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Acronyms and Abbreviations

2001 BEI  Draft Portwide Baseline Emission Inventory using 2001 Data
ACTA  Alameda Corridor Transportation Authority
APL  American President Line
AREMA  American Railway Engineering and Maintenance-of-Way Association
ATMIS  Ports Automated Traffic Management and Information System
BNSF  Burlington Northern & Santa Fe Railroad
CARB  California Air Resources Board
CO  carbon monoxide
CP  control point
CTC  Centralized Traffic Control
EPA  U.S. Environmental Protection Agency
HC  hydrocarbons
I-110  Interstate 110
I-710  Interstate 710
ICTF  intermodal container transfer facility
ITS  International Transportation Service
LAHD  Los Angeles Harbor Department
LOS  Level of Service
mph  miles per hour
MTA  Los Angeles County Metropolitan Transportation Authority
NOx  oxides of nitrogen
NYK  Nippon Yusen Kaisha
PCE  passenger car equivalent
PCT  Pacific Container Terminal
PHL  Pacific Harbor Line
PM10  particulate matter less than 10 microns in diameter
Port  Port of Los Angeles
RTC  Rail Traffic Controller
SCAQMD  South Coast Air Quality Management District
SOx  sulfur dioxide
SR  State Route
SSA  Stevedoring Services of America
TEUs  twenty-foot equivalent units
TICTF  Terminal Island Container Transfer Facility
UP  Union Pacific Railroad
V/C  volume to capacity ratio
VOC  volatile organic compounds
WBICTF  West Basin Intermodal Container Transfer Facility
YML  Yang Ming Lines
YTI  Yusen Terminal Incorporated
Chapter 1. Introduction

Purpose of Report

The purpose of this Portwide Rail Synopsis is to summarize previous technical studies completed for the Port of Los Angeles (Port) that forecast future cargo quantities and types, analyze the capacity of the existing rail system, and recommend rail improvements. While this report focuses on the rail system that serves the Port, it also provides a summary of the larger physical and operational context in which the rail analyses and recommendations were made, and discusses the interconnection of rail with trucks.

Background

Railroads were responsible for settlement of the West and the emergence of the United States into an economic superpower by allowing efficient transport of goods to and from markets. Similarly, railroads played a key role in the development of the Port into a world-class seaport. Rail is essential to both the Port’s current operation and its future growth.

The Port was connected to downtown Los Angeles by rail in 1869 when Phineas Banning opened the Los Angeles and San Pedro Railroad; in the same year, the first transcontinental rail line was completed. Southern Pacific Railroad later acquired Banning’s line and connected Los Angeles and the Port to the rest of the nation through the transcontinental railroad network. Today, Burlington Northern & Santa Fe (BNSF) Railroad and Union Pacific (UP) Railroad provide long-haul service to the Port, while Pacific Harbor Line (PHL) provides local switching and train control services.

Since the 1960s, both the volume and the percentage of goods being transported by standardized shipping containers have increased significantly. These weatherproofed steel containers can easily be transferred between ships, trains, and trucks, a process called intermodal transport. Intermodal transport has become the standard method of moving goods worldwide, resulting in improved safety and efficiency and reduced costs. Containerization has enabled dramatic increases in international trade.

The Port is the busiest container port in the United States, and the eighth busiest in the world. Located in San Pedro Bay, approximately 20 miles south of downtown Los Angeles, the Port occupies 7,500 acres of land and water along 43 miles of waterfront. In addition to the Port, San Pedro Bay is home to the Port of Long Beach. When considered together, the combined trade of the Port and the Port of Long Beach ranks third in the world in container throughput (behind Hong Kong and Singapore), and serves as the country’s primary gateway to Asian-based trading partners. About 575,000 jobs in southern California (based upon 2002 calendar year) are related to these two ports. (Port of Los Angeles 2003a.)
Half of the cargo coming through the Port is delivered by truck to the regional market, an area that is within roughly 550 miles of the Port. Goods destined for the national market beyond this area are delivered primarily by rail. As recently as 1996, all rail-bound containers traveling through the Port had to first be trucked to rail yards outside the harbor. Since that time, the Port has moved to the forefront of rail handling by constructing four on-dock intermodal container transfer facilities (ICTFs) that allow containers to move between ships and trains without traveling on streets and freeways outside the Port.

Forecasts indicate that cargo demand at the Port is expected to increase substantially over the next 5 to 20 years. Rail transport is a key component in accommodating this future growth. The purpose of this Portwide Rail Synopsis is to document existing rail conditions and identify improvements that will meet projected growth needs.

### Port Rail Policy

The Port has developed a Draft Rail Policy, submitted to the Board of Harbor Commissioners on April 22, 2004. This proposed policy recognizes the anticipated growth in container cargo and supports the need to accommodate projected demand. Specifically, the Port policy resolves to:

- Provide for near-dock access to Class I railroads for shippers, carriers, and terminal operators;
- Ensure that rail is used to its fullest feasible extent by container operations;
- Ensure that sufficient rail capacity is maintained to increase rail usage to meet future demand; and
- Provide the opportunity to direct local movements of cargo from truck to rail.

The rail analysis summarized in this report provides technical analysis and identifies recommended improvements that support this Draft Rail Policy.

### Primary Sources

This Portwide Rail Synopsis summarizes the Port Rail Capacity Analysis report prepared in 2003 and supplements its information with other sources. To prevent citing the Port Rail Capacity Analysis profusely throughout this synopsis, it will be understood that information that is not cited was taken from the Port Rail Capacity Analysis (Port of Los Angeles 2003b).

### Port Rail Capacity Analysis

The Port Rail Capacity Analysis identifies the growth in rail traffic expected to occur in order to accommodate projected future cargo demand, and to identify improvements needed for rail to meet that demand. Transportation planning tools applied in this study included a model that determined the practical capacity of freight rail based on rail yard capacity, and a simulation model that analyzed the mainline rail operations under existing and projected future conditions. The study identified system deficiencies of rail
yards and the mainline rail network in and around the Port, and recommended physical and operational strategies to alleviate those deficiencies. (Port of Los Angeles 2003b).

**Supplemental Sources**

Information that supplements the Port Rail Capacity Analysis is cited throughout this synopsis and is fully referenced at the end of the document. The following three studies are the primary supplemental sources used throughout this synopsis.

1. **San Pedro Bay Ports Rail Market Study.** The objectives of this study were to identify destinations for cargo volumes to be handled by on- and near-dock facilities; project future rail demand; assess capacities of on-, near-, and off-dock rail yards and identify associated deficiencies; conduct revenue analysis to determine the financial feasibility of recommended improvements; and define areas where further study was warranted. (Port of Los Angeles 2004a).

2. **Baseline Transportation Study.** This study was conducted to address existing and future roadway deficiencies associated with the Port. It includes analysis of existing and future vehicular traffic demand, identification of roadway system deficiencies, and recommendations for necessary improvements. Both transportation planning and traffic engineering analyses were conducted as part of this study. The study included analyses within and immediately adjacent to the Port. Regional transportation system analyses were also performed on the freeway system. (Port of Los Angeles 2003c.).

3. **Comparison of Rail and Truck Emissions per Ton-Mile of Cargo.** This study was prepared for the Association of American Railroads to compare rail and truck emissions per ton-mile of cargo for the South Coast and San Joaquin Air Basins for 2000 to 2012 (Caretto 2004).

**Overview of Report**

This report includes the following sections:

- **Chapter 1: Introduction**—Introduces the Portwide Rail Synopsis, gives a background description of the Port’s relationship with rail, and presents the main sources used to create this report.

- **Chapter 2: Cargo, Facilities, and Container Movement**—Describes the characteristics of cargo, containers, container terminals, and the transit mode combinations by which cargo moves into and out of the Port.

- **Chapter 3: Existing Transportation Facilities**—Describes the rail facilities and roadways that serve the Port.

- **Chapter 4: Cargo Forecasts**—Summarizes the cargo forecasted between now and 2020, and identifies the sources of the forecast numbers.
- **Chapter 5: Railroad Mainline Simulation Model**—Summarizes the methodology and results of the simulation of the trains in the rail network under projected future conditions.

- **Chapter 6: Summary of Rail Recommendations**—Describes the operational and infrastructure improvements to the rail system that have been identified by the technical studies.

- **Chapter 7: Relationship to Freight Truck Haulage**—Summarizes the analysis of the regional roadway system completed by the Port, as well as the roadway improvements needed to accommodate projected future truck cargo haulage. This chapter also discusses the potential impacts that elimination of truck trips in favor of rail may have on regional air quality and traffic congestion.

- **Chapter 8: Conclusion**—Presents conclusions of this report.

- **References**—Complete list of sources that are cited throughout the report.

- **Glossary**—Provides definitions of terms and place names used in the document. Terms found in the glossary are bolded throughout the report, and selected terms are highlighted in the margins of the text.
Chapter 2. Cargo, Facilities, and Container Movement

In 1959, the Matson Navigation Company’s ship “Hawaiian Merchant” made its first shipment of 20 cargo containers, marking the beginning of the containerized cargo handling at the Port. Today, intermodal transport of containerized cargo is the standard method of moving goods worldwide, accounting for about 90 percent of cargo movement. Containerization has dramatically increased the efficiency and reduced the cost of moving goods, enabling international trade to flourish. Locally, the shift to containers has reshaped the Port, and the forecasted increases in container cargo will continue this trend.

This chapter describes the characteristics of containerization and cargo, how terminals operate, where cargo goes, and how cargo moves.

Containers and Ships

Malcolm McLean, known as the “Father of Containerization,” is credited with inventing the shipping container in the 1930s. Containers initially saw little commercial use but were used by the military during World War II. McLean’s idea eventually led him to found the Sea-Land Shipping Company, which inaugurated container service in 1956. The first container ship voyage was the “Ideal X,” which carried 58 containers from New Jersey to Texas (GDV 2003). Shipping containers used in intermodal transit today generally conform to the International Organization for Standardization (ISO) container manufacturing standards. These standards are designed to allow containers to be quickly and easily moved between ships, trucks, and trains.

Although many shipping containers appear to be similar, a wide range of types are used, including general purpose or dry, insulated, flat rack or platform, open top, refrigerated, and tank designs. The majority of containers used worldwide today are 20 feet or 40 feet long, 8 feet wide, and 8.5 feet high (GDV 2003). The standard unit of measure used in shipping is the **twenty-foot equivalent unit (TEU)**. The most commonly used containers are 40 feet long and can convey 2 TEUs of cargo. While there is pressure from U.S. businesses to increase container size and thus efficiency, some countries in Europe and elsewhere oppose such changes due to the difficulties in moving larger containers on narrow roads.

Since the time when “Ideal X” initiated the use of containerization, ships have increased in size to transport more containers in a single voyage. In 1988, the first container ships too large to pass through the Panama Canal—those carrying up to 2,170 containers—went into service. These ships, referred to as “post-Panamax” ships, have continued to increase in size over the last 15 years. Ships routinely carry more than 6,000 TEUs, and the newest ships carry more than 8,000 TEUs (White 2004).

Although non-containerized cargo such as liquid petroleum products, lumber, newsprint, and other “break bulk” items not suitable for containers are important trade, their percentage of total cargo at the Port is small and is expected to remain so; most of the projected increases will be in containerized cargo. Automobiles are not shipped in containers, either. They are conveyed by “roll on-roll off” ships in conjunction with
receiving terminals that require less-specialized port facilities and equipment than containerized cargo. This has enabled smaller, less congested harbors, such as Port Hueneme in Ventura County, to be successful in competing for the auto importing trade.

## Container Terminals

The information in this section was derived from the Draft Environmental Impact Report for Berth 206–209 Interim Container Reuse Project, which was prepared in May 2004 (Los Angeles Harbor Department 2004).

The Port includes 27 major cargo terminals—eight are container terminals and 19 are non-container terminals. Combined, these terminals handle more than 120 million metric revenue tons of cargo representing some $102 billion.

The essential function of a container terminal is to transfer cargo from trucks and trains to ships, and from ships to trucks and trains. Terminals are complex facilities that integrate a variety of different physical components and operational processes. The physical components consist of container vessels, berths/wharves (dock), cranes, container storage areas (backlands), entrance and exit gates, and maintenance and administration buildings. The operational processes include loading/unloading ships (stevedoring), terminal equipment and operations, rail operations, and trucking.

Cargo is received and delivered through the truck gates and the on-dock rail yard, if the terminal has one. Export cargo typically arrives at the terminal from 1 day to 1 week prior to the scheduled departure of the ship upon which the cargo is booked to sail.

Wharf gantry cranes are used to move containers on and off ships. Gantry cranes move on rails imbedded in the wharf and typically can transfer 25 to 40 containers per hour. The cranes have anti-sway devices, lighting, and adjustable “spreadsers” (cargo hooks) that allow attachment to the various sizes of containers. The number of cranes operating simultaneously to load/unload one ship can vary from one to six cranes, depending on the size of the ship and the number of vessels at berth. Containers that are stored in terminal backlands are either stacked upon one another or stored on a trailer (chassis) and then parked.

