1994	0.51	1.439	3.870	10.478	0.624	0.059	-	-
Fork Lift	One Spot	41410611	Hyster		1987	0.3	2.689	7.896	18.096	1.411	0.059	-	-
Yard Hostler [1]	IMS	NA	Capacity		1986	0.57	2.928	8.438	19.249	1.558	0.059	-	-
Backhoe	Track Dept	UP	Case	580C	pre-1983	0.55	3.632	7.812	18.728	1.717	0.061	-	-
Yard Hostler[2]	Sid's Mobile Repair	Sids	*Capacity*		1986	0.57	2.928	8.438	19.249	1.558	0.059	-	-
Fork Lift	TTX	TTX	Cat		pre-1990	0.3	3.776	7.897	18.180	1.983	0.061	-	-
Fork Lift	TTX	TTX	Nissan		2005	0.3	0.368	3.215	5.020	0.254	0.061	-	-
Backhoe	Yard	UP	Ford	555 Special	pre-1983	0.55	3.632	7.812	18.728	1.717	0.061	-	-
Man Lift[3]	Locomotive Shop	Hertz Rental	JLG	460SJ	2001	0.46	2.245	5.045	5.481	0.579	0.068	-	-
Total													

Notes:
1. Emission factors from the OFFROAD 2006 model.

Cnty	SCC	HP	TechType	MYr	ROG-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust	Crankcase
Alameda	2270002045	250		1988	1.9519E-05	5.0507E-05	0.000135604	0.006730906	6.9859E-07	8.74718E-06	
Alameda	2270003040	175		1994	7.32E-04	1.97E-03	5.33E-03	2.89E-01	3.00E-05	3.18E-04	
Alameda	2270003020	250		1987	0.000361016	0.00106029	0.002429891	0.07630955	7.92004E-06	0.000189532	
Alameda	2270002051	175		1986	3.98067E-06	1.14736E-05	2.61737E-05	0.000772737	8.02011E-08	2.11837E-06	
Alameda	2270002066	120		1982	0.002963754	0.006457203	0.01552545	0.4865103	5.26428E-05	0.001386558	
Alameda	2270002066	120		1981	0.002580204	0.005589679	0.01342256	0.4147304	4.48759E-05	0.001212718	
Alameda	2270002066	120		1980	0.002127402	0.004583532	0.01099292	0.3349743	3.62459E-05	0.001004325	
Alameda	2270002066	120		1979	0.00175731	0.003766171	0.00902179	0.2711698	2.93419E-05	0.00083312	
Alameda	2270002066	120		1978	0.001317968	0.002810192	0.006723927	0.1993896	2.15749E-05	0.000627364	
Alameda	2270002066	120		1977	0.001075038	0.002280914	0.005451349	0.1595117	1.72599E-05	0.000513712	
Alameda	2270002066	120		1976	0.000766991	0.001619571	0.00386649	0.1116582	1.2082E-05	0.000367872	
Alameda	2270002066	120		1975	0.000418636	0.000879912	0.002098411	0.05981687	6.47248E-06	0.000201507	
Alameda	2270002066	120		1974	0.000142128	0.000297399	0.000708497	0.01993897	2.15749E-06	6.86466E-05	
Alameda			total	PRE-1983	0.013149431	0.028284573	0.067811394	2.05770014	0.000222653	0.006215823	
Alameda	2270002051	175		1986	3.98067E-06	1.14736E-05	2.61737E-05	0.000772737	8.02011E-08	2.11837E-06	
Alameda	2270003020	120		1989	0.000217507	0.000479456	0.001055423	0.04372673	4.73145E-06	0.000125856	
Alameda	2270003020	120		1988	0.000196994	0.000430709	0.000946261	0.03826087	4.14001E-06	0.000114687	
Alameda	2270003020	120		1987	0.00023978	0.000492098	0.001166965	0.03097311	3.35144E-06	0.000117503	
Alameda	2270003020	120		1986	0.000179659	0.000366051	0.000866545	0.02247068	2.43144E-06	0.000088509	
Alameda	2270003020	120		1985	0.000137768	0.000278783	0.000658861	0.01670119	1.80715E-06	6.82078E-05	
Alameda	2270003020	120		1984	9.81127E-05	0.000197255	0.000465444	0.01153899	1.24858E-06	4.88002E-05	
Alameda	2270003020	120		1983	5.31792E-05	0.000106262	0.000250355	0.006073155	6.57145E-07	2.65658E-05	
Alameda	2270003020	120		1982	1.824E-05	3.62348E-05	8.52466E-05	0.002024386	2.19049E-07	9.14909E-06	
Alameda			total	PRE-1990	0.001141239	0.002386849	0.0054951	0.171769111	1.85863E-05	0.000599278	
Alameda	2270003020	120		2005	0.0001887	0.001646804	0.002571511	0.2911002	3.14985E-05	0.000130139	
Alameda					0.000347496	0.000781005	0.000848516	0.08797719	1.0491E-05	8.96649E-05	

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}
	0.1201324	0.43000001	208	1	0.003633243	0.009401328	0.025241194	0.000130035	0.001628194
	6.031907	0.51	150	**1**	0.003 171961	0.008532035	0.0231012	0.000130035	0.001376172
	1.980715	0.3	205	**1**	0.005927335	0.017408348	0.039895111	0.000130035	0.003111824
	0.01236622	0.57	175	**1**	0.006454112	0.0186028	0.042437039	0.000130035	0.003434647
	18.82722								
	16.04946								
	12.96301								
	10.49387								
	7.716078								
	6.172864								
	4.321005								
	2.314823								
	0.7716085								
	79.6299385	0.55	75	1	0.008006388	0.01722183	0.041288807	0.000135568	0.003784673
	0.01236622	0.57	175	1	0.006454112	0.0186028	0.042437039	0.000130035	0.003434647
	2.803277								
	2.452865								
	1.985654								
	1.440573								
	1.070696								
	0.7397531								
	0.3893438								
	0.1297813								
	11.0119432	0.3	83	**1**	0.008324218	0.017409715	0.040081347	0.000135568	0.004371143
	18.66214	0.3	83	**1**	0.000812158	0.007087795	0.011067705	0.000135568	0.000560114
	8.979486	0.46	34	**1**	0.004948705	0.011122319	0.012083755	0.000149402	0.001276921

