SECTION 1  INTRODUCTION

The Port of Long Beach (the Port or POLB) shares San Pedro Bay with the neighboring Port of Los Angeles (POLA). Together, the two ports comprise a significant regional and national economic engine for California and the United States (U.S.), through which approximately 33% of all containerized trade in the nation flows (14% for POLB alone). Combined, the POLB and POLA’s customs district account for approximately $300 billion in annual trade. Despite a recent worldwide downturn in shipping, economic forecasts suggest that the demand for containerized cargo moving through the San Pedro Bay region will increase over the next two decades. The economic benefits of the ports are felt throughout the nation.

The ports recognize that their ability to accommodate the projected growth in trade will depend upon their ability to address adverse environmental impacts (and, in particular, air quality impacts) that result from such trade. In November 2006, the ports of Long Beach and Los Angeles adopted the landmark Clean Air Action Plan (CAAP) that was designed to assist the ports with developing and implementing measures and strategies necessary to reduce air emissions and health risks associated with port operations, while allowing port development, and the job creation and economic activity associated with that development, to continue. The CAAP includes strategies to reduce emissions from port-related mobile source operations such as trucks, locomotives, ships, harbor craft, cranes and yard equipment. On November 22, 2010, the harbor commissioners of the two ports unanimously approved an update to the CAAP that identifies longer-term goals that build upon the commitments made in the original CAAP.

1.1  Reason for Study

In April 2004, the Port released its first activity-based inventory of emissions from port-related cargo handling equipment, rail locomotives, and on-road heavy duty vehicles based on the 2002 calendar year. An addendum to the 2002 air emissions inventory was developed concurrently with the 2005 air emissions inventory to include emissions from ocean-going vessels and harbor craft.

Using a baseline year of 2005, annual air emissions inventories have been developed, and serve as the primary tool for the Port to track the progress of CAAP measures and regulations implemented to reduce port-related air emissions. A discussion of regulatory and CAAP measures is provided in Appendix A. The 2011 Air Emissions Inventory (EI) presents estimates of emissions from port-related mobile sources based on activities that occurred in calendar year 2011. A comparison of the 2011 air emissions to relative to 2005 levels is also conducted.

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6 Port of Long Beach annual air emissions inventories can be found at www.polb.com/emissions.
Development of the annual air emissions inventories is coordinated with a technical working group (TWG) comprised of representatives from the ports and air regulatory agencies, including the U.S. Environmental Protection Agency Region 9 (EPA), California Air Resources Board (CARB), and South Coast Air Quality Management District (SCAQMD). Through collaboration with the TWG, the ports seek the consensus of the air regulatory agencies regarding methodologies and information used to develop the emissions estimates.

1.2 Scope of Study

The emissions in this report are based on the year of activity, the characterized pollutants, the port-related source of emissions, and the geographic boundaries in which the emissions occur.

1.2.1 Pollutants

The combustion of fuel from the operation of port-related vehicles and equipment result in exhaust emissions of air pollutants, including greenhouse gases. The pollutants estimated in the EI are described below.

**Particulate Matter**

Particulate matter (PM) is a complex mixture of extremely small particles and liquid droplets made up of a number of components including organic chemicals, metals, acids, and soil or dust particles. PM that are 10 micrometers in diameter or smaller generally pass through the throat and nose and enter the lungs and can affect the heart and lungs and cause serious health effects. PM emissions are grouped into two categories, particulate matter less than 10 microns in diameter (PM$_{10}$) and particulate matter less than 2.5 microns in diameter (PM$_{2.5}$).

PM$_{10}$ emissions are inhalable coarse particles, such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter. PM$_{2.5}$ emissions are fine particles 2.5 micrometers in diameter and smaller.

**Diesel Particulate matter**

Diesel particulate matter (DPM) is part of a complex mixture that makes up diesel exhaust. In 1998, California identified diesel exhaust particulate matter as a toxic air contaminant based on its potential to cause cancer, premature death, and other health problems.

**Oxides of Nitrogen**

Oxides of nitrogen (NO$_x$) are a group of highly reactive gases produced during the fuel combustion process. NO$_x$ reacts to form ground-level ozone and smog, and can contribute to respiratory problems.

**Oxides of Sulfur**

Oxides of sulfur (SO$_x$) are gases formed when fuel containing sulfur, such as coal and oil, is burned. SO$_x$ can form particulates in the air and can contribute to respiratory problems.
Hydrocarbons
Fuels such as gasoline and diesel are mixtures of hydrocarbons (HC). HC emissions are fragments of fuel molecules that are only partially burned in the fuel combustion process. HC in the air react with NOx and sunlight to contribute to the formation of ground-level ozone and greenhouse gases.