Export cargo arrives at the terminal by either truck or rail. Containers from trucks are stacked (grounded) in the terminal by yard equipment (sidepicks) or rubber-tired gantry (RTG) cranes. Containers from trains are transferred from railcars to yard tractors (hoestlers) using yard equipment, and then transported by yard tractors to preplanned locations in the storage yard where the container is lifted to a grounded location by another crane.

When the container ship arrives, longshoremen work day and night shifts, as necessary, to unload and load the ship. Dockside gantry crane operators lift containers (import cargo) from the ships onto specialized trailers pulled by yard tractors. The containers are then taken to backlands storage areas, on-dock rail yards, or to truck loading areas. Export cargo, which is sitting ready on chassis or stacked on the ground in the yard, is then moved by yard tractor to the wharf and loaded onto the ship by gantry crane.
Cargo Origins and Destinations

In 2003, the Port handled 7.1 million TEUs. The United States generates a much higher import demand than export demand; as a result, volumes of imported cargo that travel through the Port are currently more than three times greater than volumes of exported cargo. Imports make up 75 percent of the cargo that comes through the Port. Due to the imbalance of imports and exports, ships usually arrive at West Coast ports with containers full of cargo but depart with a large number of empty containers, or containers filled with bulkier, lower value materials. The Port’s top trading partners are:

- China ($35.7 billion),
- Japan ($24.8 billion),
- Taiwan ($10.1 billion),
- Thailand ($4.3 billion), and
- South Korea ($3.8 billion).

Table 2-1 summarizes the Port’s top container imports and exports.

**Table 2-1. Top Container Imports and Exports**

<table>
<thead>
<tr>
<th>Top Container Imports</th>
<th>Top Container Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furniture</td>
<td>Wastepaper</td>
</tr>
<tr>
<td>Apparel</td>
<td>Synthetic resins</td>
</tr>
<tr>
<td>Electronic products</td>
<td>Fabric, including raw cotton</td>
</tr>
<tr>
<td>Toys</td>
<td>Animal feed</td>
</tr>
<tr>
<td>Computer equipment</td>
<td>Scrap metal</td>
</tr>
</tbody>
</table>

Source: Port of Los Angeles 2004b.

Cargo coming in through the Port is conveyed to both regional and national markets. Roughly 50 percent of incoming cargo is destined for the regional market, shown in Figure 2-1 as the area within 550 miles of the Port (Mercer Management Consulting 2001). The remaining 50 percent of cargo is destined for the national market and travels to such cities as Chicago, Atlanta, St. Louis, Memphis, New Orleans, and New York. While the cargo’s destination is always known, the method of transport depends on a complex decision-making process that assesses a number of factors.

**How Cargo Moves**

A single medium-sized container ship may unload 5,000 to 6,000 TEUs, while a new, larger ship can bring in as much as 8,100 TEUs. These containers are then delivered outside the Port boundaries by various combinations of truck or rail transit to their final...
destination. Figure 2-2 shows the percent of the Port’s 2003 TEUs by method of shipment.

**Truck Movement**

**Direct Truck Hauling.** The container is loaded onto a chassis hauled by a street-legal tractor at the terminal and then transported on roadways to its destination. An average truck carries one 40-foot container (2 TEUs). Trucks haul all cargo destined for local areas within southern California, as well as most regional cargo. Long-haul trucks convey less than 1 percent of total cargo to national markets.

**Transloaded Truck Hauling.** The container is loaded onto a chassis hauled by a street-legal tractor at the terminal and then transported on roadways to an intermediary warehouse, where the container is unloaded and the cargo is repacked into new container(s). The newly packed container is then trucked to its final destination.

**Rail Movement**

**On-Dock Rail.** Containers are loaded directly onto trains at an on-dock loading facility without traveling on public roads. Railcars are then coupled with other cars traveling to the same destination; the coupled railcars are called a **unit train.** Unit trains vary in length between 115 and 140 railcars, with each railcar carrying two stacked 40-foot containers (or equivalent 20-foot containers). With an industry-average 90-percent utilization rate, unit trains can be up to 8,000 feet in length and carry 414 to 504 TEUs of cargo. Longer trains are not currently used due to limits in railcar coupler strength, except when repositioning empty railcars along routes with 10,000-foot sidings (Leue pers. comm.). All trains traveling out of the Port are typically full, but an average of 50 percent of containers on inbound trains are empty, due to the U.S. international trade imbalance (the United States imports more than it exports).

**Near-Dock/Off-Dock Rail.** Containers are loaded onto trucks at the terminal and then hauled on public roads to a rail facility located near dock (0 to 8 miles) or off dock (8 to 22 miles), where they are then loaded onto trains for shipping throughout the country. Similar to trains used for on-dock rail, trains used for near-dock or off-dock rail typically carry 414 to 504 TEUs per haul. All trains traveling out of the near-dock and off-dock facilities have full import containers, but an average of 50 percent of railcars on inbound trains consist of empty containers from inland locations.

Although on-dock rail provides benefits of improving logistics, traffic congestion, and air quality, the decision process to select on-dock versus off-dock is complex, based on a number of critical factors. Terminal operators and shipping lines prefer to use on-dock rail to the fullest extent possible; however, some intermodal cargo will continue to be handled off dock, due mainly to the following critical issues (DiBernardo pers. comm.):
Figure 2-1
Container Delivery Methods, by Distance from Port of Los Angeles

Legend
- Delivery by Truck
- Traditional Cost Breakeven Zone for Truck versus Rail
- Potential Intermodal Market, Currently Truck
- Intermodal Market, Currently Truck
- Delivery by Railroad, (Mercer, 1998)

Source: Port of Los Angeles 2003b
Figure 2-2
Rail and Truck Shipment of Port of Los Angeles

Data Source: ACTA 2004.
- insufficient amount of cargo to create a full train,¹
- labor availability, and
- train/ship schedule conflicts (e.g., earlier departure and arrival times for off-dock rail).

These issues will be largely resolved in future years due to increased cargo volumes, new terminal developments, and improved work rules and practices. In addition, lack of off-dock capacity will force the necessity of using on-dock ICTFs. (Port of Los Angeles 2003b).

**Transloaded Rail.** Containers are loaded onto trucks at the dock and then hauled to a redistribution center located 8 to 60 miles from the Port. Each truck typically carries one 40-foot container (2 TEUs). At the redistribution center, containers are typically unloaded and the cargo is repackaged into new containers, then trucked to an off-dock rail yard where containers are loaded onto trains for transcontinental shipment.

**Shuttle Train.** The concept of shuttle trains is to use a combination of trucks and trains to move containers within the 550-mile regional market area that is currently served exclusively by trucks. The Port would be connected by short-haul shuttle train service to an intermodal “inland port” facility. Trucks would then move containers to and from final destinations, thereby avoiding the congested freeways leading to the Port. A shuttle train system could reduce traffic congestion, use the Port backland storage areas more efficiently, and reduce the need for container storage areas in Wilmington (Leue pers. comm.).

**Truck Versus Rail Movement**
Transporting containers using on-dock ICTFs reduces truck traffic. A ship carrying 5,000 TEUs of cargo generates five trains worth of intermodal cargo. Each train is equivalent to 700 truck trips; therefore, if all of the cargo on the ship is transported using on-dock rail, 3,500 trucks would be removed from the highways (Figure 2-3).

**Conclusion**
The Port of Los Angeles has reinvented itself over time in response to world market changes and new technologies (www.laporthistory.org). Over the next 5 to 20 years, the Port will continue to adapt to the anticipated growth in containerized cargo. The Port has made major investments in rebuilding terminals to include on-dock ICTF’s, and future investments in rail are planned to help meet the challenges of this growth.

---

¹ For instance, the long-haul railroads prefer to “build” trains with at least 90 railcars (180 containers). If a terminal does not have enough containers to build the train, the containers must be held on-dock until the minimum number is reached. Instead of waiting, the shipping line may chose to truck the containers to an off-dock rail yard so that it can go out on an earlier train.
Figure 2-3
Trip Equivalents for Port of Los Angeles
Freight Cargo Models

1 Ship
≈ 1 Ship
≈ 3,500 Truck Trips (each symbol represents 10 trips)

1 Train
≈ 1 Train
≈ 700 Truck Trips (each symbol represents 10 trips)

≈ 5 Train Loads of Cargo
≈ 3,500 Truck Trips (each symbol represents 10 trips)

Data Source: Port of Los Angeles 2003b
Chapter 3. Existing Transportation Facilities

As described in Chapter 2, both rail and roadway facilities are utilized separately and together to move cargo into and out of the Port. This chapter describes the rail facilities that currently serve the Port, along with roadways that are key to intermodal transport of cargo.

Railroad Facilities

The railroad infrastructure includes the following major components:

- Railroad lines,
- On-dock/near-dock ICTFs, and
- Off-dock rail yards.

Figure 3-1 is a regional view of the major railroad lines and rail yards that serve the Port. Figure 3-2 shows a more detailed view of major railroad facilities, which are described in the following sections.

Railroad Lines

Union Pacific Railroad and Burlington Northern & Santa Fe Railway Lines

The Port is served by two major railroads, BNSF and UP, whose networks cover the western two-thirds of the United States. These two railroads combined move more intermodal cargo than any other rail system in the world.

Prior to the opening of the Alameda Corridor (described below) in 2002, both UP and BNSF railroads used less direct routes, shown as dashed lines on Figure 3-1. The former BNSF line is used for local industry access and is precluded from any intermodal containers. The former UP line is used for local industry access, but also serves as an emergency backup to the Alameda Corridor. The UP and BNSF main lines shown on Figure 3-1 are also referred to as the “Alameda Corridor East,” where planning is underway to create grade separations on the east-west rail lines similar to the Alameda Corridor.

From main rail yards east of downtown Los Angeles, both UP and BNSF railroads serve transcontinental destinations to the north and to the east. To the north, UP and BNSF lines run to the Canadian border, and through the states of Oregon, Washington, and Idaho. To the east, both UP and BNSF have several railroad lines that run as far as Chicago, Illinois; St. Louis, Missouri; Memphis, Tennessee; and New Orleans, Louisiana. To destinations east of these cities, such as New York City and Miami, Florida, shippers must switch to tracks owned by other lines, such as CSX and Norfolk Southern.
Alameda Corridor

The Alameda Corridor, shown in Figure 3-3, is a 20-mile rail expressway that runs from the Ports of Los Angeles and Long Beach to downtown Los Angeles, primarily along and adjacent to Alameda Street. Half of the three-track corridor was built below ground, eliminating 200 at-grade railroad crossings and providing benefits to both rail and vehicle movement. The Alameda Corridor connects the ports to the transcontinental rail yards east of downtown Los Angeles (Washington Boulevard/Interstate 710 [I-710]), creating a faster, more efficient way to move cargo throughout the United States and to overseas markets. The grade separation allows trains to travel more quickly, increasing to approximately 30 to 40 miles per hour (mph) from the previous average speeds of 5 to 20 mph. The Alameda Corridor cut transit times for one-way train trips to 45 minutes, less than half of the 2 to 4 hours these trips previously took. This has reduced operating rail costs by approximately $1,000 per train due to time savings and crew reductions.

The Alameda Corridor handles an average of 35 train movements per day and has a capacity of 150 train movements per day. The train volume forecast increases to 128 port trains in 2020. The 150-train-per-day capacity was built to accommodate the projected increases in containerized cargo in future years. Although the Alameda Corridor is a monumental public works achievement, it is only one link in the logistics chain that connects the Port to national markets. Additional improvements, as described in Chapter 8 and the “Alameda Corridor East” project, as well as other operational factors described in Chapter 2 must be addressed to increase utilization of the Alameda Corridor.

The corridor is managed by the Alameda Corridor Transportation Authority (ACTA), whose governing board is made up of representatives from the cities and Ports of Los Angeles and Long Beach and the Los Angeles County Metropolitan Transportation Authority (MTA). The Board of Harbor Commissioners and Port staff are committed to work cooperatively with ACTA to increase the capability to move containers by rail.

Pacific Harbor Line

PHL is the third-party rail operator currently serving both ports. PHL provides the following services:

- dispatches all train moves on port rail facilities,
- spots and pulls all carload traffic within the Ports of Los Angeles and Long Beach,
- switches unit trains for railroads on request,
- switches intermodal cars within terminals on request, and
- performs track maintenance of common port rail facilities and some terminals.

PHL currently operates with a base at Water Street Yard on Pier A in the Port. This base serves as a classification yard, crew on-duty point, and locomotive service facility. The Los Angeles Harbor Department (LAHD) plans to relocate PHL in the near future to a yet to be determined location. PHL operates five switching jobs (crews) every weekday:
Figure 3-1
Major Rail Lines and Facilities
Figure 3-2
Existing Rail Facilities
Figure 3-3. Alameda Corridor
(1) Pier A to San Pedro/Wilmington,

(2) Pier A to Manuel,

(3) Pier A to Terminal Island (TI) to Toyota to LB Accounts (Baker, GP Gypsum, and National Gypsum),

(4) BNSF Interchange at Watson Yard, and

(5) UP Interchange at Dolores Yard.