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	CIR	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	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	BA	2005	0	1.73E+00	9.85E+00	4.25E-05	5.28E-04	8.14E-04	1.08E-01	1.12E-05	2.69E-05	0.00E+00	3.83E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	BA	2004	0	1.66E+00	9.42E+00	6.51E-05	5.30E-04	8.53E-04	1.03E-01	1.07E-05	3.44E-05	0.00E+00	5.87E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	2003	0	1.46E+00	8.35E+00	9.04E-05	4.91E-04	8.75E-04	9.15E-02	9.50E-06	4.28E-05	0.00E+00	8.16E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	2002	0	1.36E+00	7.79E+00	1.61E-04	4.78E-04	1.14E-03	8.51E-02	8.84E-06	7.01E-05	0.00E+00	1.46E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	2001	0	1.33E+00	7.64E+00	1.69E-04	4.88E-04	1.16E-03	8.33E-02	8.65E-06	7.51E-05	0.00E+00	1.52E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	2000	0	1.59E+00	9.11E+00	2.14E-04	6.07E-04	1.43E-03	9.94E-02	1.03E-05	9.73E-05	0.00E+00	1.93E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1999	0	1.56E+00	8.97E+00	2.23E-04	6.20E-04	1.46E-03	9.77E-02	1.01E-05	1.03E-04	0.00E+00	2.02E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1998	0	1.49E+00	8.54E+00	2.25E-04	6.13E-04	1.43E-03	9.30E-02	9.65E-06	1.06E-04	0.00E+00	2.03E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1997	0	1.40E+00	8.07E+00	2.24E-04	6.00E-04	1.40E-03	8.77E-02	9.11E-06	1.07E-04	0.00E+00	2.02E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1996	0	1.28E+00	7.38E+00	2.15E-04	5.68E-04	1.53E-03	8.02E-02	8.32E-06	9.45E-05	0.00E+00	1.94E-05
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1995	0	5.05E-01	2.91E+00	8.87E-05	2.32E-04	6.23E-04	3.16E-02	3.28E-06	3.95E-05	0.00E+00	8.01E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1994	0	3.30E-01	1.90E+00	6.06E-05	1.56E-04	4.19E-04	2.06E-02	2.14E-06	2.72E-05	0.00E+00	5.47E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1993		1.90E-01	1.10E+00	3.65E-05	9.31E-05	2.49E-04	1.19E-02	1.24E-06	1.66E-05	0.00E+00	3.30E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1992		1.54E-01	8.90E-01	3.0BE-05	7.77E-05	2.07E-04	9.63E-03	9.99E-07	1.41E-05	0.00E+00	2.78E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1991		1.35E-01	7.77E-01	2.80E-05	6.99E-05	1.86E-04	8.41E-03	8.72E-07	1.29E-05	0.00E+00	2.53E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1990		1.48E-01	8.58E-01	3.21E-05	7.94E-05	2.11E-04	9.27E-03	9.62E-07	1.49E-05	0.00E+00	2.90E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1989		1.04E-01	6.01E-01	2.33E-05	5.72E-05	1.52E-04	6.49E-03	6.74E-07	1.09E-05	0.00E+00	2.10E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment		P	NHH	NP	Alameda	SF	BA	1988		6.49E-02	3.76E-01	1.51E-05	3.67E-05	9.72E-05	4.06E-03	4.21E-07	7.10E-06	0.00E+00	1.36E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks	D	175	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	BA	1987	0	3.86E-02	2.27E-01	1.20E-05	3.49E-05	7.97E-05	2.41E-03	2.50E-07	6.36E-06	0.00E+00	1.08E-06
2005	Annual	Mon-Sun	2270002051	Off-Highway Trucks		175	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M		0	1.24E-02	7.27E-02	3.98E-06	1.15E-05	2.62E-05	7.73E-04	8.02E-08	2.12E-06	0.00E+00	3.59E-07
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2005	73	1.84E+02	4.33E+02	2.96E-03	2.66E-02	4.17E-02	4.76E+00	5.15E-04	2.06E-03	0.00E+00	2.67E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2004	77	1.93E+02	4.55E+02	5.34E-03	2.94E-02	4.81E-02	4.98E+00	5.39E-04	3.10E-03	0.00E+00	4.82E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2003	76	1.90E+02	4.52E+02	1.14E-02	3.20E-02	5.96E-02	4.92E+00	5.32E-04	5.73E-03	0.00E+00	1.03E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2002	70	1.77E+02	4.21E+02	1.10E-02	3.05E-02	5.67E-02	4.58E+00	4.96E-04	5.64E-03	0.00E+00	9.95E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2001	69	1.75E+02	4.15E+02	1.13E-02	3.07E-02	5.69E-02	4.51E+00	4.88E-04	5.86E-03	0.00E+00	1.02E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	2000	80	2.02E+02	4.80E+02	1.35E-02	3.63E-02	6.70E-02	5.21E+00	5.64E-04	7.11E-03	0.00E+00	1.22E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1999	78	1.98E+02	4.70E+02	1.36E-02	3.63E-02	6.69E-02	5.10E+00	5.52E-04	7.31E-03	0.00E+00	1.23E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1998	77	1.93E+02	4.59E+02	1.38E-02	3.62E-02	6.65E-02	4.98E+00	5.39E-04	7.46E-03	0.00E+00	1.24E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1997	75	1.89E+02	4.49E+02	1.39E-02	3.61E-02	8.24E-02	4.87E+00	5.27E-04	6.96E-03	0.00E+00	1.25E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1996	74	1.86E+02	4.44E+02	1.42E-02	3.64E-02	8.28E-02	4.81E+00	5.21E-04	7.16E-03	0.00E+00	1.28E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1995	58	1.47E+02	3.51E+02	1.15E-02	2.93E-02	6.65E-02	3.80E+00	4.11E-04	5.89E-03	0.00E+00	1.04E-03
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1994	40	1.02E+02	2.42E+02	8.18E-03	2.06E-02	4.67E-02	2.62E+00	2.84E-04	4.22E-03	0.00E+00	7.38E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1993	28	6.95E+01	1.66E+02	5.76E-03	1.44E-02	3.25E-02	1.80E+00	1.94E-04	3.00E-03	0.00E+00	5.20E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1992	28	6.94E+01	1.66E+02	5.92E-03	1.46E-02	3.30E-02	1.79E+00	1.94E-04	3.11E-03	0.00E+00	5.34E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1991	26	6.53E+01	1.56E+02	5.71E-03	1.40E-02	3.16E-02	1.69E+00	1.82E-04	3.02E-03	0.00E+00	5.15E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1990	40	1.01E+02	2.41E+02	9.05E-03	2.20E-02	4.95E-02	2.60E+00	2.82E-04	4.83E-03	0.00E+00	8.16E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1989	24	5.96E+01	1.43E+02	5.49E-03	1.32E-02	2.98E-02	1.54E+00	1.67E-04	2.95E-03	0.00E+00	4.95E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1988	16	4.04E+01	9.68E+01	3.82E-03	9.15E-03	2.05E-02	1.04E+00	1.13E-04	2.06E-03	0.00E+00	3.44E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1987	14	3.49E+01	8.46E+01	4.91E-03	1.10E-02	2.67E-02	9.01E-01	9.75E-05	2.23E-03	0.00E+00	4.43E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1986	12	3.12E+01	7.56E+01	4.49E-03	1.00E-02	2.42E-02	8.06E-01	8.72E-05	2.06E-03	0.00E+00	4.0SE-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1985	11	2.84E+01	6.90E+01	4.18E-03	9.29E-03	2.24E-02	7.34E-01	7.94E-05	1.93E-03	0.00E+00	3.78E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1984	10	2.41E+01	5.85E+01	3.63E-03	8.00E-03	1.93E-02	6.22E-01	6.73E-05	1.68E-03	0.00E+00	3.27E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1983	8	2.13E+01	5.18E+01	3.28E-03	7.19E-03	1.73E-02	5.50E-01	5.95E-05	1.53E-03	0.00E+00	2.96E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1982	7	1.88E+01	4.58E+01	2.96E-03	6.46E-03	1.55E-02	4.87E-01	5.26E-05	1.39E-03	0.00E+00	2.67E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1981	6	1.60E+01	3.91E+01	2.58E-03	5.59E-03	1.34E-02	4.15E-01	4.49E-05	1.21E-03	0.00E+00	2.33E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1980	5	1.30E+01	3.16E+01	2.13E-03	4.58E-03	1.10E-02	3.35E-01	3.62E-05	1.00E-03	0.00E+00	1.92E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1979	4	1.05E+01	2.56E+01	1.76E-03	3.77E-03	9.02E-03	2.71E-01	2.93E-05	8.33E-04	0.00E+00	1.59E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1978	3	7.72E+00	1.88E+01	1.32E-03	2.81E-03	6.72E-03	1.99E-01	2.16E-05	6.27E-04	0.00E+00	1.19E-04
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1977	2	6.17E+00	1.51E+01	1.08E-03	2.28E-03	5.45E-03	1.60E-01	1.73E-05	5.14E-04	0.00E+00	9.70E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1976	2	4.32E+00	1.06E+01	7.67E-04	1.62E-03	3.87E-03	1.12E-01	1.21E-05	3.68E-04	0.00E+00	6.92E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1975	1	2.31E+00	5.67E+00	4.19E-04	8.80E-04	2.10E-03	5.98E-02	6.47E-06	2.02E-04	0.00E+00	3.78E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes		120	Construction and Mining Equipment	U	P	NHH	NP	Alameda	SF	M	1974	0	7.72E-01	1.89E+00	1.42E-04	2.97E-04	7.08E-04	1.99E-02	2.16E-06	6.86E-05	0.00E+00	1.28E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2005	4	1.45E+01	7.32E+01	2.32E-04	1.33E-03	5.97E-03	8.10E-01	8.41E-05	1.33E-04	0.00E+00	2.09E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2004	4	1.39E+01	7.05E+01	3.02E-04	1.32E-03	6.13E-03	7.79E-01	8.09E-05	1.37E-04	0.00E+00	2.73E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2003	4	1.28E+01	6.50E+01	3.88E-04	1.26E-03	6.33E-03	7.18E-01	7.46E-05	1.46E-04	0.00E+00	3.50E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2002	3	1.09E+01	5.55E+01	4.99E-04	1.11E-03	7.04E-03	6.13E-01	6.36E-05	1.64E-04	0.00E+00	4.S0E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2001	3	1.05E+01	5.33E+01	5.02E-04	1.09E-03	6.93E-03	5.88E-01	6.10E-05	1.66E-04	0.00E+00	4.53E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	2000	3	1.14E+01	5.80E+01	5.71E-04	1.22E-03	7.74E-03	6.40E-01	6.64E-05	1.90E-04	0.00E+00	5.16E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1999	3	1.18E+01	5.99E+01	6.15E-04	1.30E-03	8.18E-03	6.60E-01	6.85E-05	2.05E-04	0.00E+00	5.55E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1998	3	1.13E+01	5.74E+01	6.15E-04	1.28E-03	8.04E-03	6.33E-01	6.57E-05	2.06E-04	0.00E+00	5.SSE-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1997	3	1.02E+01	5.18E+01	5.77E-04	1.18E-03	7.43E-03	5.71E-01	5.93E-05	1.94E-04	0.00E+00	5.21E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1996	1	4.35E+00	2.21E+01	2.56E-04	5.19E-04	3.24E-03	2.44E-01	2.53E-05	8.63E-05	0.00E+00	2.31E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1995	1	2.90E+00	1.49E+01	3.76E-04	1.04E-03	2.83E-03	1.62E-01	1.69E-05	1.59E-04	0.00E+00	3.39E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1994	1	2.15E+00	1.10E+01	2.88E-04	7.89E-04	2.14E-03	1.20E-01	1.25E-05	1.23E-04	0.00E+00	2.60E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1993	0	1.20E+00	6.19E+00	1.67E-04	4.52E-04	1.23E-03	6.73E-02	6.99E-06	7.22E-05	0.00E+00	1.51E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1992	0	9.53E-01	4.91E+00	1.37E-04	3.67E-04	9.93E-04	5.34E-02	5.54E-06	5.96E-05	0.00E+00	1.24E-05
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1991		6.81E-01	3.51E+00	1.01E-04	2.68E-04	7.24E-04	3.81E-02	3.96E-06	4.43E-05	0.00E+00	9.12E-06
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1990		6.00E-01	3.10E+00	9.19E-05	2.42E-04	6.52E-04	3.36E-02	3.49E-06	4.07E-05	0.00E+00	8.30E-06
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1989	0	3.60E-01	1.86E+00	5.69E-05	1.48E-04	3.99E-04	2.02E-02	2.10E-06	2.53E-05	0.00E+00	5.13E-06
2005	Annual	Mon-Sun	2270002045	Cranes		250	Construction and Mining Equipment	U	N	NHH	P	Alameda	SF	M	1988	0	1.20E-01	6.21E-01	1.95E-05	5.05E-05	1.36E-04	6.73E-03	6.99E-07	8.75E-06	0.00E+00	1.76E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2005	7	9.42E+00	8.41E+00	7.57E-05	5.00E-04	7.66E-04	9.23E-02	1.10E-05	5.17E-05	0.00E+00	6.83E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2004	7	9.88E+00	8.86E+00	1.46E-04	6.00E-04	8.35E-04	9.68E-02	1.15E-05	6.37E-05	0.00E+00	1.32E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2003	7	9.76E+00	8.85E+00	3.40E-04	7.78E-04	9.06E-04	9.56E-02	1.14E-05	9.10E-05	0.00E+00	3.07E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2002	7	9.11E+00	8.27E+00	3.35E-04	7.60E-04	8.53E-04	8.93E-02	1.06E-05	8.B0E-05	0.00E+00	3.02E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	2001	7	8.98E+00	8.16E+00	3.47E-04	7.81E-04	8.49E-04	8.80E-02	1.0SE-05	8.97E-05	0.00E+00	3.14E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	2000	7	9.86E+00	8.97E+00	4.00E-04	8.93E-04	9.40E-04	9.66E-02	1.15E-05	1.02E-04	0.00E+00	3.61E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts		50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	1999	7	9.66E+00	8.81E+00	4.11E-04	9.11E-04	9.30E-04	9.47E-02	1.13E-05	1.03E-04	0.00E+00	3.71E-05