Carbon Monoxide
Carbon monoxide (CO) is a colorless, odorless gas emitted from the fuel combustion process. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

Greenhouse Gases
Emissions of greenhouse gases (GHG) carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), which are combustion by-products, are estimated in this inventory. Other GHGs, such as fluorinated gases are not estimated because they are produced as a result of industrial processes not typically found at ports or in the maritime industry.

Since each GHG differs in its ability to absorb heat in the atmosphere, GHG emissions were normalized by multiplying individual GHG pollutant emissions by their respective global warming potentials (GPWs), listed below, and presented in the normalized units of CO2E:

- CO2 – 1
- CH4 – 21
- N2O – 310

1.2.2 Emission Sources
Emissions are estimated from the following five port-related mobile source categories:

- Ocean-going vessels (OGV)
- Harbor craft
- Cargo handling equipment (CHE)
- Locomotives
- Heavy-duty vehicles (HDV)

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The Port is a landlord port; it builds terminal facilities and leases them to shipping lines and stevedoring companies. The Port does not operate the terminals, ships, yard equipment, trucks or trains that move the cargo. Port tenants and shipping lines who own, operate and maintain equipment and own or charter vessels play an essential role in the development of an EI by providing the most accurate activity and operational information available for each of the source categories above. Activity and operational data collected are input into a database and emissions estimates are developed for each source category in a manner consistent with the latest estimating methodologies agreed upon by the Port and the TWG. Specific data collection and analytical approaches unique to each of the five source categories are described in subsequent sections of this report.

1.2.3 Geographical Domain
The 2011 EI includes emissions from equipment and vehicles that operate on Port-owned and privately owned property within the Port of Long Beach Harbor District to the South Coast Air Basin boundaries. For OGVs and commercial harbor craft, the geographical extent is based on the same boundary used in previous marine vessel inventories developed for the SCAQMD.

This section describes the geographic boundaries used for all source categories in this report.

Ocean-Going Vessels and Commercial Harbor Craft
The geographical domain of the OGV EI is the same boundary that has been used in the previous Port EIs since 2005. Originally selected to be consistent with the regulatory OGV EIs for the region, the geographical or over-water boundary is used to define the lengths of the various shipping routes used to access the Port. The lighter blue shading shows the CARB state inventory boundary line while the dark blue shows the South Coast Air Basin (SoCAB) over-water boundary. The geographic domain includes the area from the Port’s berths and channels to the breakwater and beyond the breakwater to the following points that form a “box” that extends seaward from the Port:

- The northwest corner is located where the Ventura County and Los Angeles County lines intersect the Pacific Ocean at latitude 34° 02’ 42.4” N, longitude 118° 56’ 41.2” W.
- The southwest corner is located over the water, just south of the Territorial Sea boundary, south of San Nicolas Island at latitude 33° 00’ 00.0” N, longitude 119° 30’ 00.0” W.
- The southeast corner is located over the water, south of the Territorial Sea, south of San Clemente Island at latitude 32° 30’ 00.0” N and longitude 118° 30’ 00.0” W.
- The northeast corner is located where the Orange County and San Diego County lines intersect the Pacific Ocean at latitude 33° 23’ 12.7” N, longitude 117° 35’ 46.4” W.
There are four primary shipping routes into the Port as designated by Marine Exchange of Southern California (MarEx). The North route is typically used in West Coast United States/Canada and trans-Pacific voyages, the East route is used in transits to and from El Segundo Bay, the South route is used in Central/South American and Oceania voyages, and the West route is used in Hawaiian and eastern Oceania voyages. Each route is comprised of an inbound and an outbound lane, which separate vessel traffic arriving and departing the Port. The distances of these routes from the outer edge of the precautionary zone (PZ) to the over-water boundary and the distances of these routes from the breakwater (BW) to the outer edge of the PZ are listed in Table 1.1. These distances represent average distances traveled by ships on each route.