On weekends, switching job (3) and sometimes job (2) are dropped from the weekday list, resulting in three or four switching jobs per weekend day.

Carload switching totals 32,000 carloads annually, not including empties; 85 percent of the carload business is with LAHD. Unit train switching typically involves 10 intermodal switch jobs per day on a fairly regular schedule, but at the discretion of the railroads. The weekly switching includes 50 starts split nearly evenly between UP and BNSF. UP trains include those to American President Line (APL), Evergreen, and International Transportation Service (ITS). BNSF trains include those to Maersk, Pacific Container Terminal (PCT), Yusen Terminal Incorporated (YTI), Yang Ming Lines (YML), and ITS. PHL also switches trains to Toyota’s Edison Yard.

**On-dock ICTFs**

The Port currently is served by four ICTFs, as shown in Figure 3-4 and described as follows.

- West Basin ICTF (WBICTF)—This on-dock ICTF is currently operated by Marine Terminal Corporation, and receives rail service from BNSF.

- Terminal Island Container Transfer Facility (TICTF)—This on-dock ICTF is currently operated in two halves divided bilaterally. One half is operated by Marine Terminal Corporation for Evergreen, with rail service by UP. The other half is operated by Stevedoring Services of America (SSA) for Nippon Yusen Kaisha (NYK) and its alliance members, and receives rail service from BNSF.

- Pier 300—The yard is currently operated by Eagle Marine Service for APL and its alliance members, and receives rail service from UP.

- Pier 400 ICTF—This is the newest on-dock ICTF at the Port. The yard is currently operated by APM Terminals (Maersk-Sealand), and receives rail service from BNSF.
Figure 3-4. On-dock ICTFs at Port of Los Angeles
Off-dock and Near-dock Rail Yards

The locations of major off-dock and near-dock facilities are shown in Figures 3-1 and 3-2, respectively. Seven major off-dock rail yards serve the Port. Their existing characteristics are summarized in Table 3-1.

Table 3-1. Off-dock Rail Yards

<table>
<thead>
<tr>
<th>Facility</th>
<th>Railroad</th>
<th>Track Length (feet)</th>
<th>Parking Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Working track</td>
<td>Storage track</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hobart</td>
<td>BNSF</td>
<td>42,698</td>
<td>87,275</td>
</tr>
<tr>
<td>East LA</td>
<td>UP</td>
<td>30,800</td>
<td>71,000</td>
</tr>
<tr>
<td>UP-ICTF</td>
<td>UP</td>
<td>24,100</td>
<td>50,000</td>
</tr>
<tr>
<td>Los Angeles Transportation Center</td>
<td>UP</td>
<td>30,800</td>
<td>71,000</td>
</tr>
<tr>
<td>City of Industry</td>
<td>UP</td>
<td>7,200</td>
<td>20,000</td>
</tr>
<tr>
<td>Commerce</td>
<td>BNSF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Bernardino</td>
<td>BNSF</td>
<td>22,766</td>
<td>22,476</td>
</tr>
</tbody>
</table>

Source: Port of Los Angeles 2003b

Roadways

Figure 3-5 illustrates the major freeways that provide regional access to the Port, as well as the local roadway system in the area. The highlighted roads are those primarily used to move containers from the Ports of Los Angeles and Long Beach to the near-dock UP ICTF rail yard north of Willow Street. Two freeways provide the major regional access to the Port:

- **Long Beach Freeway and Harbor Freeway.** I-710 and Interstate 110 (I-110) both provide regional access to the Ports of Los Angeles and Long Beach. Both freeways are north-south highways that extend from the port area to downtown Los Angeles. They each have six lanes in the vicinity of the harbor and widen to eight lanes to the north.

  Both I-710 and I-110 are part of the Eisenhower Interstate System of the National Highway System, while Seaside Avenue/Ocean Boulevard, Alameda Street, Harry Bridges Boulevard, and State Routes (SR)-47/103 are classified as “other National Highway System routes.” The portion of Sepulveda Boulevard from SR-103 to Alameda Street is classified as an approved intermodal connector on the National Highway System.

  Both interstates provide regional freeway connections to the following freeways: the San Diego Freeway (I-405), Riverside Freeway (SR-91), Century Freeway (I-105), Santa Monica Freeway (I-10), and the Santa Ana Freeway (I-5).
■ **Terminal Island Freeway (SR-47/SR-103).** The Terminal Island Freeway runs north-south and connects Terminal Island with the cities of Wilmington, Carson, and western Long Beach. It also provides direct access to the ICTF located north of Sepulveda Boulevard in the City of Carson. The Terminal Island Freeway is designated SR-47 between Ocean Boulevard and the Henry Ford Avenue ramps. North of the Henry Ford Avenue ramps, it is designated SR-103.

In addition to accommodating trucks that carry local and long-haul cargo within and beyond the region, the roadway system is utilized by trucks that carry intermodal cargo that is transferred at near-dock and off-dock facilities, as well as transloaded rail. Cargo trucks share the roadway system with regional general purpose traffic, and the travel time and reliability of these trucks can be significantly impacted if the roadways are operating under congested conditions. The local and regional roadway system is described and evaluated in detail in the Baseline Transportation Study (Port of Los Angeles 2003c). Conceptual recommended roadway improvements provided in the Baseline Transportation Study, as well as some discussion of rail versus roadway issues, are included in Chapter 7 of this report.
Figure 3-5
Key Roadways Used Between UP ICTF and Ports
Chapter 4. Cargo Forecasts

This chapter describes the forecasts that were developed for the Ports of Los Angeles and Long Beach through 2020. These forecasts provide the basis for capacity analysis and improvement recommendations for the regional rail and roadway systems. Forecasts for both rail and roadway include the following components:

- **Unconstrained Forecasts**—Initial forecasts for the Ports of Los Angeles and Long Beach were based primarily upon market analysis, and were not constrained according to the physical capacity of port facilities.

- **Capacity Considerations**—For both the rail and roadway future analyses, the unconstrained forecasts provided the starting point for analysis, but capacity constraints were then considered. The roadway analysis and rail analysis employed separate methods to account for capacity in future conditions analysis. For rail analysis, additional rail yard capacity that would be required to meet the projected demand for intermodal cargo was identified.

### Unconstrained Forecasts

The Mercer Management Consulting Study (July 2001) evaluated the potential container throughput demand for the Ports of Los Angeles and Long Beach. This market-based forecast was prepared by Mercer Management Consulting to project long-term trends for various types of waterborne cargo, including containerized cargo. Mercer examined a wide range of market conditions, trade scenarios, demographics, trade barriers, and economic models for trading partners on a global basis. Although this forecast did examine general infrastructure and cargo handling capabilities of the Ports of Los Angeles and Long Beach, it is primarily a demand-based market forecast that projects the volume of cargo that could be handled at the ports provided the physical capacity to do so is unconstrained (Port of Los Angeles 2003c).

### Capacity Consideration for Truck Haul Forecasts

Roadway analysis presented in the Transportation Baseline Report utilized a second source of information, the Capacity Analysis Report (JWD 2002). This report evaluated the physical capacity of the Port’s existing and planned container terminal expansion for 2002, 2005, 2010, and 2025. Unlike the previous forecast approach, this report examined the physical throughput capacity of each terminal based on a detailed analysis of berthing and backland operational criteria. The capacity scenarios developed for roadway analysis are described in more detail in Chapter 7 of this report.

### Capacity Consideration for Rail Forecasts

Capacity analysis for intermodal rail began with unconstrained Mercer forecasts for 2005, 2010, 2015, and 2020. The Mercer cargo forecast estimates that intermodal cargo will comprise approximately 50 percent of the cargo moved through each of the Ports of Los Angeles and Long Beach. This is the total volume of cargo that is expected to be loaded onto trains at either on- or off-dock rail yards (Total Intermodal Demand). The forecast...
Total Intermodal Demand in 2020 will be loaded onto trains at either on- or off-dock ICTFs. Approximately 8.8 million TEUs are projected to be moved through the Port in 2020, which is about half of the rail volume forecast for the combined Ports of Los Angeles and Long Beach.

The analysis of on-dock intermodal rail yards is central to the Rail Capacity Analysis. The demand and capacity for each of the Port’s rail yards will determine the cargo volumes that could be handled through on-dock rail yards, which would avoid generation of truck traffic. The resulting on-dock rail volumes were used to determine the train traffic that would need to be accommodated by the Port rail network and the Alameda Corridor, as described in the following chapter.

**Capacity Analysis of Rail Yards**

The maximum practical capacity (MPC) of on-dock and near-dock rail yards was analyzed to understand the relative volumes of trains that could be generated by the container terminals. In addition to analyzing capacity constraints of existing and future facilities, the Rail Capacity Analysis identified expansion projects for the ICTF facilities that would allow future ICTF capacity to adequately meet future demand.

The capacity for each of the Port’s rail yards determines the cargo volumes that could be handled by rail. The resulting rail volumes were used to determine the train traffic that must be accommodated by the Port rail network and Alameda Corridor in order to meet future demand.

**ICTF Capacity**

Figure 4-1 shows the locations of existing and proposed ICTFs that were considered in future conditions analysis.
Figure 4-1. Existing and Proposed Future ICTFs at Port of Los Angeles
Following are the **working track** and **storage track** expansion projects proposed for the ICTFs in order to allow the capacity of the on-dock facilities to adequately meet projected future demand. Table 4-1 summarizes the projections between now and 2020. The proposed expansion projects are described in the paragraphs that follow the table.

**Table 4-1. Port Summary of Rail Yard Capacities**

<table>
<thead>
<tr>
<th>Facility</th>
<th>Track Type</th>
<th>DS-Units(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Existing</td>
</tr>
<tr>
<td>Pier 300</td>
<td>Working</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>104</td>
</tr>
<tr>
<td>Pier 400</td>
<td>Working</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>126</td>
</tr>
<tr>
<td>TICTF</td>
<td>Working</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>136</td>
</tr>
<tr>
<td>WBICTF(b)</td>
<td>Working</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>54</td>
</tr>
<tr>
<td>West Basin-East(b)</td>
<td>Working</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Total Working Track</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td>Total Storage Track</td>
<td>422</td>
</tr>
</tbody>
</table>

(a) DS-unit = a 5-unit articulated railcar ≈ 305 feet of track ≈ 20 TEUs.

(b) Expansion of storage track enabled through proposed expansion of the Transfer Yard.

**Proposed New Facilities**

- **Transfer Yard.** Adequate storage track is essential to the efficient operation of intermodal rail yards. The WBICTF rail facilities were found to be constrained by a lack of storage track under the existing conditions. Therefore, an effort was undertaken to develop adequate storage track facilities within the constraints of the WBICTF land uses and the needs of the marine terminal container yards. The conclusion of this effort was that an expansion of the existing transfer yard between Alameda Street and the DAS Terminal would provide effective rail operation with significant benefits to WBICTF and West Basin-East ICTF, as well as the other rail facilities in the vicinity.

- **West Basin-East.** This is a proposed facility in the conceptual stages of development. The opening date could occur by 2005. The proposed on-dock ICTF is conceptualized to have in its initial configuration 21 double-stacked car (DS-cars) of working track and 21 DS-cars of storage track. A planned expansion would add 63
DS-cars to the storage track (provided at POLA Transfer Yard) by 2015, and 21 DS-cars to the working track by 2020.

**Proposed ICTF Expansion**

- **West Basin-West (WBICTF).** Expansion planned by 2015 would add nine DS-cars to the working tracks and nine DS-cars to the storage track. An additional storage track expansion of 27 DS-cars would be implemented by dedicating track in the expanded POLA Transfer Yard to the intermodal operations. A planned 2020 expansion would add 27 DS-cars to the working track.

- **Terminal Island (TICTF).** Expansion planned by 2010 would add 42 DS-cars to the working track.

- **Pier 300.** Planned expansion by 2015 would add 15 DS-cars to the working track.

- **Pier 400.** Expansion planned by 2015 would add 24 DS-cars to the working track and 109 DS-cars to the storage track. Additional expansion by 2020 would add 20 DS-cars to the working tracks and 15 DS-cars to the storage track.

**Maximum Practical Capacity Modeling of ICTF Facilities**

The intermodal rail yard throughput capacities at each of the on-dock rail yards were calculated using the **MPC Model**. This throughput model is a tool that directly considers rail operations, including switching, loading and unloading trains, and departing trains. It considered the effects of storage tracks, arrival/departure tracks, and rail yard configuration (e.g., track lengths, stub-end yard, and end-to-end storage). The model incorporated the effects of these indirect impacts based on studies of operating times in typical railroad operations.

Summaries of the MPC Model results with the proposed expansions to the ICTFs and the POLA Transfer Yard are provided in Table 4-2 (only Port facilities) and in Table 4-3 (both Ports of Los Angeles and Long Beach facilities).