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	CIR	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	2270003010	Aerial lifts	D	50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	BA	1998	7	9.44E+00	8.68E+00	5.21E-04	1.13E-03	1.10E-03	9.24E-02	1.10E-05	1.20E-04	0.00E+00	4.70E-05
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	BA	1997	7	9.24E+00	8.52E+00	5.32E-04	1.14E-03	1.09E-03	9.06E-02	1.08E-05	1.21E-04	0.00E+00	4.80E-05
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	BA	1996	7	9.17E+00	8.46E+00	5.50E-04	1.18E-03	1.09E-03	8.98E-02	1.07E-05	1.23E-04	0.00E+00	4.96E-05
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	BA	1995	6	7.99E+00	7.39E+00	4.98E-04	1.06E-03	9.54E-04	7.83E-02	9.34E-06	1.11E-04	0.00E+00	4.50E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	BA	1994	4	5.14E+00	4.76E+00	3.33E-04	7.04E-04	6.18E-04	5.03E-02	6.00E-06	7.30E-05	0.00E+00	3.00E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	BA	1993	2	3.13E+00	2.91E+00	2.10E-04	4.43E-04	3.79E-04	3.07E-02	3.66E-06	4.57E-05	0.00E+00	1.90E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1992	2	3.15E+00	2.92E+00	2.19E-04	4.59E-04	3.83E-04	3.08E-02	3.68E-06	4.71E-05	0.00E+00	1.97E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1991	2	2.96E+00	2.75E+00	2.12E-04	4.44E-04	3.63E-04	2.90E-02	3.45E-06	4.54E-05	0.00E+00	1.92E-05
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1990	4	5.25E+00	4.89E+00	3.90E-04	8.12E-04	6.48E-04	5.14E-02	6.13E-06	8.26E-05	0.00E+00	3.52E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1989	2	3.10E+00	2.90E+00	2.38E-04	4.94E-04	3.86E-04	3.04E-02	3.63E-06	5.00E-05	0.00E+00	2.15E-05
2005	Annual	Mon-Sun	2270003010	Aeriallifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1988	2	2.11E+00	1.97E+00	1.67E-04	3.45E-04	2.64E-04	2.06E-02	2.46E-06	3.47E-05	0.00E+00	1.50E-05
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1987		1.82E+00	1.70E+00	1.51E-04	3.05E-04	2.32E-04	1.78E-02	2.12E-06	3.07E-05	0.00E+00	1.36E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1986		1.62E+00	1.53E+00	1.39E-04	2.80E-04	2.09E-04	1.59E-02	1.90E-06	2.80E-05	0.00E+00	1.26E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1985		1.48E+00	1.39E+00	1.30E-04	2.62E-04	1.92E-04	1.45E-02	1.73E-06	2.61E-05	0.00E+00	1.18E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1984		1.25E+00	1.18E+00	1.14E-04	2.27E-04	1.63E-04	1.23E-02	1.47E-06	2.26E-05	0.00E+00	1.02E-05
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1983		1.11E+00	1.05E+00	1.03E-04	2.06E-04	1.46E-04	1.09E-02	1.30E-06	2.04E-05	0.00E+00	9.31E-06
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1982		9.81E-01	9.27E-01	9.36E-05	1.87E-04	1.30E-04	9.61E-03	1.15E-06	1.84E-05	0.00E+00	8.45E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1981		8.36E-01	7.92E-01	8.18E-05	1.63E-04	1.11E-04	8.19E-03	9.77E-07	1.60E-05	0.00E+00	7.38E-06
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1980		6.75E-01	6.40E-01	6.77E-05	1.34E-04	9.03E-05	6.62E-03	7.89E-07	1.32E-05	0.00E+00	6.11E-06
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1979		5.47E-01	5.19E-01	5.62E-05	1.11E-04	7.36E-05	5.36E-03	6.39E-07	1.09E-05	0.00E+00	5.07E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1978		4.02E-01	3.82E-01	4.23E-05	8.35E-05	5.44E-05	3.94E-03	4.70E-07	8.16E-06	0.00E+00	3.81E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1977		3.22E-01	3.06E-01	3.46E-05	6.83E-05	4.38E-05	3.15E-03	3.76E-07	6.65E-06	0.00E+00	3.12E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1976		2.25E-01	2.15E-01	2.48E-05	4.88E-05	3.09E-05	2.21E-03	2.63E-07	4.74E-06	0.00E+00	2.24E-06
2005	Annual	Mon-Sun	2270003010	Aerial Lifts	D	50	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1975		1.21E-01	1.15E-01	1.36E-05	2.67E-05	1.66E-05	1.18E-03	1.41E-07	2.59E-06	0.00E+00	1.22E-06
2005	Annual	Mon-Sun	2270003010	Aerial lifts	D	50	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	1974	0	4.02E-02	3.85E-02	4.62E-06	9.07E-06	5.58E-06	3.94E-04	4.70E-08	8.77E-07	0.00E+00	4.17E-07
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	2005	4	1.87E+01	2.65E+01	1.89E-04	1.65E-03	2.57E-03	2.91E-01	3.15E-05	1.30E-04	0.00E+00	1.70E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2004	4	1.91E+01	2.72E+01	3.47E-04	1.81E-03	2.94E-03	2.98E-01	3.22E-05	2.01E-04	0.00E+00	3.13E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2003	4	1.93E+01	2.76E+01	7.61E-04	2.07E-03	3.82E-03	3.01E-01	3.25E-05	3.98E-04	0.00E+00	6.87E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2002	4	2.04E+01	2.94E+01	8.63E-04	2.28E-03	4.21E-03	3.19E-01	3.45E-05	4.64E-04	0.00E+00	7.78E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2001	4	2.01E+01	2.90E+01	9.05E-04	2.34E-03	4.30E-03	3.14E-01	3.40E-05	4.99E-04	0.00E+00	8.17E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	2000	4	2.15E+01	3.10E+01	1.02E-03	2.60E-03	4.75E-03	3.35E-01	3.63E-05	5.76E-04	0.00E+00	9.25E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1999	4	2.09E+01	3.01E+01	1.05E-03	2.62E-03	4.76E-03	3.25E-01	3.52E-05	6.01E-04	0.00E+00	9.48E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1998	4	2.04E+01	2.94E+01	1.08E-03	2.65E-03	4.80E-03	3.18E-01	3.44E-05	6.29E-04	0.00E+00	9.76E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1997	4	1.95E+01	2.81E+01	1.09E-03	2.62E-03	5.88E-03	3.04E-01	3.29E-05	5.84E-04	0.00E+00	9.81E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1996	4	1.91E+01	2.76E+01	1.12E-03	2.65E-03	5.94E-03	2.98E-01	3.22E-05	6.08E-04	0.00E+00	1.01E-04
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1995	3	1.66E+01	2.40E+01	1.02E-03	2.38E-03	5.32E-03	2.59E-01	2.80E-05	5.59E-04	0.00E+00	9.16E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1994	3	1.34E+01	1.94E+01	8.57E-04	1.99E-03	4.42E-03	2.09E-01	2.26E-05	4.77E-04	0.00E+00	7.73E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1993	1	3.69E+00	5.36E+00	2.46E-04	5.64E-04	1.25E-03	5.76E-02	6.23E-06	1.38E-04	0.00E+00	2.22E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1992	1	2.62E+00	3.81E+00	1.82E-04	4.12E-04	9.13E-04	4.09E-02	4.42E-06	1.03E-04	0.00E+00	1.64E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1991	0	2.29E+00	3.32E+00	1.65E-04	3.70E-04	8.18E-04	3.57E-02	3.86E-06	9.41E-05	0.00E+00	1.49E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment	U	P	NHH	NP	Alameda	SF	M	1990	1	3.55E+00	5.17E+00	2.66E-04	5.91E-04	1.30E-03	5.53E-02	5.99E-06	1.53E-04	0.00E+00	2.40E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1989	1	2.80E+00	4.09E+00	2.18E-04	4.79E-04	1.06E-03	4.37E-02	4.73E-06	1.26E-04	0.00E+00	1.96E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1988	0	2.45E+00	3.58E+00	1.97E-04	4.31E-04	9.46E-04	3.83E-02	4.14E-06	1.15E-04	0.00E+00	1.78E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1987	0	1.99E+00	2.95E+00	2.40E-04	4.92E-04	1.17E-03	3.10E-02	3.35E-06	1.18E-04	0.00E+00	2.16E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1986	0	1.44E+00	2.14E+00	1.80E-04	3.66E-04	8.67E-04	2.25E-02	2.43E-06	8.85E-05	0.00E+00	1.62E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1985	0	1.07E+00	1.60E+00	1.38E-04	2.79E-04	6.59E-04	1.67E-02	1.81E-06	6.82E-05	0.00E+00	1.24E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1984	0	7.40E-01	1.10E+00	9.81E-05	1.97E-04	4.65E-04	1.15E-02	1.25E-06	4.88E-05	0.00E+00	8.85E-06
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1983	0	3.89E-01	5.82E-01	5.32E-05	1.06E-04	2.50E-04	6.07E-03	6.57E-07	2.66E-05	0.00E+00	4.80E-06
2005	Annual	Mon-Sun	2270003020	Forklifts		120	Industrial Equipment		P	NHH	NP	Alameda	SF	M	1982	0	1.30E-01	1.94E-01	1.82E-05	3.62E-05	8.52E-05	2.02E-03	2.19E-07	9.15E-06	0.00E+00	1.65E-06
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	2005	4	1.86E+01	6.48E+01	2.15E-04	1.19E-03	5.31E-03	7.17E-01	7.44E-05	1.20E-04	0.00E+00	1.94E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	2004	4	1.90E+01	6.64E+01	3.14E-04	1.27E-03	5.84E-03	7.34E-01	7.61E-05	1.34E-04	0.00E+00	2.83E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	2003	4	1.92E+01	6.71E+01	4.45E-04	1.34E-03	6.68E-03	7.41E-01	7.69E-05	1.60E-04	0.00E+00	4.02E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2002	4	2.04E+01	7.12E+01	6.87E-04	1.48E-03	9.39E-03	7.85E-01	8.15E-05	2.27E-04	0.00E+00	6.20E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2001	4	2.01E+01	7.02E+01	7.21E-04	1.52E-03	9.59E-03	7.74E-01	8.04E-05	2.40E-04	0.00E+00	6.50E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	2000	4	2.15E+01	7.50E+01	8.16E-04	1.69E-03	1.06E-02	8.26E-01	8.58E-05	2.74E-04	0.00E+00	7.36E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1999	4	2.08E+01	7.27E+01	8.36E-04	1.70E-03	1.06E-02	8.01E-01	8.32E-05	2.82E-04	0.00E+00	7.55E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1998	4	2.03E+01	7.11E+01	8.61E-04	1.72E-03	1.07E-02	7.83E-01	8.12E-05	2.92E-04	0.00E+00	7.77E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1997	4	1.94E+01	6.79E+01	8.65E-04	1.70E-03	1.06E-02	7.48E-01	7.77E-05	2.94E-04	0.00E+00	7.81E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1996	4	1.90E+01	6.66E+01	8.89E-04	1.72E-03	1.07E-02	7.33E-01	7.61E-05	3.03E-04	0.00E+00	8.02E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1995	3	1.65E+01	5.86E+01	1.72E-03	4.54E-03	1.22E-02	6.37E-01	6.61E-05	7.58E-04	0.00E+00	1.55E-04
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment		N	NHH	NP	Alameda	SF	M	1994	3	1.34E+01	4.74E+01	1.45E-03	3.78E-03	1.02E-02	5.15E-01	5.34E-05	6.46E-04	0.00E+00	1.31E-04
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment		N	NHH	NP	Alameda	SF	M	1993	1	3.68E+00	1.31E+01	4.17E-04	1.08E-03	2.88E-03	1.42E-01	1.47E-05	1.87E-04	0.00E+00	3.76E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1992	1	2.61E+00	9.29E+00	3.08E-04	7.86E-04	2.10E-03	1.01E-01	1.04E-05	1.40E-04	0.00E+00	2.78E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1991	0	2.28E+00	8.11E+00	2.79E-04	7.05E-04	1.88E-03	8.78E-02	9.12E-06	1.28E-04	0.00E+00	2.52E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1990	1	3.54E+00	1.26E+01	4.50E-04	1.13E-03	3.00E-03	1.36E-01	1.41E-05	2.07E-04	0.00E+00	4.06E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1989	1	2.80E+00	9.97E+00	3.68E-04	9.14E-04	2.43E-03	1.08E-01	1.12E-05	1.71E-04	0.00E+00	3.32E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1988	0	2.45E+00	8.73E+00	3.34E-04	8.21E-04	2.18E-03	9.43E-02	9.78E-06	1.55E-04	0.00E+00	3.01E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1987	0	1.98E+00	7.16E+00	3.61E-04	1.06E-03	2.43E-03	7.63E-02	7.92E-06	1.90E-04	0.00E+00	3.26E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1986	0	1.44E+00	5.20E+00	2.70E-04	7.89E-04	1.80E-03	5.54E-02	5.75E-06	1.43E-04	0.00E+00	2.44E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1985	0	1.07E+00	3.87E+00	2.07E-04	6.01E-04	1.37E-03	4.11E-02	4.27E-06	1.10E-04	0.00E+00	1.87E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1984	0	7.38E-01	2.68E+00	1.58E-04	4.36E-04	9.69E-04	2.84E-02	2.95E-06	7.87E-05	0.00E+00	1.42E-05
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	1983	0	3.88E-01	1.41E+00	8.56E-05	2.35E-04	5.21E-04	1.50E-02	1.55E-06	4.29E-05	0.00E+00	7.72E-06
2005	Annual	Mon-Sun	2270003020	Forklifts		250	Industrial Equipment		N	NHH	NP	Alameda	SF	M	1982	0	1.29E-01	4.71E-01	2.93E-05	8.01E-05	1.77E-04	4.99E-03	5.18E-07	1.48E-05	0.00E+00	2.65E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2005	3	1.11E+01	4.82E+01	2.00E-04	2.57E-03	3.97E-03	5.30E-01	5.50E-05	1.29E-04	0.00E+00	1.81E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2004	3	1.16E+01	5.06E+01	3.25E-04	2.79E-03	4.53E-03	5.56E-01	5.77E-05	1.76E-04	0.00E+00	2.93E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2003	3	1.15E+01	5.00E+01	4.99E-04	2.86E-03	5.13E-03	5.49E-01	5.70E-05	2.39E-04	0.00E+00	4.50E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2002	3	1.07E+01	4.69E+01	9.08E-04	2.76E-03	6.58E-03	5.13E-01	5.32E-05	3.84E-04	0.00E+00	8.20E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment		N	NHH	NP	Alameda	SF	M	2001	3	1.05E+01	4.62E+01	9.43E-04	2.81E-03	6.68E-03	5.05E-01	5.24E-05	4.07E-04	0.00E+00	8.51E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	M	2000	3	1.16E+01	5.08E+01	1.09E-03	3.18E-03	7.54E-03	5.55E-01	5.76E-05	4.78E-04	0.00E+00	9.82E-05