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Table 1.1: Average Route Distances, nm

<table>
<thead>
<tr>
<th>Shipping Route</th>
<th>PZ to Boundary Distance (nm)</th>
<th>BW to PZ Distance (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inbound</td>
<td>Outbound</td>
</tr>
<tr>
<td>North</td>
<td>43.3</td>
<td>42.4</td>
</tr>
<tr>
<td>West</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>South</td>
<td>31.3</td>
<td>32.5</td>
</tr>
<tr>
<td>East</td>
<td>25.7</td>
<td>25.7</td>
</tr>
</tbody>
</table>

The routes are further segmented by The Green Flag Vessel Speed Reduction program compliance zones; the 20 nautical mile (nm) zone is from the outer edge of the PZ to an arc 20 nm in radius from Point Fermin. The 20 to 40 nm zone is from the 20 nm arc to a further arc with a radius of 40 nm from Point Fermin.
Cargo Handling Equipment
The geographical scope for CHE is the terminals and facilities on which they operate. Figure 1.2 shows active Port terminals in 2011.

Figure 1.2: Cargo Handling Equipment Geographical Extent Port of Long Beach Map of Terminals
Railroad Locomotives and Heavy-Duty Vehicles

Emissions from switching and line haul locomotives are estimated for on-dock rail yards, intermodal yards on Port property, and the rail lines linking these facilities. For HDV associated with the hauling of cargo, emissions from queuing at terminal entry gates, travel and idling within the terminals, and queuing at the terminal exit gates are included in the 2011 EI. In addition to emissions that occur inside the Port facilities, emissions from locomotives and HDVs transporting cargo to or from the Port are estimated for activity that occurs within the SoCAB boundaries. Emissions are estimated up to the cargo’s first point of rest within the SoCAB or up to the basin boundary, whichever occurred first. First point of rest is defined as the location where cargo, such as a container of goods, is first off-loaded from the transport device (truck or train) after leaving the Port. Examples include cargo transported from the Port by truck to a distribution center or to an off-port intermodal yard. Figure 1.3 shows the SoCAB boundary for locomotives and HDVs relative to the Port. Since the ports of Long Beach and Los Angeles are interconnected with intermodal transportation linkages, every effort was made to only account for freight movements originating from or having a destination at the POLB.

Figure 1.3: Railroad Locomotives and Heavy Duty Vehicles Geographical Extent
South Coast Air Basin Boundary
**Railroad Locomotives**

Figure 1.4 illustrates the rail track system serving both ports, and Figure 1.5 presents a broader view of the major rail routes in the SoCAB that are used to move port-related intermodal cargo.

**Figure 1.4: Port Area Rail Lines**
Alameda Corridor

The Alameda Corridor is a 20-mile rail line used by intermodal and other trains servicing the San Pedro Bay ports and other customers in the area. Opened in 2002, the Alameda Corridor provides a more direct route between the ports and the transcontinental rail network interconnection near downtown Los Angeles than the routes that had previously been used, shortening the travel distance, eliminating many at-grade crossings, and reducing traffic congestion. Figure 1.6 illustrates the route of the Alameda Corridor and the routes it has replaced.
Figure 1.6: Alameda Corridor
1.2.4 Sources Not Included in the Emissions Inventory

The inventory does not include emissions from stationary sources because they are accounted for in stationary source permitting programs administered by the SCAQMD. The inventory also does not include emissions from vessels and equipment used in oil production operations, located either within the port boundary or offshore. The following industrial operations and other emission-producing activities, located on Port property or on private property within the Port boundaries are not included in the 2011 EI:

- Harbor Co-generation
- South East Resource Recovery Facility
- Tidelands Oil Production Company
- THUMS Oil Operations
- Long Beach Generation

These operations and activities are excluded from the 2011 EI because they are not related to the Port's goods movement activities or operations. Emissions associated with Tidelands and Thums Oil Operations, are included in a separate study conducted to quantify oil industry-related emissions published in 20069.

1.3 Report Organization

This report presents the emissions and methodologies used for each source category in each of the following sections:

- Section 2 discusses ocean-going vessels
- Section 3 discusses harbor craft
- Section 4 discusses cargo handling equipment
- Section 5 discusses locomotives
- Section 6 discusses heavy-duty vehicles
- Section 7 discusses findings and results
- Section 8 compares 2011 emissions to 2005 emissions
- Section 9 discusses emissions metrics by source category
- Section 10 discusses anticipated impacts of control programs on emissions and improvements to methodologies for estimating emissions

The report also includes:

- Appendix A – Regulatory and San Pedro Bay Ports Clean Air Action Plan Measures
- Appendix B – Ocean-going vessels
- Appendix C – Harbor craft
- Appendix D – Cargo handling equipment
- Appendix E – Heavy-duty vehicles

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9 City of Long Beach, *Long Beach Gas and Oil Air Emissions Inventory*, prepared by Starcrest Consulting Group, LLC (Starcrest), October 2006.