**Table 4-2. Port of Los Angeles Intermodal MPC Model Results**

<table>
<thead>
<tr>
<th>Intermodal Volume Category</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total intermodal demand</td>
<td>3,413,500</td>
<td>4,912,250</td>
<td>6,586,000</td>
<td>8,814,750</td>
</tr>
<tr>
<td>Maximum potential on-dock demand</td>
<td>2,224,675</td>
<td>3,683,461</td>
<td>5,617,071</td>
<td>7,525,623</td>
</tr>
<tr>
<td>Maximum practical on-dock capacity</td>
<td>2,592,178</td>
<td>3,324,872</td>
<td>5,072,250</td>
<td>6,801,311</td>
</tr>
<tr>
<td>Maximum practical on-dock throughput</td>
<td>2,180,171</td>
<td>3,109,878</td>
<td>4,747,830</td>
<td>6,715,137</td>
</tr>
<tr>
<td>Maximum practical on-dock throughput (percent of total Port of Los Angeles throughput)</td>
<td>32%</td>
<td>32%</td>
<td>36%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Source: Port of Los Angeles 2003b.
Table 4-3. Ports of Los Angeles and Long Beach Intermodal MPC Model Results

<table>
<thead>
<tr>
<th>Intermodal Volume Category</th>
<th>Annual Intermodal Volumes (TEUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
</tr>
<tr>
<td>Total intermodal demand</td>
<td>6,827,000</td>
</tr>
<tr>
<td>Maximum potential on-dock demand</td>
<td>4,381,919</td>
</tr>
<tr>
<td>Maximum practical on-dock capacity</td>
<td>4,152,463</td>
</tr>
<tr>
<td>Maximum practical on-dock throughput</td>
<td>3,659,673</td>
</tr>
<tr>
<td>Maximum practical on-dock throughput (% of total throughput, Ports of Los Angeles and Long Beach combined)</td>
<td>27%</td>
</tr>
</tbody>
</table>

Source: Port of Los Angeles 2004c.

The expanded Transfer Yard condition was used for subsequent intermodal volume forecasts and resulting train traffic forecasts. This condition was prudent to apply to the train traffic forecasts so that the increased rail traffic generated by the improved West Basin intermodal rail yards would be considered when evaluating the ability of the Port rail network to accommodate rail traffic.

Off-dock Rail Capacity Versus Demand

The existing (2002) capacity of off-dock facilities, which includes rail yards in downtown Los Angeles and further inland, is estimated at 5.8 million TEUs (Port of Los Angeles 2004c). This capacity is allocated between domestic cargo, transload cargo, and international cargo. The Ports of Los Angeles and Long Beach Market Study estimated future demand for off-dock rail yards under two growth scenarios. The “Low Transload Scenario” assumes that domestic and transload intermodal volumes grow 3 percent year. The “High Transload Scenario” assumes that domestic and transload intermodal volumes grow at approximately 6 percent per year, which would be a similar rate to international volumes. The analysis concluded that under the lower growth scenario, all off-dock capacity would be utilized by 2010. To accommodate the higher growth scenario, nearly twice the amount of off-dock capacity would be required. Thus, the study concludes that international intermodal cargo will need to be handled by on-dock and near-dock facilities, since the off-dock facilities will be fully utilized by transload and domestic cargo by 2010. (Port of Los Angeles 2004c.)

Near-dock Rail Demand

Current near-dock capacity is provided at the UP ICTF, and is approximately 1.5 million TEUs. Analysis indicates that additional rail yard capacity would be required by 2010 to meet the projected demand for intermodal cargo. Analysis takes into account the proposed expansion of on-dock rail yards. As described in the previous section, domestic and transload cargo operations are expected to fully utilize off-dock rail yards. Thus it is recommended that additional rail yard capacity be provided at near-dock intermodal facilities to meet the additional projected future demand. (Port of Los Angeles 2004c.)
It is recommended that near-dock rail yard capacity be developed in the Port vicinity south of I-405. This development could be in the form of a new rail yard or expansion of the existing ICTF rail yard. Near-dock facilities are preferred since they have the least impact on regional highway traffic. Near-dock development would need to begin immediately to address community concerns and land use changes necessary to have a project opened for the 2010 forecast condition.

On-dock ICTF improvements, as described in this chapter, were conceptually planned as part of the Rail Capacity Analysis (Port of Los Angeles 2003b). Off-dock and near-dock improvements were beyond the scope of the study and only the forecast requirements for these facilities were provided, as described above.

**Intermodal Volume Forecasts**

Table 4-4 summarizes the forecast for the combined Ports of Los Angeles and Long Beach. The table shows that additional near-dock rail yard capacity would be required for the ports by 2010 to meet the projected demand for intermodal cargo. If the on-dock capacity expansion were not implemented to the extent described in the Rail Capacity Analysis, near-dock capacity additional to the capacity need shown in Table 4-4 would be required to meet projected future intermodal cargo demand (Port of Los Angeles 2004c).

**Table 4-4. Ports of Los Angeles and Long Beach Intermodal Demand and Rail Yard Capacities**

<table>
<thead>
<tr>
<th></th>
<th>Annual Throughput (millions TEU)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Existing</td>
</tr>
<tr>
<td>Total intermodal demand</td>
<td>5.3</td>
</tr>
<tr>
<td>International cargo demand</td>
<td>4.0</td>
</tr>
<tr>
<td>On-dock rail yard capacity</td>
<td>1.6</td>
</tr>
<tr>
<td>Near-dock (UP ICTF) capacity</td>
<td>1.5</td>
</tr>
<tr>
<td>Off-dock capacity for international cargo</td>
<td>0.9</td>
</tr>
<tr>
<td>Demand for additional near-dock (ICTF south) capacity</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Port of Los Angeles 2004c.
Chapter 5. Railroad Mainline Simulation Model

This chapter summarizes the methodology and results of the simulation of the trains in the rail network under projected future conditions.

The existing and forecast conditions were simulated using a dynamic simulation model to determine the LOS provided to trains in the rail network system. The simulation model assisted in the identification of bottlenecks to train traffic so that these deficiencies can be corrected. The phased recommended improvements that are presented in Chapter 8 were developed based on the model results.

The major components of the simulation modeling process can be summarized as follows:

1. **Existing Port rail operations (2000)**. Existing conditions within the Port were simulated during the period selected as the benchmark, which was October 2000.

2. **Future Port operations (2005, 2010, 2015, and 2020)**. Simulation cases were run for each forecast year (2005, 2010, 2015, and 2020). The mainline simulation model scenarios (Scenarios 1 through 4) were performed with rail network extents covering the entire Ports of Los Angeles and Long Beach area and onto Alameda Corridor as far as Sepulveda Boulevard. The ACTA scenarios (ACTA 1 through 5) include the Alameda Corridor and the Port rail network. These cases tested the entire port-related rail network connecting the Ports of Los Angeles and Long Beach with the UP and BNSF mainlines, and additionally include the East Yard and Alameda Corridor through Hobart Yard.

**Model Overview**

The Rail Traffic Controller (RTC) Model is a sophisticated computer program designed to simulate both freight and passenger rail operations in either a planning environment or an online control center. While simulating the movement of many trains interacting with one another throughout a network, RTC uses standard operating rules to resolve meet and pass conflicts between trains. RTC accumulates train delay by individual trains as well as train type.

**Overview of Simulation Approach**

Figure 5-1 illustrates the overall approach employed for railroad simulation. The nine operational scenarios shown in the figure are four that have boundaries that include the immediate Port vicinity, and five with boundaries that include the Alameda Corridor.
Figure 5-1. Major Steps of Railroad Simulation
Description of Simulation Elements

Three major elements are defined for rail simulation: cargo forecasts, train forecasts, and the rail network. These are described as follows.

Cargo Forecasts
Intermodal cargo forecasts were developed for 2005, 2010, 2015, and 2020, as described in Chapter 4 and summarized in Table 4-4. These intermodal volumes provided the basis for estimating train traffic forecasts, as described in the following section.

Train Forecasts
Forecasted train volumes include non-intermodal and intermodal volumes. The train forecasts and simulations considered both the Ports of Los Angeles and Long Beach.

Light Engine and Yard Switcher Moves
Light engine moves occur through engine fueling/maintenance and crew change requirements. After 2010, rail capacity limitations are expected to constrain these moves.

Yard switcher moves occur through inter-terminal distribution of rail deliveries. The deliveries may be empty railcars or loads that were delivered to one rail yard with a mix of cars ultimately destined to other terminals. Other yard switcher moves can include PHL making rounds that are not included in the direct delivery accounted for in the intermodal and non-intermodal train traffic numbers.

Non-Intermodal Volumes
The Rail Capacity Analysis assumed that non-intermodal operations (e.g., automobiles, slab steel, bulk, and boxcars) would maintain at existing train volumes; the Mercer forecast does not project these volumes to increase.

Intermodal Volumes
The forecast of intermodal trains is based on the Maximum On-dock Share intermodal throughput presented in Chapter 4. The unit-trains are estimated to average 23, 24, 25, and 25 DS-cars in forecast years 2005, 2010, 2015, and 2020, respectively. Train volumes are counted as individual train movements, such that an inbound train counts as one movement and an outbound train counts as a second movement.

Summary of Train Volumes
The resulting rail volume forecasts are presented in Table 5-1. These volumes were used to generate trains in the mainline rail simulation model.
Table 5-1. Ports of Los Angeles and Long Beach Peak Day Train Forecast

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermodal</td>
<td>12</td>
<td>32</td>
<td>45</td>
<td>77</td>
<td>104</td>
</tr>
<tr>
<td>Non-intermodal</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Light engine/yard switcher</td>
<td>20</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Total Port network trains</td>
<td>58</td>
<td>82</td>
<td>97</td>
<td>129</td>
<td>156</td>
</tr>
<tr>
<td>Alameda Corridor trains</td>
<td>38</td>
<td>58</td>
<td>71</td>
<td>103</td>
<td>130</td>
</tr>
</tbody>
</table>

Model Network

The fundamental building blocks of the model networks are nodes and links. A prerequisite to obtaining useful results from RTC is the accurate description of track and signal layouts using nodes and links.

- Nodes represent locations—switch points, foul points, signals, station stops, speed change locations, and major grade change locations.

- Links represent track that connects node locations. Accurate lengths, speed limits, and ruling grades must be coded into the simulation network for the links.

The minimum level of detail needed to simulate a train in RTC includes specifying the train’s origin, destination, and intermediate station or crew change points (if any). Users must specify a departure time from a train’s origin node. Departure and arrival times after the origin node are optional. However, if intermediate stop locations (such as crew change points) do not have specified departure times, minimum dwell time must be specified for them.

Summary of Simulation Scenarios

Rail Level of Service Definition

Rail network system performance is presented as a Level of Service (LOS), which is report card-type grading (A through F) based on delay ratio (total accumulated train delay time/running time). An LOS of C or better is considered acceptable based on experience at similar rail terminal environments and on the length of delays that were experienced by individual trains during simulation runs with those delay ratios. An LOS worse than C and delay ratio greater than 27 percent is considered unacceptable. The relationship between delay ratio and LOS for the Port area rail operations is summarized in Table 5-2.
Table 5-2. Level of Service Criteria for Port Area Rail Operations

<table>
<thead>
<tr>
<th>Delay Ratio</th>
<th>LOS</th>
<th>Delay/Traffic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 12%</td>
<td>A</td>
<td>Minimal/Light</td>
</tr>
<tr>
<td>12% to 20%</td>
<td>B</td>
<td>Minor/Light-Moderate</td>
</tr>
<tr>
<td>20% to 27%</td>
<td>C</td>
<td>Moderate/Moderate</td>
</tr>
<tr>
<td>27% to 32%</td>
<td>D</td>
<td>Significant/Heavy</td>
</tr>
<tr>
<td>32% to 37%</td>
<td>E</td>
<td>Severe/Unstable</td>
</tr>
<tr>
<td>37% +</td>
<td>F</td>
<td>Gridlock/Failed</td>
</tr>
</tbody>
</table>

The results of the ACTA simulation runs were difficult to directly compare with the Port runs due to differences in inputs for:

- **Train Volumes.** Intermodal train volumes were very nearly the same with minor adjustments, based on updated plans by the Port. However, the volumes of non-intermodal and light engine traffic were significantly increased in the ACTA runs. The ICTF in Carson was also included as a contributor of traffic to the Alameda Corridor.

- **Rail Network Extents.** The ACTA model covers the entire Alameda Corridor in addition to the Port rail network. Trains traveling through the corridor do not exhibit significant delays; therefore, the same delays incurred in the Port are averaged out over a greater running time. The delay ratios calculated for the ACTA model runs could be 5 to 10 percent lower than the Port Rail Capacity Analysis runs even though they are showing the same LOS in the Port. Thus, an adjusted definition of LOS was required to be used with the ACTA simulation runs since they modeled a larger system.

The modified LOS definition for the Alameda Corridor/Port rail network model is shown in Table 5-3.