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	CIR	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	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1999	3	1.13E+01	4.98E+01	1.12E-03	3.22E-03	7.60E-03	5.44E-01	5.64E-05	5.00E-04	O.OOE+OO	1.01E-04
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1998	3	1.11E+01	4.87E+01	1.14E-03	3.24E-03	7.63E-03	5.31E-01	5.51E-05	5.18E-04	0.00E+00	1.03E-04
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1997	3	1.09E+01	4.77E+01	1.17E-03	3.26E-03	7.67E-03	5.20E-01	5.40E-05	5.37E-04	0.00E+00	1.05E-04
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1996	3	1.08E+01	4.74E+01	1.21E-03	3.33E-03	9.06E-03	5.16E-01	5.35E-05	5.13E-04	0.00E+00	1.09E-04
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1995	2	9.38E+00	4.13E+01	1.10E-03	2.98E-03	8.09E-03	4.50E-01	4.67E-05	4.71E-04	0.00E+00	9.89E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1994	2	6.03E+00	2.66E+01	7.32E-04	1.97E-03	5.33E-03	2.89E-01	3.00E-05	3.18E-04	0.00E+00	6.60E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1993	1	3.68E+00	1.62E+01	4.63E-04	1.23E-03	3.33E-03	1.76E-01	1.83E-05	2.03E-04	0.00E+00	4.18E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1992	1	3.69E+00	1.63E+01	4.82E-04	1.27E-03	3.42E-03	1.77E-01	1.84E-05	2.13E-04	0.00E+00	4.35E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1991	1	3.47E+00	1.53E+01	4.68E-04	1.22E-03	3.29E-03	1.66E-01	1.73E-05	2.09E-04	0.00E+00	4.23E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1990	2	6.16E+00	2.72E+01	8.60E-04	2.22E-03	5.97E-03	2.95E-01	3.07E-05	3.86E-04	0.00E+00	7.76E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1989	1	3.64E+00	1.61E+01	5.25E-04	1.35E-03	3.60E-03	1.75E-01	1.81E-05	2.37E-04	0.00E+00	4.74E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1988	1	2.47E+00	1.09E+01	3.68E-04	9.35E-04	2.50E-03	1.19E-01	1.23E-05	1.67E-04	0.00E+00	3.32E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1987	1	2.13E+00	9.55E+00	4.23E-04	1.28E-03	2.96E-03	1.02E-01	1.06E-05	2.17E-04	0.00E+00	3.81E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1986	0	1.91E+00	8.54E+00	3.89E-04	1.17E-03	2.70E-03	9.14E-02	9.49E-06	2.00E-04	0.00E+00	3.51E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1985	0	1.74E+00	7.79E+00	3.65E-04	1.09E-03	2.51E-03	8.32E-02	8.64E-06	1.89E-04	0.00E+00	3.29E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1984	0	1.47E+00	6.62E+00	3.40E-04	9.68E-04	2.17E-03	7.06E-02	7.33E-06	1.65E-04	0.00E+00	3.06E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1983	0	1.30E+00	5.86E+00	3.09E-04	8.74E-04	1.96E-03	6.24E-02	6.48E-06	1.51E-04	0.00E+00	2.78E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1982	0	1.15E+00	5.19E+00	2.80E-04	7.88E-04	1.76E-03	5.52E-02	5.73E-06	1.38E-04	0.00E+00	2.53E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1981	0	9.82E-01	4.43E+00	2.45E-04	6.86E-04	1.53E-03	4.71E-02	4.88E-06	1.21E-04	0.00E+00	2.21E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1980	0	7.93E-01	3.58E+00	2.03E-04	5.65E-04	1.26E-03	3.80E-02	3.94E-06	1.00E-04	0.00E+00	1.83E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1979	0	6.42E-01	2.91E+00	1.79E-04	4.75E-04	1.13E-03	3.08E-02	3.19E-06	8.37E-05	0.00E+00	1.61E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1978	0	4.72E-01	2.14E+00	1.35E-04	3.56E-04	8.48E-04	2.26E-02	2.35E-06	6.32E-05	0.00E+00	1.22E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1977	0	3.78E-01	1.71E+00	1.10E-04	2.90E-04	6.90E-04	1.81E-02	1.88E-06	5.19E-05	0.00E+00	9.95E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1976	0	2.64E-01	1.20E+00	7.90E-05	2.07E-04	4.91E-04	1.27E-02	1.31E-06	3.73E-05	0.00E+00	7.13E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1975	0	1.42E-01	6.43E-01	4.33E-05	1.13E-04	2.67E-04	6.79E-03	7.04E-07	2.05E-05	0.00E+00	3.90E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	175	Industrial Equipment	U	N	NHH	NP	Alameda	SF	BA	1974	0	4.72E-02	2.15E-01	1.47E-05	3.82E-05	9.06E-05	2.26E-03	2.35E-07	7.00E -06	0.00E+00	1.33E-06

APPENDIX F

TANKS OUTPUT AND SPECIATE DATABASE SECTIONS FOR THE GASOLINE STORAGE TANK

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

Identification

User Identification:	TNKG-0080
City:	Oakland
State:	California
Company:	UPRR
Type of Tank:	Horizontal Tank
Description:	One Spot

Tank Dimensions

Shell Length (ft):	11.00
Diameter (ft):	5.00
Volume (gallons):	1,000.00
Turnovers:	5.51
Net Throughput (gal/yr):	5,510.00
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: San Francisco AP, California (Avg Atmospheric Pressure= 14.75 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 13)	All	59.20	54.43	63.97	57.12	6.8436	6.2534	7.4772	62.0000			92.00	Option 4: RVP=13, ASTM Slope=3