Table 5-3. Level of Service Criteria for Port/Alameda Corridor Rail Operations

<table>
<thead>
<tr>
<th>Delay Ratio</th>
<th>LOS</th>
<th>Delay/Traffic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 7%</td>
<td>A</td>
<td>Minimal/Light</td>
</tr>
<tr>
<td>7% to 14%</td>
<td>B</td>
<td>Minor/Light-Moderate</td>
</tr>
<tr>
<td>14% to 20%</td>
<td>C</td>
<td>Moderate/Moderate</td>
</tr>
<tr>
<td>20% to 25%</td>
<td>D</td>
<td>Significant/Heavy</td>
</tr>
<tr>
<td>25% to 30%</td>
<td>E</td>
<td>Severe/Unstable</td>
</tr>
<tr>
<td>30% +</td>
<td>F</td>
<td>Gridlock/Failed</td>
</tr>
</tbody>
</table>
Conclusions from Simulation

Existing Conditions
Existing rail analysis indicated that the rail network can readily accommodate the rail traffic operating over it most of the time without unreasonable train delays. However, there are periods of relatively dense traffic when delays can be significant and the physical plant may have already been inadequate. When the Badger Bridge over the Cerritos Channel was opened for marine traffic in simulation, as many as four train movements were delayed. Cross-traffic at Long Beach Junction at that time was anticipated to diminish as the Alameda Corridor route opened and removed trains from the former UP San Pedro Branch via Wilmington Wye.

Centralized Traffic Control (CTC) is a method of operation used by railroads to control and direct trains over a specified corridor. The electronic signal system that is used to provide this type of control is defined as a Traffic Control System in Part 236 of the Code of Federal Regulations 49.

Simulation of existing conditions indicated that it may be advantageous to equip frequently-used turnouts (track switches) that are and will remain outside of CTC/Traffic Control System limits with power switch machines and enable train crews to operate them by remote local control either from a locomotive cab or from a convenient ground location. This could improve railroad-operating efficiency within the Port at locations where installation of CTC/Traffic Control System is not justified or desirable.

Future Conditions
The simulation results provided insight regarding:

- Rail performance by Port area,
- Terminal Island access, and
- Light engine moves.

The conclusions drawn from analyses for these categories are discussed in the following sections.

Rail Performance by Port Area
The network performance results of the Mainline Rail Simulation are based on the operations of the overall port rail system. This overall network result is the clearest indicator of system performance; however, the results of individual corridors within the Ports of Los Angeles and Long Beach were analyzed as well.

Port of Los Angeles–West
The proposed enhancements to West Basin access (e.g., the second “runner” and modification to the UP Transfer Yard leads) are just enough to absorb both the growth in traffic and the impact of an added West Basin-East ICTF without unacceptable congestion. At 2005 demand (nine movements per day), Port-West suffers 2 hours of delay per day, or
21.5 percent of unimpeded running time. In 2010, with 11 movements per day, these numbers rise to 2-¼ hours of delay per day, which is only 19 percent of running time. By 2015, the Port-West delay ratio is down to just more than 12 percent, or 1.5 freight train hours per operating day. An LOS value is difficult to assign to a localized subsystem, but the performance measure for Port-West up through 2015 indicates acceptable system performance with approximately LOS C.

By 2020, when West Basin-East is modeled at its full capacity, the delay ratio rises to 30.3 percent, and the actual hours rise to 4.6 hours per day with 17 to 18 movements per day. These numbers indicate a struggling system (approximate LOS D), and the need for all recommended improvements.

Train operations with West Basin-East trains working toward WBICTF (ACTA-5) are not significantly worse; however, by 2015 performance is marginal. Train operations are expected to be unacceptable after 2015 without the POLA Transfer Yard expansion.

**Port of Long Beach–Proper**

The results show that, except for Terminal Island, the Port of Long Beach mainlines (Long Beach Subdivision) function very well all the way through planning horizon year 2020. Various improvement projects are recommended to achieve this performance, as listed in Chapter 6.

**Terminal Island**

The greatest concern identified by the rail simulation is the function of the mainline onto Terminal Island. Both the Ports of Los Angeles and Long Beach have major terminal developments on Terminal Island and it is critical to provide access for the high level of traffic generated by these terminals. The issues facing Terminal Island rail traffic include:

- Addressing the impacts of lifting Badger Bridge for vessel traffic, and
- Adding an additional mainline track.

Table 5-4 presents the system performance indicated by the simulation modeling of the different Badger Bridge lift scenarios. Badger Bridge is currently raised for vessels transiting the Cerritos Channel, causing delays to trains trying to cross the bridge. The Badger Bridge delays have a significant impact on rail system performance. The scenarios presented in Table 5-4 focus on the effects of Badger Bridge and mainline tracks onto Terminal Island, but all other Port rail improvement projects are included in these runs as well. The results of four scenarios are presented in Table 5-4. A bold line delineates the acceptable level of rail service for each year (scenarios below the bold line and shaded have acceptable rail service).
Table 5-4. Network Performance Results for Ports of Los Angeles and Long Beach Rail System

<table>
<thead>
<tr>
<th>Scenario (Badger Bridge Up-time)</th>
<th>LOS (Delay Ratio)</th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bridge Lifts after 47-foot Commodore Heim Bridge Replacement</td>
<td></td>
<td>B</td>
<td>D (30%)</td>
<td>D (32%)</td>
<td>F (&gt;45%)</td>
<td>F (&gt;60%)</td>
</tr>
<tr>
<td>2. Bridge Lifts for reduced vessels (160 minutes/day)</td>
<td></td>
<td>B</td>
<td>C (24%)</td>
<td>C (26%)</td>
<td>F (40%)</td>
<td>F (55%)</td>
</tr>
<tr>
<td>3. Bridge Lifts for Emergency Only (0 minutes/day)</td>
<td></td>
<td>A</td>
<td>B (15%)</td>
<td>B (17%)</td>
<td>E (32%)</td>
<td>F (47%)</td>
</tr>
<tr>
<td>4. Scenario 4 plus Third Mainline from CP Mole to W. Thenard (0 mins/day)</td>
<td></td>
<td>A</td>
<td>A (12%)</td>
<td>A (13%)</td>
<td>B (20%)</td>
<td>C (27%)</td>
</tr>
<tr>
<td>Conclusion – Badger Bridge requirement</td>
<td>OK with current bridge lifts</td>
<td>Bridge lifts &lt; 160 minutes</td>
<td>Bridge lifts &lt; 160 minutes</td>
<td>0 lifts; add third track</td>
<td>0 lifts; add third track</td>
<td></td>
</tr>
</tbody>
</table>

Recommendations for Badger Bridge, based on the analysis results summarized in Table 5-4, are as follows:

- **By 2005**—Badger Bridge is currently raised at least 280 minutes daily for vessels transiting the Cerritos Channel. These intermittent closures to train traffic will cause significant impacts to rail operations by 2005. Bridge lifts need to be reduced to 160 minutes per day for acceptable rail service.

- **Between 2005 and 2010**—The Badger Bridge operation will need to be reduced by 2005 in order to provide acceptable rail service as defined by delay ratio. The simulation results show an unacceptable LOS of D with the current number of Badger Bridge lifts. Bridge lifts of 160 minutes per day will provide LOS for rail that is marginally acceptable by 2010.

- **After 2010**—Badger Bridge will need to be kept in the down position except in emergency situations after 2010 in order to provide acceptable rail service.

- **By 2015**—The volume of train traffic accessing Terminal Island will require an additional mainline track from Control Point (CP) West Thenard to CP Mole, with added crossovers at both ends. Adding a track will be challenging since this stretch of rail runs through the highly constrained “Texaco Slot,” through the Henry Ford Grade Separation (which currently only has width for two existing tracks), across Badger Bridge (which currently only has width for two existing tracks), and through the crowded CP Mole area with two built-out grade separations and numerous yard lead limitations. To achieve acceptable rail service, the Port will also need to extend CTC to the last turnout onto yard leads beyond CP Mole to Pier T, Pier 400, Pier 300, and TICTF.
Light Engine Moves

At current light engine ratios (as tested by ACTA-1 and -2), the locomotive moves clearly tax the available capacity of the network and contribute significantly to system delay hours. The 153 light engines in the 2015 scenario lose 43 hours over the 4 days (10.75 hours per day, 17 minutes per move). The 196 light engines in the 2020 scenario lose 96 hours over the 4 days (24 hours per day, almost 30 minutes per move). Thus, it’s clear that both the cost and reliability of the power moves become a serious issue between 2010 and 2015; the power component of the system performance is unacceptable after 2015, and by 2020 it’s unacceptable even if it is assumed that only 44 percent (instead of 50 percent) of trains require an associated light engine movement.

Relocating the engine service facilities closer to the major intermodal terminals (as tested in ACTA-3 and -4) helps alleviate congestion, but the improvement is modest and not sufficient to eliminate the long-term need for a third main track between CP Sepulveda and CP Mole.

Two factors combine to limit the positive effect on overall congestion that results simply from relocating the engine facilities:

1. While the light engines cause congestion by traveling farther to be serviced, it’s still principally the long intermodal trains interfering with each other that are causing network congestion. This "train"-related congestion is helped, but not eliminated, by relocating the facilities. The light engines themselves are often victims of congestion, rather than its cause, and in this respect the relocation of facilities helps significantly (see below).

2. The engine facility at Brighton Beach (CP Mole) has to be located along Ocean Boulevard, between CP LAXT on the west and the leads to Piers T/W/400 on the east. This is the only area that allows connections from the service tracks to Pier 300 on the west and Terminal Island on the east. Even so, engines using this facility must cross over the leads within the interlocking plant at CP Mole. Significantly less time is required for such movements than the cases in which engines travel to the Dolores or Manuel yards. However, congestion still exists for these movements.

Where the relocated facility benefits really show up is in reduced locomotive hours. This is a different benefit measure than just looking at congestion because it includes not only the time lost to congestion-related delay, but the savings in pure running time that comes from shorter trips. The reduction in locomotive time required to move power to and from unit and double-stack trains ranges from 22.6 percent under 2015 and 2020 double-track conditions to 19 percent under 2015 triple-track conditions, and ranges from about 10 to 15 hours per operating day. This is a significant benefit, especially considering that most of the locomotive consists modeled contain four relatively new and expensive units. (Each locomotive consist has approximately 17,600 horsepower, so each hour of delay or travel time is 17,600 horsepower hours.)

In summary, the high volume of light engine moves that would result from maintaining current operations will cause rail service problems in the 2010–2020 timeframe. Constructing engine service facilities within the Port will provide benefits, but there will
continue to be pressure on the rail capacity due to light engine movements. The operating concept of using shuttle engines that are maintained with fresh crews at an inland location should be pursued with the railroads. The shuttle engines would be established to allow dropping a consist and then immediately picking up a prepared train for departure, allowing the engines to be turned at a rail yard without generating light engine moves.

Shuttle engines combined with the concept of classifying cars into terminal-specific westbound trains will provide significant benefits to the LOS on the Port rail network.
Chapter 6. Summary of Rail Recommendations

A Port rail improvement program has been developed to address deficiencies in the Port rail network and its supporting systems. The recommended improvements are based on the results of mainline simulation modeling. Deficiencies are defined based on train delays and a minimum acceptable LOS. The locations of the proposed infrastructure improvements are shown in Figure 6-1.

Track Improvements

2000–2005 Mainline Rail Capacity Improvements

Rail capacity improvement projects that are recommended for the Port, to be completed by 2005, some of which have been completed, include:

- Renovate Port Transfer Rail Yard as required for PHL,
- Crossover Connecting East Leg of TI Wye, and
- WBICTF Access Track Improvements.

The corresponding letter for each of these improvements is shown in Figure 6-1.

Additional improvements that have been recommended for the Port of Long Beach for this time period (not shown in the figure), include:

- Long Beach Lead/TILT Connection,
- Pier T East Rail Access Improvements,
- Extend Pier F and Metro Leads, and
- Remove Pier G (ITS) Gate on Mainline Track.

2005–2010 Mainline Rail Capacity Improvements

Rail capacity improvement projects that are recommended for the Port, to be completed by 2010, include:

- Modify Policy to Lift Badger Bridge for Emergency Vessels Only and
- Second Lead to Pier 400.

The corresponding letter for each of these improvements is shown in Figure 6-1.

Additional improvements that have been recommended for the Port of Long Beach for this time period (not shown in the figure), include:

- Second Mainline Track to Pier J,
- Pier E Lead Improvements, and
- Pier G (ITS) Lead Improvements.

**2010–2015 Mainline Rail Capacity Improvements**
Rail capacity improvement projects that are recommended for the Port, to be completed by 2015, include:

- Expand POLA Transfer Yard to Support West Basin operations.

**2015–2020 Mainline Rail Capacity Improvements**
Rail capacity improvement projects that are recommended for the Port, to be completed by 2020, include:

- Third Mainline from CP Anaheim to CP West Thenard, with Added Crossovers and
- Third Mainline onto Terminal Island, including Badger Bridge to CP Mole.

Two alternatives were developed to potentially address the additional track from Badger Bridge through CP Mole (shown as H1 and H2 in Figure 6-1).

Additional improvements that have been recommended for the Port of Long Beach for this time period (not shown in the figure), include:

- Pier B Rail Yard Expansion, Phase 2.

**Centralized Traffic Control System Improvements**
CTC is one of the train operating systems presently in use by PHL for the Ports of Los Angeles and Long Beach Railroad Network. CTC is described in the American Railway Engineering and Maintenance-of-Way Association (AREMA) Signal Manual as a system of railroad operation by which the movement of trains over routes and through blocks on a designated section of track is directed by signals controlled from a designated point without requiring the use of train orders and without the superiority of trains. CTC systems are also used where traffic patterns mandate the efficient management of train movement through a specified territory or ingress and egress through critical facilities.

The proposed additions to the existing system include extension of CTC in the years between 2010 and 2015. The proposed extensions that apply to the Port are shown in Figure 6-2, and described as follows:

- Extend CTC to Last Mainline Turnout into Yard Leads in the Port and
- Extend CTC to Last Mainline Turnout into Yard Leads on Terminal Island.

Additional improvements that have been recommended for the Port of Long Beach for this time period (not shown in Figure 6-2), include:

- Extend CTC to Last Mainline Turnout into Yard Leads in Port of Long Beach.
**Recommended Port Rail Capacity Improvements**

- **2000–2005**
  - Renovation of Port Transfer Yard as Required for PHL
  - Crossover Connecting East Leg for T1 Wye
  - WBICTF Access Track Improvements and South Wilmington Grade Separation

- **2005–2010**
  - Restriction of Badger Bridge Lift Operations for Emergency Vessals Only
  - Second Lead to Pier 400
  - Potential ICTF South

- **2010–2015**
  - Expansion of Port Transfer Yard to Support West Basin Operations

- **2015–2020**
  - Third Mainline between CP Thenard and CP Anaheim, with Added Crossovers
  - Third Mainline onto Terminal Island, Including Badger Bridge to CP Mole – Alternative 1
  - Third Mainline onto Terminal Island, Including Badger Bridge to CP Mole – Alternative 2

**Legend**

Data Source: Port of Los Angeles 2003b
Figure 6-2
Recommended Extension of Port Centralized Traffic Control, 2010-2015

CITIES
Los Angeles
Long Beach
Carson

RAIL FACILITIES
Existing Rail
Alameda Corridor
On-Dock ICTF (Port of LA)
Near-Dock ICTF
Non-ICTF Rail Yards

LIMITS OF CENTRALIZED TRAFFIC CONTROL (CTC)
Existing/Under Design
Proposed
RECOMMENDED CTC EXPANSION 2010–2015
Extend CTC to Last Mainline Turnout into Yard Leads in the Port
Extend CTC to Last Mainline Turnout into Yard Leads on Terminal Island

Legend
Source: Port of Los Angeles 2003b
Other Operating Improvements
The Rail Capacity Analysis identified operating improvements that were necessary to achieve an acceptable level of train service. These improvements are required in addition to the track and CTC system improvements. The operating improvements look for ways to limit any unnecessary train traffic since the Port rail network will be operating near its capacity by 2015.

- Turn locomotives within the terminal. Intermodal trains should make dual moves to individual terminals to reduce light engine traffic. This means that a locomotive delivers a unit train to a specific terminal and then hooks up to an eastbound train that is built and has brakes charged and ready for departure. Achieving this operation would require several features:
  - Adequate departure tracks;
  - Ability to address fueling, maintenance, and crew change needs (accomplished with regional shuttle engines or with in-Port fueling facilities); and
  - Locomotives that can pull in either direction to avoid wye turns (engines at both ends of locomotive set must be fully functional with such thing as instrumentation, windshield wipers, and toilets).

- Avoid inter-terminal train traffic. Intermodal trains that arrive in the Port are not currently sorted for single-terminal delivery. PHL or the Class I operator must break and sort trains somewhere inside the Port for delivery to several individual terminals. This practice would not fit within the capacity of the Port rail network by 2015. It is recommended that westbound trains be classified by terminal to create terminal-specific trains somewhere outside the Port/Los Angeles region (i.e., beyond where rail congestion and rail yard land prices are high). One concept is to provide the classification at the same location where regional shuttle trains are exchanged, which could occur at an inland empire site.
Chapter 7.  Relationship to Freight Truck Haulage

This chapter summarizes the analysis of the regional roadway system completed by the Port, as well as the roadway improvements needed to accommodate projected future truck freight haulage. This chapter also discusses the potential impacts that elimination of truck trips in favor of rail may have on regional air quality and traffic congestion.

Port Baseline Transportation Study

The Port Baseline Transportation Study (Port of Los Angeles 2003c) was conducted by Meyer Mohaddas Associates to address existing and future roadway deficiencies expected to result from projected increases in cargo throughput. The study includes analysis of existing and future vehicular traffic demand, transportation system deficiencies, and necessary improvements. Both transportation planning and traffic engineering analyses were conducted for the study, which included analyses within and immediately adjacent to the Port. Regional transportation system analyses were also performed on the freeway system.

Baseline Study Approach

The Port Baseline Transportation Study project included the following tasks:

- Assessment of existing roadway traffic conditions;
- Forecasts of container terminal truck trips by type (e.g., bobtail, chassis, container loads, and empties), container terminal auto trips, and non-container terminal auto and truck trips;
- Analysis of the transportation system operating conditions for key intersections in and around the Port for existing and future (2010 and 2025) years;
- Development of a comprehensive travel demand modeling tool for use in assessment of future travel patterns and projection of future deficiencies;
- Identification of future transportation system deficiencies;
- Recommended physical transportation system improvements and Intelligent Transportation System improvements in the Port; and
- Identification of Port truck traffic and deficiencies on the key regional access routes to the Port.

Existing Intersection Conditions Analysis

The existing intersection conditions analysis for signalized locations was conducted using the Critical Movement Analysis methodology. Unsignalized intersections were analyzed using methodologies contained in the Highway Capacity Manual (Transportation Research Board 2000). Basic input data for the existing intersection conditions analysis include number of lanes by type, signal or stop sign control, and peak hour traffic volumes (auto and truck).
LOS is a qualitative indication of an intersection’s operating conditions as represented by traffic congestion, delay, and volume to capacity (V/C) ratio. For signalized intersections, operating conditions are measured from LOS A (excellent conditions with little or no delay conditions) to LOS F (extreme congestion and intersection failure), with LOS D (V/C of 0.90) typically considered to be the threshold of acceptability. The relationship between V/C ratio and LOS for signalized intersections is summarized in Table 7-1.

**Table 7-1. Level of Service Criteria for Signalized Intersections**

<table>
<thead>
<tr>
<th>V/C Ratio</th>
<th>LOS</th>
<th>Traffic Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.60</td>
<td>A</td>
<td>Little or no delay/congestion</td>
</tr>
<tr>
<td>0.61 to 0.70</td>
<td>B</td>
<td>Slight congestion/delay</td>
</tr>
<tr>
<td>0.71 to 0.80</td>
<td>C</td>
<td>Moderate delay/congestion</td>
</tr>
<tr>
<td>0.81 to 0.90</td>
<td>D</td>
<td>Significant delay/congestion</td>
</tr>
<tr>
<td>0.91 to 1.00</td>
<td>E</td>
<td>Extreme congestion/delay</td>
</tr>
<tr>
<td>1.01 +</td>
<td>F</td>
<td>Intersection failure/gridlock</td>
</tr>
</tbody>
</table>

Stop-controlled intersections were analyzed using methodologies contained in the Highway Capacity Manual, in which LOS is based on average vehicular delay. The relationship between delay and LOS for stop-controlled intersections (two-way and multi-way stops) is summarized in Table 7-2.

**Table 7-2. Level of Service Criteria for Unsignalized Intersections**

<table>
<thead>
<tr>
<th>LOS</th>
<th>Average Delay (sec/vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≤10</td>
</tr>
<tr>
<td>B</td>
<td>&gt;10 and ≤15</td>
</tr>
<tr>
<td>C</td>
<td>&gt;15 and ≤25</td>
</tr>
<tr>
<td>D</td>
<td>&gt;25 and ≤35</td>
</tr>
<tr>
<td>E</td>
<td>&gt;35 and ≤50</td>
</tr>
<tr>
<td>F</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>

LOS analysis results indicate that 14 intersections currently operate at LOS E or F (considered deficient), while the rest operate at LOS D or better. The majority of the LOS E/F locations are along Gaffey Street, Western Avenue, Pacific Coast Highway, Figueroa Street, or at freeway on/off ramps, including Harbor Boulevard, Swinford Street, I-110, and SR-47.

**Capacity Consideration for Truck Haul Forecasts**

Roadway analysis presented in this report utilized a source of information secondary to the Mercer forecast described in Chapter 4, the Capacity Analysis Report (JWD 2002). This report evaluated the physical capacity of the Port’s existing and planned container
terminal expansion for 2002, 2005, 2010, and 2025. Unlike the Mercer forecast approach, this report examined the physical throughput capacity of each terminal based on a detailed analysis of berthing and backland operational criteria. Changes to operational labor practices, increased hours of operation, ship sizes, container stacking heights, and other factors were built into a capacity analysis model that calculated the future years throughput capacity for the berths and backland areas independently for each terminal. The report also determined whether the backland or berth was the limiting factor for each terminal and reported an overall terminal capacity for each of the analysis years.

The Baseline Transportation Study applied the following 2010 and 2025 scenarios for purposes of analysis:

- **2010 Port Capacity/Mercer Constrained Scenario.** Assumes 19.7 million TEUs throughput in both ports, with Port TEUs based on terminal capacity and Port of Long Beach taking the remainder. Also assumes some changes to terminal operating parameters.

- **2010 Ports of Los Angeles and Long Beach Mercer Unconstrained Scenario.** Assumes 26.9 million TEUs throughput, with each port taking 50 percent of the throughput.

- **2025 Modified 24-hour Operations Scenario 1.** Assumes 47.2 million TEUs throughput in both ports combined, split equally among the two ports. Assumes some changes to terminal operating parameters, including expanded gate hours during weekdays, expanded use of weekend operations, and more on-dock rail. However, this scenario is more conservative because it does not assume full use of expanded gate hours. The assumed shift split is 60 percent of throughput during the day shift and 20 percent in each of the night and hoot shifts.

- **2025 Modified 24-hour Operations Scenario 2.** Assumes major changes to terminal operating parameters, including maximum use of on-dock rail, maximum use of extended gate hours, and full application of all other foreseeable operations changes to take port truck traffic away from the peak commute hours operation. This is the best case scenario, and it actually may result in reduced port trucks during peak hours at some locations as compared to 2010, when such drastic changes to terminal operations are not assumed. The assumed shifts split is 40 percent during the day, 40 percent during the night, and 20 percent during the hoot shift.

**Recommended Roadway Improvements**

Concept-level transportation system improvement recommendations were developed as part of the Transportation Baseline Study to mitigate the projected future deficiencies in the Port area (Port of Los Angeles 2003c). The recommendations include operations improvements, infrastructure improvements, and Intelligent Transportation Systems measures. Currently, the Port is initiating development of a Portwide Master Transportation Plan. The plan will include a review of previous studies that have been completed and more detailed evaluation of roadway improvements that have been...
identified and recommended in the existing preliminary studies (Leue pers. comm). Improvements that have been identified at the conceptual level include the following.

**Operations Improvements**

The results of the traffic studies have indicated the need for operational changes and improvements in both ports. Operational improvements are required even if a full range of physical improvements is implemented. The improvement program must include both changes in how the Port terminals operate and increased capacity to the roadway system in order to maintain adequate LOS. The purpose of operational changes will include:

- Reduce truck traffic through maximum use of on-dock rail movements.
- Increase efficiency of trucking operations, avoid peak hours to the extent feasible, and avoid sensitive routes. Shift truck trips from peak hours to off-peak hours (second shift and night shift) and also to weekends.
- Improve communications between truckers and Port terminal operators.
- Increase efficiency of longshore worker movements to and from the Port.

This effort must be an ongoing cooperative effort of the two ports, the two city councils, terminal operators, drayage companies, cargo companies, unions, and others. This issue involves two-way flow of goods; therefore, simply opening terminal gates at off hours will not result in substantial changes. It must involve the entire logistics chain, including inland warehouses that receive goods. The types of operations improvements to pursue will include, but not be limited to, the following:

- Maximize use of on-dock rail to shift containers to rail instead of drayage movement to off-dock rail yards.
- Implement better scheduling and management practices to avoid truck trips and truck queuing during peak commute traffic periods.
- Improve communications via on-road signage, changeable message signs, and appointments for gate entrances.