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

Annual Emission Calculations	
Standing Losses (lb):	369.3127
Vapor Space Volume (cu ft):	137.5697
Vapor Density (lb/cu ft):	0.0762
Vapor Space Expansion Factor:	0.1840
Vented Vapor Saturation Factor:	0.5244
Tank Vapor Space Volume	
Vapor Space Volume (cu ft):	137.5697
Tank Diameter (ft):	5.0000
Effective Diameter (ft):	8.3704
Vapor Space Outage (ft):	2.5000
Tank Shell Length (ft):	11.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0762
Vapor Molecular Weight (lb/lb-mole):	62.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.8436
Daily Avg. Liquid Surface Temp. (deg. R):	518.8668
Daily Average Ambient Temp. (deg. F):	57.1000
Ideal Gas Constant R (psia cult / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	516.7900
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,552.9 167
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.1840
Daily Vapor Temperature Range (deg. R):	19.0799
Daily Vapor Pressure Range (psia):	1.2238
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.8436
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	6.2534
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	7.4772
Daily Avg. Liquid Surface Temp. (deg R):	518.8668
Daily Min. Liquid Surface Temp. (deg R):	514.0968
Daily **Max.** Liquid Surface Temp. (deg R):	523.6367
Daily Ambient Temp. Range (deg. **R):**	16.2333
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.5244
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.8436
Vapor Space Outage (ft):	2.5000
Working Losses (lb):	55.6642
Vapor Molecular Weight (lb/lb-mole):	62.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	6.8436
Annual Net Throughput (gal/yr.):	5,510.0000
Annual Turnovers:	5.5100
Turnover Factor:	1.0000
Tank Diameter (ft):	5.0000

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

Working Loss Product Factor:	1.0000
Total Losses (lb):	424.9769

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 13)	55.66	369.31	424.98

Exerpts from CARB's Speciation Profile Database

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

APPENDIX G

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR TRUs AND REEFER CARS

Emission Factors for Transport Refrigeration Units and Refrigerated Railcars
Oakland Rail Yard, Oakland, CA

TRU Equip Type	Average Rating (hp)'	Fuel Type	Load Factor[2]	Emission Factors (g/hp-hr)3					VOC Evaporative Emission Factors[4]	
				HC	CO	NOx	DPM	SOx	Part 1 (g/hr)	Part 2 (g/yr)
Container	28.56	Diesel	0.56	2.85	6.78	6.43	0.71	0.07		
Railcar	34	Diesel	0.53	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. Load factors are the default factors from the OFFROAD 2006 model.
3. Emission factors from OFFROAD 2006 model.
4. VOC 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
Oakland Rail Yard, Oakland, CA

Source	DPM Emissions (tons/yr)
Locomotives	3.914
On-Road Diesel-Fueled Trucks	0.008
HHD Diesel-Fueled Trucks - Intermodal	1.716
HHD Diesel-Fueled Trucks - Distribution Centers	0.162
Cargo Handling Equipment	1.638
Heavy Equipment	0.200
Transport Refrigeration Units - Intermodal	1.372
Transport Refrigeration Units - Distribution Centers	1.782
Emergency Generator	0.019
Total	**10.811**

Summary of Toxic Air Contaminant Emissions
Oakland Rail Yard, Oakland, CA

CAS	Chemical Name	Emissions (tons/yr)		
		Gasoline Storage Tank	WWTP	Total
540841	2,2,4-trime thylpentane	0.0028		0.0028
71432	benzene	0.0008	0.0001	0.0009
	Bis(2-ethylhexyl)Phthalate		0.0000	0.0000
	Bromomethane		0.0002	0.0002
	Chloroform		0.0001	0.0001
110827	cyclohexane	0.0022		0.0022
100414	ethylbenzene	0.0003	0.0005	0.0008
78784	isopentane	0.0793		0.0793
98828	isopropylbenzene (cumene)	0.0000		0.0000
	Methylene Chloride		0.0019	0.0019
108383	m-xylene	0.0007		0.0007
110543	n-hexane	0.0033		0.0033
95476	a-xylene	0.0003		0.0003
106423	p-xylene	0.0002		0.0002
108883	toluene	0.0036	0.0006	0.0042
	total xylenes		0.0010	0.0010
Total		**0.0934**	**0.0043**	**0.0978**

Summary of Diesel Particulate Emissions from Locomotives
Oakland Rail Yard, Oakland, CA

Activity	DPM Emissions (tpy)
Through Trains	0.460
Intermodal Trains	0.624
Other Trains	0.464
Power Moves	0.011
Yard Operations	1.875
Service and Shop Idling	0.476
Load Test	0.004
Total	**3.914**

Summary of Emissions from On-Road Diesel- Fueled Trucks
Oakland Rail Yard, Oakland, CA

Running Exhaust Emissions

Equipment Type	Equipment Owner/ID	Vehicle Class	Make	Model	Model Year	Annual VMT	Emission Factors (g/mi)					Emissions (tons/yr)				
							ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Fuel Truck	Harbor Services	HHD	Ford	8000 series	1984	120	9.07	30.24	27.22	5.04	0.00	0.0012	0.0040	0.0036	0.0007	0.0000
Auger Truck	MoW	HHD	Ford	K84	1985	100	9.07	30.51	28.04	4.95	0.00	0.0010	0.0034	0.0031	0.0005	0.0000
Fuel Truck	LERI	HHD	Mack	M5200	1989	520	9.07	30.91	28.90	4.37	0.34	0.0052	0.0177	0.0166	0.0025	0.0002
Tire Truck	50033	LHDTI	Ford	350 Econoline	1989	400	0.60	2.42	4.84	0.60	0.00	0.0003	0.0011	0.0021	0.0003	0.0000
Boom Truck	Track Dept	HHD	Ford	F800	1992	200	6.05	30.24	30.24	3.02	0.38	0.0013	0.0067	0.0067	0.0007	0.0001
Boom Truck	1915-72762	HHD	Volvo	WG64	2001	730	3.60	8.81	27.88	1.47	0.27	0.0029	0.0071	0.0224	0.0012	0.0002
Total												**0.0119**	**0.0399**	**0.0545**	**0.0058**	**0.0005**

Idling Exhaust Emissions

Equipment Type	Equip. Owner/ID	Vehicle Class	Make	Model	Model Year	Idling[1]		Emission Factors (g/hr)					Emissions (tons/yr)				
						(min/day)	(hr/yr)	ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Fuel Truck[3]	Harbor Services	HHD	Ford	8000 series	1984	15	91	33.61	74.81	58.65	7.10	0.58	0.0034	0.0075	0.0059	0.0007	0.0001
Auger Truck[3]	MoW	HHD	Ford	K84	1985	15	91	33.61	74.81	58.65	7.10	0.58	0.0034	0.0075	0.0059	0.0007	0.0001
Fuel Truck[3]	LERI	HHD	Mack	M5200	1989	15	91	19.68	61.68	100.70	2.65	0.58	0.0020	0.0062	0.0101	0.0003	0.0001
Tire Truck	50033	LHDTI	Ford	350 Econoline	1989	15	91	3.17	26.30	75.05	2.38	0.37	0.0003	0.0026	0.0075	0.0002	0.0000
Boom Truck[3]	Track Dept	HHD	Ford	F800	1992	15	91	15.71	56.75	100.70	2.65	0.58	0.0016	0.0057	0.0101	0.0003	0.0001
Boom Truck[3]	1915-72762	HHD	Volvo	WG64	2001	15	91	9.43	46.94	118.24	1.38	0.58	0.0009	0.0047	0.0119	0.0001	0.0001
Total													**0.0116**	**0.0343**	**0.0515**	**0.0023**	**0.0003**

Notes:
1. Annual VMT estimated by UPRR personnel.
2. Idling time (min/day) estimated by UPRR personnel.
3. Running exhaust emissions calculated using the EMFAC-WD 2006 model with the BURDEN output option.
4. Running exhaust emission factor calculations assumed an average speed of 15 mph.
5. Idling exhaust emissions factors calculated using the EMFAC-WD 2006 model with the EMFAC output option.

Summary of Emissions from Intermodal HHD Diesel-Fueled Truck Traffic
Oakland Rail Yard, Oakland, CA

Running Exhaust Emissions

Number of Truck Trips	VMT per Trip	VMTper Year	Emission Factors (g/mi)					Emissions (tons/yr)				
			ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
349,585	1.5	524,377.50	4.81	12.92	26.71	1.99	0.26	2.78	7.47	15.44	1.15	0.15

Idling Exhaust Emissions

Number of Truck Trips	Idling		Emission Factors (g/hr)					Emissions (tons/yr)				
	(mins/trip)	(hr/yr)	ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
349,585	30	174,792.50	16.35	55.87	99.69	2.93	0.58	3.15	10.77	19.21	0.56	0.11

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 chassie or trailer and trucks with an empty chassie).
2. VMT per trip and idling time (mins/trip) is an engineering estimate from personal observation.
3. Running exhaust emission factors calculated from EMFAC-WD 2006 model with the BURDEN output option.
4. Running exhaust emission factor calculations assumed an average speed of 15 mph.
5. Idling exhaust emission factors calculated from EMFAC-WD 2006 model with the EMFAC output option.

Summary of HHD Truck Emissions from Distribution Centers
Oakland Rail Yard, Oakland, CA

Truck Volumes

Center Name	Center Location	No. of Truck Bays[1]	Center Operations (hrs/day)[1]	Center Operations (d ays/yr)	Truck Volumes (trucks/day)[1]	Truck Volumes (trucks/yr)
Pacific Coast Containers	2099 7th St.	42	18	365	110	40,150
Pacific Transload System	737 Bay St.	42	13	365	100	36,500
Total		**84**			**210**	**76,650**

Running Exhaust Emissions

Center Name	VMT (mi/trip/	VMT (mi/yr)	Emission Factors (g/mi/ ROG	CO	NOx	DPM	SOx	Emissions (tons/yr) ROG	CO	NOx	DPM	SOx
Pacific Coast Containers	0.20	8,030	4.81	12.92	26.71	1.99	0.26	0.04	O.ll	0.24	0.02	0.00
Pacific Transload System	0.25	9,125	4.81	12.92	26.71	1.99	0.26	0.05	0.13	0.27	0.02	0.00
Total		**17,155**						**0.09**	**0.24**	**0.51**	**0.04**	**0.00**

Idling Exhaust Emissions

Center Name	Idling (min/trip)3	Idling (hr/yr)	Emission Factors (g/hr)5 ROG	CO	NOx	DPM	SOx	Emissions (tons/yr) ROG	CO	NOx	DPM	SOx
Pacific Coast Containers	30	20,075	16.35	55.87	99.69	2.93	0.58	0.36	1.24	2.21	0.06	0.01
Pacific Transload System	30	18,250	16.35	55.87	99.69	2.93	0.58	0.33	1.12	2.01	0.06	0.01
Total		**38,325**						**0.69**	**2.36**	**4.21**	**0.12**	**0.02**

Notes:
1. Estimates provided by Pacific Coast Containers, Inc.
2. Estimated from satellite photos.
3. Assumes 10 miutes during queuing and staging at gate, 15 minutes to drop off/pick up container, 5 minutes for any additional delays.
4. From EMFAC-WD 2006 with the BURDEN output option.
5. From EMFAC-WD 2006 with the EMFAC output option.