**Infrastructure Improvements**

The following sections describe the concept-level improvements that are required for the transportation system based on the results of the transportation demand modeling results. The 2025 deficiency locations and recommended mitigation measures are based on the modified operations worst case scenario, with 60 percent of the terminal traffic remaining in the day shift. The other scenarios, including “24/7” with more traffic on the second and night shifts, would result in fewer deficiencies. Therefore, the mitigation analysis is based on the assumption that only some of the operational improvements can be made by 2025. This is a conservative analysis. The potential roadway improvement types and locations are illustrated in Figure 7-1.
Figure 7-1
Potential Improvements to the Roadway System
Intelligent Transportation Systems Measures

The Ports of Los Angeles and Long Beach have been seeking to implement and expand Intelligent Transportation Systems applications in and around the ports area for several years. An earlier version of the Ports Automated Traffic Management and Information System (ATMIS) was submitted to Caltrans in 1998 for inclusion in the federally designated Southern California Priority Corridor–Los Angeles/Ventura Region Intelligent Transportation Systems Deployment Plan. The Ports ATMIS has been identified in the Caltrans Statewide Goods Movement Intelligent Transportation Systems Action Plan, and is contained in Caltrans’ Global Gateways Development Program. The objectives of the program are to improve major freight gateways and improve access at seaports, intermodal transfer facilities, and goods movement distribution centers.

The Ports ATMIS, which will improve traffic flow for both ports as well as the adjacent regional transportation system, consists of the following components:

- Port Transportation Facility Security System/Emergency Response and Evacuation System,
- Advanced Transportation Management System,
- Advanced Traveler Information System, and
- Communication System.

The following potential benefits of a Port ATMIS could be achieved:

- Improved security and safety,
- Improved multimodal mobility,
- Improved incident response time,
- Enhanced goods movement,
- Improved reliability and predictability of the transportation system, and
- Reduced travel delay and emissions.

An ATMIS project for the ports involves regional, subregional, and local agencies; planning authorities; emergency response agencies; private information providers; and different modes of transportation, such as trucking companies and railroads. The Ports of Los Angeles and Long Beach, and the ACTA would be the primary partners for this project.

Impact of Freight Rail on Air Quality

Introduction

As discussed in Chapter 2, approximately 50 percent of the import cargo at the Ports of Los Angeles and Long Beach currently is carried by rail at some point during shipment:
- 16 percent is loaded on rail at the docks;
- 9 percent is trucked to rail loading sites within 8 miles of the docks;
- 14 percent is trucked to rail loading sites located 8 to 22 miles from the docks; and
- 11 percent is trucked to warehouses and then trucked to rail facilities.

The other 50 percent of the cargo is trucked on roadways to its destination:

- 32 percent is loaded on dock and trucked directly to regional markets (i.e., markets within 550 miles of the Port);
- 18 percent is trucked to warehouses or distribution centers and then trucked to regional markets; and
- Less than 1 percent is loaded on dock and trucked to markets outside the region.

This chapter summarizes the regulations and policies that apply to air emissions from trains and trucks, summarizes a draft 2001 baseline emissions inventory for the Port, compares the air quality effects of train and truck transport based on a study of the South Coast Air Basin, and examines the potential for air quality benefits from increasing the proportion of import cargo moved from the Port by rail.

**Air Quality Regulations and Policies**

It has long been recognized that emissions from trains and trucks can significantly affect air quality locally and regionally. For example, the South Coast Air Quality Management District (SCAQMD) estimates that on-road heavy-duty diesel trucks generate nearly 20 percent of the regional summertime emission of oxides of nitrogen (NOx) (SCAQMD 2003). Trains generate proportionately fewer emissions (roughly 4 percent of the region’s NOx) but can have proportionately more localized impacts because their emissions are generated along a relatively small number of rail corridors.

To control and reduce emissions from both sources, the U.S. Environmental Protection Agency (EPA) has promulgated and the California Air Resources Board (CARB) has implemented regulations that set emission standards for pollutants from vehicles. The standards are for the major constituents of tailpipe emissions, including: NOx, volatile organic compounds (VOC), carbon monoxide (CO), hydrocarbons (HC), sulfur dioxide (SOx), and particulate matter less than 10 microns in diameter (PM10). EPA and CARB also have adopted non-regulatory policies that encourage voluntary emission reductions.

**Emission Standards for Locomotives**

In 1998, EPA promulgated final emission standards (40 CFR Part 92, Control of Emissions from Locomotives and Locomotive Engines) for NOx, HC, CO, and PM10. The standards limit emissions from newly manufactured engines and from refurbished or remanufactured engines. The specific emission limits and the time schedule for complying with the limits were based on three tiers. Tier 0 standards (the least stringent) apply to locomotives built between 1973 and 2001 and require compliance with the
emission limits when the engines are remanufactured. Tier 1 standards apply to locomotives built between 2002 and 2004 and require immediate compliance upon remanufacture. Tier 2 standards (the most stringent) will apply to engines built in 2005 and will apply immediately. Compared to other EPA emission standards, those for locomotives are less stringent. For example, the most stringent NOx standard for locomotives will be 5.5 g/hp-hr in 2005; the 2007 NOx standard for heavy-duty diesel trucks will be 0.20 g/hp-hr. EPA has indicated that it may propose Tier 3 standards for locomotives, perhaps in 2004. However, the timing and details of such standards is uncertain at this time.

**Emission Standards for On-road Heavy-duty Diesel Trucks**

In 2000, EPA enacted the most recent, and most stringent, emission limits for on-road heavy-duty diesel trucks. The newest limits augment the steadily more stringent emission standards that EPA enacted between 1990 and 2004. The new standards will be phased in for new trucks manufactured between 2007 and 2010. The new emission standards for NOx and HC are reduced to 0.20 g/hp-hr and 0.14 g/hp-hr, respectively. EPA’s regulation also requires manufacturers of diesel fuel to greatly reduce the sulfur content of the fuel because existing sulfur content in diesel fuel would preclude the use of efficient NOx and HC control equipment that will be required to comply with the stringent new emission limits.

**Voluntary Emission Reduction Policies**

SCAQMD has no authority to enact emission standards for locomotives or diesel trucks that are more stringent than the new EPA standards. However, the Port has worked with the air regulatory agencies to enact the following voluntary emission reduction policies to reduce cargo shipping emissions to below what would be accomplished solely by complying with regulatory limits.

- **Carl Moyer Diesel Engine Program.** CARB and the regional air quality districts have implemented voluntary programs to encourage diesel truck operators to accelerate the replacement of older, high-emission equipment with newer, low-emission equipment. These voluntary programs will not change the future emission standards or the long-term regional emissions. However, they are expected to significantly increase the rate of future emission reductions from on-road diesel trucks and thereby reduce the near-future regional emission rates, compared to the rates of improvement that EPA has forecasted nationwide.

- **South Coast Locomotive Fleet Average Emissions Program.** In July 1998, the railroads and CARB entered into a Memorandum of Mutual Understanding and Agreements to accelerate the schedule by which locomotives would comply with EPA emission standards. The railroads have committed that all locomotives serving the Port will comply with EPA’s Tier 2 locomotive emission standards by 2010.

- **Gateway Cities Air Quality Improvement Program.** Under this program, commercial truck owners who trade in their older diesel trucks for newer models with cleaner-burning engines are partially reimbursed for the cost of purchasing newer diesel trucks. This is part of a pilot program that is exploring a variety of ways to reduce diesel emissions in southeast Los Angeles County and throughout the South Coast.
Air Basin. The program compensates owners of 1983 or older trucks when they buy a 1994 or newer used diesel truck that is more reliable, cleaner, and fuel efficient. An average grant is $20,000 to $25,000, and varies depending on the age of the truck and number of miles driven in the past 2 years. As an example, a typical used diesel truck costs about $35,000. Under the Clean Air Program, an owner could be reimbursed up to $25,000.

**Draft 2001 Baseline Emission Inventory**

In June 2004, the Port completed a draft Portwide baseline emission inventory using 2001 data (2001 BEI). The 2001 BEI provides emission estimates for all significant sources operating in the Port, with a focus on diesel particulate matter. Five source categories are considered: ocean-going vessels, harbor craft (e.g., tugboats, ferries, commercial fishing vessels, and dredges), off-road cargo handling equipment, railroad locomotives, and on-road heavy-duty diesel trucks. The inventory does not include stationary sources, as these are included in stationary source permitting programs administered by SCAQMD.

In the 2001 BEI, railroad operations are typically described in terms of line haul and switching. Because of different types of information provided by the railroad companies, emissions were estimated using two basic methods. For most of the switching activities, emission estimates were based on the percentage of time spent in the different throttle notch settings. This information was obtained from onboard observations of switch engine operations during normal shift duties and from onboard dataloggers. For line-haul activities (and a limited amount of switching activity), fuel usage was used as a surrogate measure of the level of activity of the locomotives. EPA has published emissions information for switch and line-haul locomotive operations in both throttle notch and fuel consumption modes, and this information was used to crosscheck between the estimating methods to demonstrate the degree of agreement.

Emissions from heavy-duty diesel trucks were calculated for on-road (off-terminal) travel and on-terminal operations. Data for on-road activity were developed by Meyer, Mohaddes Associates, Inc. (MMA), using trip generation and travel demand models in previous Port traffic studies. A Port-specific model for year distribution was developed by CARB and SCAQMD. On-terminal emissions were estimated using information from terminal operators regarding traffic patterns, including time spent waiting at the entry gate, time and distance on terminal while dropping off and/or picking up cargo, and time spent waiting at exit gates. Off- and on-terminal emissions were estimated by multiplying the appropriate emission factor derived from EMFAC 2002 by the time and distance parameters established for the terminals.

Results of the 2001 BEI are summarized in Tables 7-3 and 7-4 in terms of tons per year and tons per day, respectively. These estimates include emissions related to: 1) Port operations occurring within the Port boundary/district (in-port) and 2) the transportation of Port-related cargo within the South Coast Air Basin (regional). In summary, the ocean-going vessels account for the largest percentage of emission for every pollutant except CO. Railroad locomotives account for 13 percent of the NOx, 9 percent of the TOG, 6 percent of the CO, 6 percent of the PM10, and less than 2 percent of the SOx baseline emissions. On-road heavy-duty diesel trucks account for 23 percent of the NOx, 17
percent of the TOG, 21 percent of the CO, 9 percent of the PM10, and less than 1 percent of the SOx baseline emissions.

**Comparison of Rail and Truck Emissions**

In March 2004, the Association of American Railroads released a report by L.S. Caretto entitled, A Comparison of Rail and Truck Emissions per Ton-Mile of Freight. In the report, Caretto estimates and compares air emissions from truck and rail sources in the South Coast Air Basin and San Joaquin Valley Air Basin for the period from 2000 to 2012. The estimates in the report take into account Tier 0, 1, and 2 standards for locomotives and Tier 1, 2, and 3 standards for heavy-duty diesel trucks. For the South Coast Air Basin, Caretto also takes into account the Memorandum of Understanding between CARB and railroads regarding average fleet emissions. Under the Memorandum of Understanding, the railroads have agreed that average emission levels for their fleets will not exceed the Tier 2 NOx limit for calendar year 2010 and beyond.
### Table 7-3. 2001 Portwide Emissions by Source Category, Tons Per Year

<table>
<thead>
<tr>
<th>Source Category</th>
<th>NOx</th>
<th>TOG</th>
<th>CO</th>
<th>PM 10</th>
<th>PM25</th>
<th>SOx</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In-Port</td>
<td>Regional</td>
<td>In-Port</td>
<td>Regional</td>
<td>In-Port</td>
<td>Regional</td>
</tr>
<tr>
<td>Ocean-going Vessels</td>
<td>1,967.6</td>
<td>6,922.7</td>
<td>55.6</td>
<td>233.6</td>
<td>159.8</td>
<td>553.9</td>
</tr>
<tr>
<td>Harbor Craft</td>
<td>1,968.0</td>
<td>3,530.7</td>
<td>172.2</td>
<td>376.0</td>
<td>701.5</td>
<td>1,622.8</td>
</tr>
<tr>
<td>Cargo Handling Equipment</td>
<td>1,862.6</td>
<td>1,862.6</td>
<td>204.5</td>
<td>204.5</td>
<td>725.5</td>
<td>725.5</td>
</tr>
<tr>
<td>Railroad Locomotives</td>
<td>445.9</td>
<td>2,465.8</td>
<td>17.0</td>
<td>99.7</td>
<td>49.6</td>
<td>249.4</td>
</tr>
<tr>
<td>On-road Heavy Duty Trucks</td>
<td>872.5</td>
<td>4,463.5</td>
<td>53.1</td>
<td>185.5</td>
<td>246.0</td>
<td>815.3</td>
</tr>
<tr>
<td>Total</td>
<td>7,116.6</td>
<td>19,245.3</td>
<td>502.4</td>
<td>1,099.2</td>
<td>1,882.4</td>
<td>3,966.9</td>
</tr>
</tbody>
</table>

### Table 7-4. 2001 Portwide Emissions by Source Category, Tons Per Day

<table>
<thead>
<tr>
<th>Source Category</th>
<th>NOx</th>
<th>TOG</th>
<th>CO</th>
<th>PM 10</th>
<th>PM25</th>
<th>SOx</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In-Port</td>
<td>Regional</td>
<td>In-Port</td>
<td>Regional</td>
<td>In-Port</td>
<td>Regional</td>
</tr>
<tr>
<td>Ocean-going Vessels</td>
<td>5.4</td>
<td>19.0</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Harbor Craft</td>
<td>5.4</td>
<td>9.7</td>
<td>0.5</td>
<td>1.0</td>
<td>1.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Cargo Handling Equipment</td>
<td>3.1</td>
<td>5.1</td>
<td>0.6</td>
<td>0.6</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Railroad Locomotives</td>
<td>1.2</td>
<td>6.8</td>
<td>0.0</td>
<td>0.3</td>
<td>0.1</td>
<td>0.7</td>
</tr>
<tr>
<td>On-road Heavy Duty Trucks</td>
<td>2.4</td>
<td>12.2</td>
<td>0.1</td>
<td>0.5</td>
<td>0.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td>19.5</td>
<td>52.7</td>
<td>1.4</td>
<td>3.0</td>
<td>5.2</td>
<td>10.9</td>
</tr>
</tbody>
</table>
In Caretto’s report, emissions per ton-mile of cargo were computed separately for trucks and rail using the different sets of data available for these two modes. Emissions from trucks were based on the CARB mobile source emission model, EMFAC 2002. Rail emissions were based on projections for rail operations in the regulatory support document prepared by EPA. Truck emission data were converted to grams per ton-mile based on average cargo load as determined by Caltrans surveys. Rail emission data were converted to gram per ton-mile based on data from Association of American Railroads on revenue ton-miles per gallon of fuel for rail operation.