Summary of Emissions from Diesel-Fueled Cargo Handling Equipment
Oakland Rail Yard, Oakland, CA

Equipment Type	Equipment ID/Owner	Make	Model	Engine Make	Engine Model	Year	Rating (hp)	Annual Hours of Operation	Load Factor	No. of Units	Emission Factors (g/bhp-hr)					Emission (tons/yr)				
											HC	CO	NOx	DPM	SOx	HC	CO	NOx	DPM	SOx
RTG	99073	Mi Jack	JOOOR	Detroit	6-71	1990	238	3500	0.43		0.681	3.300	9.016	0.455	0.060	0.269	1.303	3.560	0.180	0.024
RTG	97924	Detroit	800 AC	Detroit	6-71	1979	238	0	0.43		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.060	0.000	0.000	0.000	0.000	0.000
RTG	99951	Taylor	9040S	Detroit	Series 50	1999	238	3600	0.43		0.270	1.009	6.409	0.155	0.060	0.110	0.410	2.603	0.063	0.024
RTG	99952	Mi Jack	850	Detroit	Series 50	1999	300	2800	0.43		0.270	1.009	6.409	0.155	0.052	0.107	0.402	2.552	0.062	0.021
RTG	90412	Mi Jack	1200 R	Detroit	Series 50	2004	300	1700	0.43		0.091	0.946	4.162	0.097	0.052	0.022	0.229	1.006	0.023	0.013
RTG	90510	Mi Jack	1200 R	Detroit	Series 50	2005	300	1500	0.43		0.074	0.933	3.836	0.094	0.052	0.016	0.199	0.818	0.020	0.011
Crane	73316	Drott	2500	Case	504 BOT	1973	250	36	0.43		1.301	6.417	15.457	0.919	0.060	0.006	0.027	0.066	0.004	0.000
Chassis Stacker	69916	Taylor	TCS 90	Cummins	6 BT	1999	155	300	0.30		0.538	2.851	6.862	0.360	0.060	0.008	0.044	0.106	0.006	0.001
Chassis Stacker	69917	Taylor	TCS 90	Cummins	6 BT	1999	155	255	0.30		0.538	2.851	6.862	0.360	0.060	0.007	0.037	0.090	0.005	0.001
Chassis Stacker	60302	Taylor	THD 2005	Cummins	6 BT	2003	155	1650	0.30		0.248	2.765	5.091	0.210	0.060	0.021	0.234	0.431	0.018	0.005
Chassis Stacker	30505	Taylor	T300M	Cummins	6 BT	2005	155	3700	0.30		0.117	2.722	4.239	0.134	0.060	0.022	0.516	0.804	0.025	0.011
Yard Hostler	10038	Ottawa	Ottawa	Cummins	5.9	2000	175	2777	0.55		0.541	2.862	6.885	0.364	0.060	0.159	0.843	2.028	0.107	0.018
Yard Hostler	10040	Ottawa	Ottawa	Cummins	5.9	2000	175	2292	0.55		0.541	2.862	6.885	0.364	0.060	0.132	0.696	1.674	0.088	0.015
Yard Hostler	10051	Ottawa	Ottawa	Cummins	59	2000	175	1823	0.55		0.541	2.862	6.885	0.364	0.060	0.105	0.554	1.332	0.070	0.012
Yard Hostler	10068	Ottawa	Ottawa	Cummins	59	2000	175	1856	0.55		0.541	2.862	6.885	0.364	0.060	0.107	0.564	1.356	0.072	0.012
Yard Hostler	10113	Ottawa	Ottawa	Cummins	59	2001	175	2047	0.55		0.532	2.835	6.827	0.355	0.060	0.116	0.616	1.483	0.077	0.013
Yard Hostler	10313	Ottawa	Ottawa	Cummins	59	2003	175	2358	0.55		0.250	2.781	5.117	0.214	0.060	0.063	0.696	1.280	0.053	0.015
Yard Hostler	10314	Ottawa	Ottawa	Cummins	59	2003	175	3564	0.55		0.250	2.781	5.117	0.214	0.060	0.095	1.052	1.935	0.081	0.023
Yard Hostler	10315	Ottawa	Ottawa	Cummins	59	2003	175	4038	0.55		0.250	2.781	5.117	0.214	0.060	0.107	1.191	2.192	0.091	0.026
Yard Hostler	10316	Ottawa	Ottawa	Cummins	59	2003	175	3828	0.55		0.250	2.781	5.117	0.214	0.060	0.102	1.129	2.078	0.087	0.024
Yard Hostler	10317	Ottawa	Ottawa	Cummins	59	2003	175	3426	0.55		0.250	2.781	5.117	0.214	0.060	0.091	1.011	1.860	0.078	0.022
Yard Hostler	10355	Ottawa	Ottawa	Cummins	59	2003	175	1123	0.55		0.250	2.781	5.117	0.214	0.060	0.030	0.331	0.610	0.025	0.007
Yard Hostler	10356	Ottawa	Ottawa	Cummins	59	2003	175	3505	0.55		0.250	2.781	5.117	0.214	0.060	0.093	1.034	1.903	0.079	0.022
Yard Hostler	10357	Ottawa	Ottawa	Cummins	59	2003	175	3389	0.55		0.250	2.781	5.117	0.214	0.060	0.090	1.000	1.840	0.077	0.021
Yard Hostler	10472	Ottawa	Ottawa	Cummins	59	2004	175	2874	0.55		0.164	2.754	4.553	0.165	0.060	0.050	0.840	1.388	0.050	0.018
Yard Hostler	10473	Ottawa	Ottawa	Cummins	59	2004	175	2510	0.55		0.164	2.754	4.553	0.165	0.060	0.044	0.733	1.212	0.044	0.016
Yard Hostler	10569	Ottawa	Ottawa	Cummins	59	2005	175	2410	0.55		0.117	2.727	4.246	0.135	0.060	0.030	0.697	1.086	0.035	0.015
Yard Hostler	10570	Ottawa	Ottawa	Cummins	59	2005	175	2109	0.55		0.117	2.727	4.246	0.135	0.060	0.026	0.610	0.950	0.030	0.013
Yard Hostler	10571	Ottawa	Ottawa	Cummins	59	2005	175	814	0.55		0.117	2.727	4.246	0.135	0.060	0.010	0.236	0.367	0.012	0.005
Yard Hostler	10572	Ottawa	Ottawa	Cummins	59	2005	175	1758	0.55		0.117	2.727	4.246	0.135	0.060	0.022	0.509	0.792	0.025	0.011
Yard Hostler	10573	Ottawa	Ottawa	Cummins	59	2005	175	1434	0.55		0.117	2.727	4.246	0.135	0.060	0.018	0.415	0.646	0.021	0.009
Yard Hostler	10574	Ottawa	Ottawa	Cummins	59	2005	175	2063	0.55	1	0.117	2.727	4.246	0.135	0.060	0.026	0.597	0.929	0.030	0.013
Total										**32**						**2.100**	**18.754**	**40.977**	**1.638**	**0.440**

Notes:
1. Emission factors from CARB's Cargo Handling Equipment Emission Calculation Spreadsheet.
2. Hours of operation provided by UPRR personnel.

[redacted]

Summary of Emissions from Diesel- Fueled Heavy Equipment
Oakland Rail Yard, Oakland, CA

Equipment Type	Location	Equipment ID/Owner	Make	Model	Year	Rating (hp)	Annual Hours of Operation	No of Units	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions		Emissions (tons/yr)				
										ROG	CO	NOx	DPM	SOx	Part I (g/hr	Part 2 (g/yr	ROG	CO	NOx	DPM	SOx
Crane	One Spot	8900304	Lorain	LRT250D	1975	*200*	60	1	0.43	1.648	4.264	11.449	0.739	0.059	-	-	0.009	0.024	0.065	0.004	0.000
Trackmobile	One Spot	NA	Track Mobile	TM2400	1994	147	520	1	0.51	1.439	3.870	10.478	0.624	0.059	-	-	0.062	0.1 66	0.450	0.027	0.003
Fork Lift	One Spot	41410611	Hyster		1987	225	547.5	1	0.3	2.689	7.896	18.096	1.411	0.059	-	-	0.110	0.322	0.737	0.058	0.002
Yard Hostler[1]	IMS	NA	Capacity		1986	125	*25*	1	0.57	2.928	8.438	19.249	1.558	0.059	-	-	0.006	0.017	0.038	0.003	0.000
Backhoe	Track Dept	UP	Case	580C	pre-1983	62	75	1	0.55	3.632	7.812	18.728	1.717	0.06 1	-	-	0.010	0.022	0.053	0.005	0.000
Yard Hostler[2]	Sid's Mobile Repair	Sids	*Capacity*		*1986*	*125*	*365*	1	0.57	2.928	8.438	19.249	1.558	0.059	-	-	0.084	0.242	0.552	0.045	0.002
Fork Lift	TTX	TTX	Cat		pre-1990	*90*	730	1	0.3	3.776	7.897	18.180	1.983	0.061	-	-	0.082	0.1 72	0.395	0.043	0.001
Fork Lift	TTX	TTX	Nissan		2005	114	416	1	0.3	0.368	3.215	5.020	0.254	0.061	-	-	0.006	0.050	0.079	0.004	0.001
Backhoe	Yard	UP	Ford	555 Special	pre-1983	55	150	1	0.55	3.632	7.812	18.728	1.71 7	0.061	-	-	0.oI8	0.039	0.094	0.009	0.000
Man Lift[3]	Locomotive Shop	Hertz Rental	JLG	460SJ	2001	50	*250*	1	0.46	2.245	5.045	5.481	0.579	0.068	-	-	0.01 4	0.032	0.035	0.004	0.000
Total								**10**									**0.40**	**1.09**	**2.50**	**0.200**	**0.01**

Notes:

1. Per IMS, this unit runs about 125 miles per year and idles 10 hours per year. Total operating hours were calculated assuming that the unit operated 125 miles at an average speed of 10 miles per hours pl us the 10 hours per year of idling.
2. Per Sid's Mobile Repair personnel, this unit is used approximately once per day to transport a container to the faciltiy for repair. Based on personal observation, it was assumed that the average use was no more than 1 hour per day.
3. Hours of operation are an engineering estimate based on personnal observation.
4. VOC evaporative emissions are negligible.

Summary of Equipment Specifications and Emissions from Storage Tanks
Oakland Rail Yard, Oakland, CA

Tank No.	Tank Location	Material Stored	Tank Capacity	Tank Dimensions	Shell Color	Shell Condition	2005 Throughput (gal/yr)	VOC Emissions (tons/yr)	Permitted?	Citation
GENSET-1	Intermodal Offices	Diesel	170	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.1
LER-1	Intermodal Crane Pad	Used Oil	550	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.2
LER-2	Intermodal Crane Pad	Hydraulic Oil	300	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.4
LER-3	Intermodal Crane Pad	Motor Oil	300	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.4
LER-4	Intermodal Crane Pad	Trans. Fluid	230	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.1
LER-5	Intermodal Crane Pad	Motor Oil	230	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.1
TKND-0820	Intermodal Crane Pad	Diesel	10,000	NA	White	Good	NA	NA	Exempt	Rule 2-1-123.3.5
TNKO-0303	Intermodal Crane Pad	Used Oil	550	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.2
TNKO-0304	Car Shop	Waste Oil	1,500	NA	White	Good	NA	NA	Exempt	Rule 2-1-123.3.2
TNKW-0197	Car Shop	Wastewater	1,000	11 x 4.0 (H)	White	Good	3740000	neg.	Yes	NA
TNKD-0822	Car Shop	Diesel	1,000	NA	White	Good	NA	NA	Exempt	Rule 2-1-123.3.5
TNKG-0080	Car Shop	Gasoline	1,000	11 x 3.6 (H)	White	Good	5510	0.212	Yes	NA
TNKW-0196	Car Shop	Wastewater	5,000	8x15(H)	Gray	Good	3740000	neg.	Yes	NA
TNKO-0299	Loco Service Track	Lube Oil	15,000	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.4
TNKO-0300	Loco Service Track	Used Oil	10,000	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.2
TNKO-0301	WWTP	Used Oil	12,000	NA	NA	NA	NA	NA	Exempt	Rule 2-1-123.3.2
TNKW-0145	WWTP	Wastewater	250,000	20 x 50 (V)	Gray	Good	3740000	neg.	Yes	NA
TNKO-0302	WWTP	Sludge	10,000	NA	Gray	Good	neg.	NA	Solids	NA
1450	WWTP	Nalco		NA	NA	Good	NA	NA	Exempt	Rule 2-1-123.3.9

Notes:
1. Gasoline throughput for TNKG-0080 provided by Jim Diel.
2. Emissions calculated using EPA's TANKS 4.0 program.

Toxic Air Contaminant Emissions from the Gasoline Storage Tank TNKG-0080
Oakland Rail Yard, Oakland, CA

CAS	Chemical Name	Organic Fraction	Emissions (tons/yr)
540841	2,2,4-trimethylpentane	0.0129	0.0028
71432	benzene	0.0036	0.0008
110827	cyclohexane	0.0103	0.0022
100414	ethylbenzene	0.0012	0.0003
78784	isopentane	0.3734	0.0793
98828	isopropylbenzene (cumene)	0.0001	0.0000
108383	m-xylene	0.0034	0.0007
110543	n-hexane	0.0154	0.0033
95476	o-xylene	0.0013	0.0003
106423	p-xylene	0.0011	0.0002
108883	toluene	0.0170	0.0036
Total		**0.44**	**0.0934**

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 SPECIATE database and the AB2588 list.

Toxic Air Contaminant Emissions from the DAF and Oil/Water Separator at the Wastewater Treatment Plant
Oakland Rail Yard, Oakland, CA

Pollutant	Emission Rate (g/sec)			Emissions (tons/yr)
	Oil/Water Separator	DAF Unit	Total	
Benzene	4.93E-09	6.62E-06	6.62E-06	8.85E-05
Bis(2-ethylhexyl) Phthalate	6.92E-09	1.27E-10	7.05E-09	9.41E-08
Bromomethane	1.00E-08	1.17E-05	1.17E-05	1.56E-04
Chloroform	6.14E-09	8.18E-06	8.19E-06	1.09E-04
Ethylbenzene	2.51E-08	3.75E-05	3.75E-05	5.0lE-04
Methylene Chloride	7.79E-08	1.40E-04	1.40E-04	1.87E-03
Toluene	3.08E-08	4.46E-05	4.46E-05	5.96E-04
Xylene	5.16E-08	7.49E-05	7.50E-05	1.00E-03
Total	**2.13E-07**	**3.24E-04**	**3.24E-04**	**4.32E-03**

1. Emission rates are from the *Air Emissions Inventory and Regulatory Analysis Report for Oakland Yard,* Trinity Conulstants, July 17, 2000.
2. Emission rates from USEPA's Water8 Program and are based on a wastewater flow rate of9,737,000 gallons per year.
3. Emissions (lb/yr) were calculated multipling the emission rate by the ratio of the 1999 wasterwater flow rate and the 2005 wastewater flow rate.

lb/yr = Emission Rate (g/sec) x (3600 sec/hr) x (8760 hr/yr) x (1 lb/ 453.59 g) x (3,740,000 gal/yr / 9,737,000 gal/yr)

4. The 2005 wastewater flow rate was provided by Mr. Jim Diel of Union Pacific.

Summary of Emissions from Transport Refrigeration Units and Refrigerated Railcars
Oakland Rail Yard, Oakland, CA

TRU Equip Type	Average Rating (hp)[1]	Fuel Type	Average No. Units in Yard[2]	Hours of Operation		Load Factor[5]	Emission Factors (g/hp-hr)[6]					VOC Evaporative Emission Factors[6]		Emissions (tpy)				
				(hr/day)[3]	(hr/yr)[4]		HC	CO	NOx	DPM	SOx	Part I (g/hr)	Part 2 (g/yr)	HC	CO	NOx	DPM	SOx
Container	28.56	Diesel	70	4	1,460	0.56	2.85	6.78	6.43	0.71	0.07			5.12	12.16	11.53	1.281	0.12
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			**74**		**2,920**									**5.49**	**13.03**	**12.31**	**1.372**	**0.13**

Notes:
1. Based on the average horsepower distribution in the OFFROAD 2006 model.
2. UPRR staff estimate that there are 6-35 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. VOC evaporative emissions are negligible.

Summary of Emissions from Transport Refrigeration Units and Refrigerated Railcars
Oakland Rail Yard , Oakland, CA

Center	TRU Equip Type	Average Rating (hp)[1]	Fuel Type	Average No. Units in Yard[2]	Hours of Operation		Load Factor[5]	Emission Factors (g/hp-hr)[6]					VOC Evaporative Emission Factors[6]		Emissions (tpy)				
					(hr/day)[3]	(hr/yr)[4]		HC	CO	NOx	DPM	SOx	Part I (g/hr)	Part 2 (g/yr)	HC	CO	NOx	DPM	SOx
Pacific Coast Container	Container	28.56	Diesel	38	4	1,460	0.56	2.85	6.78	6.43	0.71	0.07	-	-	2.78	6.60	6.26	0.695	0.07
	Railcar	34	Diesel	18	4	1,460	0.53	3.23	7.49	6.71	0.79	0.07	-	-	1.69	3.91	3.50	Q.410	0.04
Pacific Transload System	Container	28.56	Diesel	27	4	1,460	0.56	2.85	6.78	6.43	0.71	0.07	-	-	1.97	4.69	4.45	0.494	0.05
	Railcar	34	Diesel	8	4	1,460	0.53	3.23	7.49	6.71	0.79	0.07	-	-	0.75	1.74	1.56	0.182	0.02
Total				**91**		**5,840**									**7.19**	**16.93**	**15.76**	**1.782**	**0.17**

Notes:
1. Based on the average horsepower distribution in the OFFROAD 2006 model.
2. From Pacific Coast Container's website. Number of containers is equal to the total number of truck bays minus the number of bays with a reefer plug. Number of rail cars per day was provided by Pacific Coast Containers.
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. VOC evaporative emissions are negligible.

Summary of Emissions from Emergency Generator

Location	Equipment Type	Make	Fuel Type	Rating (hp)	Annual Hours of Operation (hr/yr)	Emission Factors (g/hp-hr)					Emissions (tons/yr)				
						ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Intermodal Yard	Emergency Generator	Cat 3406C	Diesel	587	30	1.14	3.03	14.06	1.00	0.93	0.02	0.06	0.27	0.02	0.02

Notes:

I. Hours of operation provided by Jim Diel of UPRR.

2. Emission factors from AP-42, Table 3.3-1, 10/96.

Summary of Emissions from Sand Tower Operations
Oakland Rail Yard, Oakland, CA

Pollutant	2005 Sand Throughput (ton/yr)	Pneumatic Transfer Emission Factor (lb/ton)	Gravity Transfer Emission Factor (lb/ton)	Process Emissions (tons/yr)		
				Pneumatic Transfer	Gravity Transfer	Total
PM10	270.00	0.00034	0.00099	4.59E-05	1.34E-04	1.80E-04

Notes:
1. Sand throughput provided by UPRR.
2. Pneumatic transfer emission factor from AP-42, Table 11.12-2, 6/06. Factor for controlled pneumatic cement unloading to elevated storage silo was used. The unit is equipped with a fabric filter.
3. Gravity transfer emission factor from AP-42, Table 11.12-2, 6/06. Factor for sand transfer was used.
4. There are no TAC emissions from this source.

Equipment Specifications for Steam Cleaners
Oakland Rail Yard, Oakland, CA

Location	Emission Unit	Fuel Type	Rating (MMBtu/hr or hp)
Car Shop	Pump	Gasoline	11
	Heater	Diesel	0.05
Locomotive Shop	Pump	Gasoline	11
	Heater	Diesel	0.05

Notes:
1. Heaters with a rated capacity of less then 1 MMBtu/hr are exempt from permitting requirements per Rule 2-1-114-1.1.
2. Internal combustion engins with a rated capacity of 50 hp or less are exempt from permitting requirements per Rule 2-1-114-.2.1.

Equipment Specifications for Heaters
Oakland Rail Yard , Oakland, CA

Location	Heater Type	Fuel Type	Rating (MMBtu/hr)
Facility Wide	Heater	Natural Gas	0.0600
Facility Wide	Heater	Natural Gas	0.0600
Facility Wide	Heater	Natural Gas	0.0600
Facility Wide	Heater	Natural Gas	0.0600
Facility Wide	Heater	Propane	0.0600
Facility Wide	Heater	Natural Gas	0.0600
Car Shop/ One Spot	Heater	Natural Gas	0.1000
Car Shop/ One Spot	Heater	Natural Gas	0.1000
Car Shop/ One Spot	Heater	Natural Gas	0.1000
Car Shop/ One Spot	Heater	Natural Gas	0.1000
Car Shop/ One Spot	Heater	Natural Gas	0.1000
Car Shop/ One Spot	Heater	Natural Gas	0.1000

Notes:
1. Heaters with a rated capacity of less then 1 MMBtu/hr are exempt from permitting requirements per Rule 2-1-114-1.1.

Equipment Specifications for Welders
Oakland Rail Yard, Oakland, CA

Location	Fuel Type	Rating (hp)
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Car Shop/One Spot	Gasoline	16
Locomotive Shop	Gasoline	12.5
Locomotive Shop	Gasoline	16
Crane Shop	Gasoline	<50
Crane Shop	Gasoline	<50
Crane Shop Service Truck	Gasoline	<50
Crane Shop Service Truck	Gasoline	<50
TTX	Gasoline	18
TTX	Gasoline	18
TTX	Gasoline	18
TTX	Gasoline	18
IMS	Gasoline	<15

Notes:
1. Internal combustion engins with a rated capacity of 50 hp or less are exempt from permitting requirements per Rule 2-1-114-.2.1.
2. Welding equipment is exempt from permitting per Rule 2-1-128.11.

Specifications for Miscellanous Combustion Equipment
Oakland Rail Yard, Oakland, CA

Location	Equipment Type	Fuel Type	Rating (hp)
WWTP	Emergency Generator	Gasoline	3
WWTP	Emergency Generator	Gasoline	10
Microwave Tower	Emergency Generator	Natural Gas	40.25
Telephone Exchange	Emergency Generator	Natural Gas	20.1
1851-B 5th Street	Emergency Generator	Natural Gas	26.8
WWTP	Pressure Washer	Gasoline	16
Crane Maintenance	Air Comprssor	Gasoline	45
TTX	Hydraulic Lift	Diesel	11

Notes:
1. Internal combustion engins with a rated capacity of 50 hp or less are exempt from permitting requirements per Rule 2-1-114-.2.1.

APPENDIX I

DETAILED RISK SCREENING CALCULATIONS

Summary of Risk Index Values
Oakland Rail Yard, Oakland, CA

Source	Risk Index Value Cancer	% of Total Cancer Risk	Risk Index Value Chronic	% of Total Chronic Risk
Locomotives	1.17E-03	36.20	1.96E+01	23.53
On-Road Diesel-Fueled Trucks	2.45E-06	0.08	4.08E-02	0.05
HHD Diesel-Fueled Trucks - Intermodal	5.15E-04	15.87	8.58E+00	10.31
HHD Diesel- Fueled Trucks - Distribution Centers	4.85E-05	1.49	8.08E-01	0.97
Cargo Handling Equipment	4.91E-04	15.15	8.19E+00	9.85
Heavy Equipment	6.01E-05	1.85	1.00E+00	1.20
Transport Refrigeration Units - Intermodal	4.12E-04	12.69	6.86E+00	8.25
Transport Refrigeration Units - Distribution Centers	5.35E-04	16.48	1.07E+01	12.86
Storage Tanks	2.22E-08	0.00	2.54E+01	30.56
WWTP	3.14E-09	0.00	1.92E+00	2.31
Sand Tower	0.00E+00	0.00	0.00E+00	0.00
Emergency Generator	5.81E-06	0.18	9.69E-02	0.12
Total	3.24E-03	100.00	8.32E+01	100.00
De Minimis Sources (% of Total)		3.60		4.65

Notes:
1. There are no TAC emissions from the sand tower.

Calculation of Risk Index Values for Diesel-Fueled Sources
Oakland Rail Yard, Oakland, CA

Source	DPM Emissions (tons/yr)	Unit Risk Factor Cancer	Cancer Risk Index Value	Unit Risk Factor Chronic	Chronic Risk Index Value
Locomotives	3.914	3.00E-04	1.17E-03	5.00E+00	1.96E+01
On-Road Diesel-Fueled Trucks	0.008	3.00E-04	2.45E-06	5.00E+00	4.08E-02
HHD Diesel-Fueled Trucks - Intermodal	1.716	3.00E-04	5.15E-04	5.00E+00	8.58E+00
HHD Diesel- Fueled Trucks - Distribution Centers	0.162	3.00E-04	4.85E-05	5.00E+00	8.08E-01
Cargo Handling Equipment	1.638	3.00E-04	4.91E-04	5.00E+00	8.19E+00
Heavy Equipment	0.200	3.00E-04	6.01E-05	5.00E+00	1.00E+00
Transport Refrigeration Units - Intermodal	1.372	3.00E-04	4.12E-04	5.00E+00	6.86E+00
Transport Refrigeration Units - Distribution Centers	1.782	3.00E-04	5.35E-04	6.00E+00	1.07E+01
Emergency Generator	0.019	3.00E-04	5.81E-06	5.00E+00	9.69E-02
Total	**10.811**		**3.24E-03**		**5.58E+0l**

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

Calculation of Risk Index Values for TAC Sources
Oakland Rail Yard, Oakland, CA

CAS	Chemical Name	Emissions (tpy/yr)		Unit Risk Factor	Unit Risk Factor	Cancer Risk Index Value		Chronic Risk Index Value	
		Gasoline Tank	WWTP	Cancer	Chronic	Gasoline Tank	WWTP	Gasoline Tank	WWTP
540841	2,2,4-trimethylpentane	0.0028							
71432	benzene	0.0008	0.0001	2.90E-05	6.00E+01	2.22E-08	2.57E-09	4.59E-02	5.31E-03
	Bis(2-ethylhexyl) Phthalate		0.0000						
	Bromomethane		0.0002						
	Chloroform		0.0001	5.30E-06	3.00E+02		5.79E-10		3.28E-02
110827	cyclohexane	0.0022							
100414	ethylbenzene	0.0003	0.0005	-	2.00E+03			5.01E-01	1.00E+00
78784	isopentane	0.0793							
98828	isopropylbenzene (cumene)	0.0000							
	Methylene Chloride		0.0019						
108383	m-xylene	0.0007	-	-	7.00E+02			5.10E-01	
110543	n-hexane	0.0033		-	7.00E+03			2.29E+01	
95476	o-xylene	0.0003	-	-	7.00E+02			1.90E-01	
106423	p-xylene	0.0002		-	7.00E+02			1.59E-01	
108883	toluene	0.0036	0.0006	-	3.00E+02			1.08E+00	1.79E-01
	total xylenes		0.0010	-	7.00E+02				7.01E-01
Total		**0.0934**	**0.0043**			**2.22E-08**	**3.14E-09**	**2.54E+01**	**1.92E+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 were first allocated to the areas of the yard where their activity occurs, and were 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 were 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 within 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 Oakland Rail Yard		
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 - Intermodal Trucks (traveling)	Volume	Assumed that 90% of the emissions from HHD truck traveling occurred in the trailer parking area and the remaining 10% occurred on a route from the center of the east unloading area to the gate.
HHD Diesel-Fueled Trucks - Distribution Centers (idling and traveling)	Volume	Pacific Coast Containers - allocated all emissions to the area in and around the PCC facility. Pacific Transload System - allocated all emissions to the area in and around the PTS facility.
Cargo Handling Equipment (low level)	Volume	Chassis Stackers - assumed emissions were evenly allocated between the 2 chassis storage areas. Yard Hostlers - allocated all of the emissions to the trailer parking area. Drott 2500 Crane - allocated all emissions to trailer parking area.
Cargo Handling Equipment (RTGs)	Point	Assumed 10% of the total emissions from RTGs occurred at the crane pad and the remaining emissions occurred in the areas around the unloading tracks.
Heavy Equipment (idling and traveling)	Point or Volume	Loraine Crane, Trackmobile, and Hyster Forklift - allocated all emissions to the area in and around the One Spot as point (Loraine Crane) or volume sources. Yard Hostlers (2), Backhoe, and TTX Forklifts (2) - allocated all emissions to the Intermodal Yard area as volume sources. Man Lift - allocated all emissions to the area in and around the locomotive shop/service track.

Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources Oakland Rail Yard		
Source	Source Treatment	Assumptions for Spatial Allocation of Emissions
TRUs and Reefer Cars	Volume	Assumed all emissions from TRUs and reefer cars associated with the PCC distribution centers occurred at the each distribution center. Emissions from TRUs associated with intermodal operations occurred in the trailer parking area

APPENDIX K

SEASONAL AND DIURNAL ACITIVITY PROFILES

Appendix K

Development of Temporal Activity Profiles for the UPRR Oakland Yard

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 and service idling, and yard switching at the UPRR Oakland Yard. 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 and service activity.

Table K-1. Hourly Activity Factors for Train Activity at the UPRR Oakland Yard

Hour	Train and Service Idling	Train Movements (Daytime)	Train Movements (Nighttime)	Yard Switching (Daytime(	Yard Switching (Nighttime)
1	0.831	0.000	0.778	0.000	1.000
2	0.805	0.000	0.796	0.000	1.000
3	0.724	0.000	0.787	0.000	1.000
4	0.834	0.000	0.934	0.000	1.000
5	0.989	0.000	0.952	0.000	1.000
6	1.137	0.000	1.135	0.000	1.000
7	1.077	0.961	0.000	1.000	0.000
8	1.095	1.010	0.000	1.000	0.000
9	1.024	0.890	0.000	1.000	0.000
10	1.238	1.082	0.000	1.000	0.000
11	1.247	0.831	0.000	1.000	0.000
12	1.301	1.547	0.000	1.000	0.000
13	1.043	1.194	0.000	1.000	0.000
14	0.949	1.113	0.000	1.000	0.000
15	0.828	0.854	0.000	1.000	0.000
16	0.836	0.943	0.000	1.000	0.000
17	0.724	0.715	0.000	1.000	0.000
18	0.711	0.769	0.000	1.000	0.000
19	0.751	0.000	0.679	0.000	1.000
20	1.244	0.000	0.930	0.000	1.000
21	1.424	0.000	1.010	0.000	1.000
22	1.389	0.000	1.873	0.000	1.000
23	0.946	0.000	1.180	0.000	1.000
24	0.851	0.000	1.037	0.000	1.000

Table K-2. Seasonal Activity Factors for the UPRR Oakland Yard

Activity Type	Winter	Spring	Summer	Fall
Trains	0.914	1.047	1.052	0.987
Service	1.122	1.101	0.918	0.860

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' . 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

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

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).*