Results of the comparison of emissions for the period in the South Coast Air Basin are summarized in Table 7-5 and Figures 7-2 through 7-5. Key points are as follows:

1. Emissions per ton-mile from rail cargo are less than those from truck cargo.

2. Although trends are different for different pollutants, there is a general decrease in emissions for both trucks and rail over the period as standards are tightened.

3. Because the standards for trucks during the period are more stringent than those for locomotives, truck emissions show a faster decrease than rail emissions between 2000 and 2012. The difference between truck and rail emissions narrows over the period, largely due to the Tier 3 NOx and PM standards for trucks.

Caretto also notes the possibility that new technology capable of reducing emissions from both truck and rail may be available around 2010. For example, railroads and manufacturers are looking at the possibility of hybrid locomotives that could reduce fuel consumption and hence certain emissions. Railroads also are looking at using truck engines (which are subject to stricter emission standards) for road switch locomotives.

<table>
<thead>
<tr>
<th>Source</th>
<th>Year</th>
<th>NOx</th>
<th>PM10</th>
<th>VOC</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>2000</td>
<td>41.2</td>
<td>1.0</td>
<td>1.8</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>17.9</td>
<td>0.9</td>
<td>1.7</td>
<td>7.0</td>
</tr>
<tr>
<td>Trucks</td>
<td>2000</td>
<td>226.7</td>
<td>4.8</td>
<td>7.8</td>
<td>37.7</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>160.2</td>
<td>3.5</td>
<td>6.6</td>
<td>30.2</td>
</tr>
</tbody>
</table>

Source: Caretto 2004.

### Potential for Air Quality Benefits from Increased Use of Rail Cargo

As described in Chapter 2, rail traffic to and from the Port travels along the consolidated rail line in the Alameda Corridor. Improvements to the corridor consolidated three separated at-grade rail lines into a single, grade-separated line running from the Ports of Los Angeles and Long Beach to a rail yard in downtown Los Angeles. The fully grade-separated line allows trains to move through the area more efficiently and at a greater speed. The grade separation also eliminates traffic delays that used to occur at grade crossings when trains passed.
Due to the greater efficiency of a consolidated line, the Port estimates that NOx emissions from locomotives in the corridor have decreased by more than 182 tons per year (based on 2002 usage of the corridor). The elimination of crossing delays also has reduced NOx emissions from motor vehicles in the corridor by approximately 28 tons per year.

A key issue now being considered by the Port is whether increased use of rail cargo would have additional air quality benefits locally and/or regionally. Increasing the proportion of cargo shipped by rail to and from the ports has the potential to reduce the total truck trips associated with the shipments and therefore the total emissions from those trips. However, emission reductions and other air quality benefits will depend on several factors, including:

- The amount and proportion of the increased use of on-dock rail versus rail that requires trucking to a rail site and/or an intermediary storage/distribution site;
- The ability of existing rail and transfer sites to handle increased usage and potentially to increase capacity;
- The ability of (and incentives for) cargo carriers and receivers to change current shipment patterns;
- The time required to implement changes;
- The narrowing of differences between train and truck emissions as Tier 3 truck standards take effect, especially if Tier 3 standards for locomotives are not enacted in the near future; and
- The success or failure of the Port and region in meeting emission standards set for other pollutant sources, especially given the contribution from sources not within the control of the Port or region.

**Impact of Freight Rail on Roadway Congestion**

Traffic volumes on roadways and highways in Southern California are expected to continue to increase steadily over the next 20 years. The Port Baseline Transportation Study provides a detailed assessment of both existing and projected future conditions on the regional roadways that are most impacted by Port operations, and provides recommendations for roadway improvements that should allow future roadways to operate at adequate LOS.

Any cargo that is hauled by train instead of truck will help alleviate traffic congestion, and will benefit both regional freight and passenger mobility. Shifting cargo shipments from truck to rail would reduce the number of required haul trucks operating throughout the region, resulting in the following advantages to users of the regional transportation system and the agencies that maintain it:

- Elimination of truck trips from the regional roadway system reduces demand on the existing infrastructure, which would result in some improvement of traffic congestion.
Estimated Annual Average Tons Per Day of Rail Emissions, South Coast Air Basin, 2000 and 2010

Source: Caretto 2004

Estimated Annual Average Tons Per Day of Truck Emissions, South Coast Air Basin, 2000 and 2010

Source: Caretto 2004
Figure 7-4
Estimated NOX Emissions Per Ton Mile of Rail and Truck Freight, South Coast Basin, 2000-2012

Figure 7-5
Estimated PM10 Emissions Per Ton Mile of Rail and Truck Freight, South Coast Basin, 2000-2012
- Reduction of traffic congestion increases travel speed and reliability for both passenger users and the remaining cargo users of the regional roadways.

- Elimination of truck trips from the regional roadway system can have significant impact on lengthening the functional design life of roadway pavement.

- As rail operates within exclusive right-of-way, cargo that is shipped via rail will travel with speed and reliability that is not hindered by local roadway conditions.

Chapter 2 discusses the approximate traffic volumes of trains versus trucks that are required to carry a shipload of container cargo, indicates that the shift of cargo to one train can eliminate as many as 700 truck trips from the regional roadways, and that a shipload of cargo can fill up five trains, which in turn could eliminate up to 3,500 truck trips. These volumes are even more substantial when considered in the context of passenger car equivalents (PCEs).

PCEs of trucks and other heavy vehicles are considered for both LOS analysis and roadway pavement design and analysis. These PCE factors account for the larger roadway space used by trucks, their heavier weights, and their slower acceleration rates, which result in a greater use of roadway capacity. As their name implies, PCEs provide an estimate of the approximate numbers of passenger car capacity that one truck utilizes. As trucks vary in size and weight, so do their exact PCEs; the PCE of a typical truck is most generally used for LOS analysis. Table 7-6 summarizes PCEs for trucks that are utilized for freeway LOS analysis under Highway Capacity Manual procedures. The table shows PCEs as a function of the roadway grades that characterize the surrounding terrain since steep grades tend to magnify the performance inferiority of heavy vehicles.

Table 7-6. Passenger Car Equivalents for LOS Effects of Trucks on Freeways

<table>
<thead>
<tr>
<th>Type of Terrain</th>
<th>Passenger Car Equivalent for Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>1.7</td>
</tr>
<tr>
<td>Rolling</td>
<td>4.0</td>
</tr>
<tr>
<td>Mountainous</td>
<td>8.0</td>
</tr>
</tbody>
</table>

*Source: Transportation Research Board 2000.*

Table 7-6 shows that for LOS analysis, the PCE of trucks is considered to range between 1.7 and 8.0, depending on the type of surrounding terrain. For the Port Baseline Transportation Study, PCE factors for intersection operations were assumed using previously applied factors used in Port studies of 2.0 for container trucks, 2.0 for chassis, and 1.1 for bobtails. For the Vincent Thomas Bridge analysis, higher PCE factors are applied to account for the grade of the bridge structure.

For pavement design and analysis, the Equivalent Single Axle Load of projected truck traffic is considered. Similar in concept to the PCE, the Equivalent Single Axle Load is calculated based on specific truck volumes and mix of truck types (defined by number of
axles and typical loads) expected to use a roadway. Typical Equivalent Single Axle Load values can range between 1.5 and 6.0. 

Utilizing a conservative equivalency factor of 2.0 (the estimated volume of 3,500 truck trips that a shipload of cargo shifted to rail would eliminate) can be considered comparable to elimination of approximately 7,000 passenger cars from the roadway system. Truck trips generated by the Port would be expected to be more concentrated on the roadways that are located near Port facilities, and become increasingly dispersed as distances from the Port increase. Dispersion of truck traffic on the roadway system is very difficult to estimate without the development of a regional transportation model (similar to the model developed for analysis presented in the Port Baseline Transportation Study). However, the general effect of change in traffic volumes on LOS can be assessed by considering typical traffic conditions under increasing traffic volumes.

Table 7-7 summarizes the general operational performance characteristics for different LOS conditions of a freeway segment, assuming ideal conditions and a free-flow speed of 70 mph. A freeway under ideal conditions has full 12-foot lane widths, full shoulders that are at least 6 feet wide, and no heavy vehicles.

Table 7-7 presents typical thresholds for a roadway built to freeway standards. For other roadways with lower functional classification (i.e., highways with no access control, and urban arterials and collectors) the traffic volume thresholds for each LOS condition are lower.

**Table 7-7. LOS for Basic Freeway Sections**

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Flow Condition</th>
<th>V/C Limit</th>
<th>Volume (veh. lane/hour)</th>
<th>Average Speed (miles/hour)</th>
<th>Density (veh./mile/lane)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Free</td>
<td>0.35</td>
<td>700</td>
<td>≥ 60</td>
<td>≤ 12</td>
</tr>
<tr>
<td>B</td>
<td>Stable</td>
<td>0.54</td>
<td>1,100</td>
<td>≥ 57</td>
<td>≤ 20</td>
</tr>
<tr>
<td>C</td>
<td>Stable</td>
<td>0.77</td>
<td>1,550</td>
<td>≥ 54</td>
<td>≤ 30</td>
</tr>
<tr>
<td>D</td>
<td>High Density</td>
<td>0.93</td>
<td>1,850</td>
<td>≥ 46</td>
<td>≤ 40</td>
</tr>
<tr>
<td>E</td>
<td>Near Capacity</td>
<td>1.00</td>
<td>2,000</td>
<td>≥ 30</td>
<td>≤ 67</td>
</tr>
<tr>
<td>F</td>
<td>Breakdown</td>
<td>Unstable</td>
<td>&lt; 30</td>
<td>&gt; 67</td>
<td></td>
</tr>
</tbody>
</table>

Source: May 1990.

Even if the generation of 7,000 equivalent passenger car trips occurred over several hours and were distributed over numerous roadways, the thresholds shown in Table 7-7 indicate that absence or presence of this level of additional traffic on the roadway system could have considerable effect on the roadway LOS, particularly in the roadways located near the Port, where the cargo truck traffic would be more concentrated. Any increase in the use of rail for cargo transport will have a favorable impact on roadway LOS by eliminating some truck traffic from the regional roadway system.
Chapter 8. Conclusion

Cargo movement into and out of the Port is a very complex process, and the amount of cargo that can be moved through the Port depends upon many factors. Market analysis projects that cargo demand at the Port will increase substantially over the next 15 to 20 years. However, the amount of cargo throughput that can be feasibly served by the Port is restricted not only by logistical and operational constraints, but also by the capacity of the transportation system. Technical studies have been completed that identify physical and operational improvements that will need to be made to the regional rail system, roadway system, and cargo storage and transfer facilities in order for the Port to meet expected future cargo demand.

Forecasts project that 50 percent of future Port cargo will be carried by rail. To meet this future intermodal demand, expansion of the rail yards and cargo transfer facilities, and the development of new near-dock capacity is recommended. In addition, track improvements and operational improvements are recommended so that the railroad system can accommodate the volumes of trains that will be needed to transport projected intermodal cargo.

Maximizing the use of on-dock and near-dock ICTFs is beneficial because it allows for more cargo to be carried by rail, which translates to less cargo being carried by trucks. Any truck traffic that can be eliminated from the regional roadway system will have a beneficial impact on roadway congestion. Increased use of rail can also have a beneficial impact on air quality, but in order for long-term air quality benefits to be fully realized, the implementation of the stricter Tier 3 emissions standards may be needed.

The technical reports that are described in this synopsis primarily consist of preliminary and planning-level analyses. Together they provide a comprehensive examination of the existing capabilities and future needs of the transportation system that serves the Port. For the rail system evaluation, the next steps that are recommended are completion of operator interviews and sensitivity analyses to verify the assumptions that underlie the improvement recommendations, and to conduct more detailed siting and financial analyses of the potential near-dock ICTF and rail yard expansions (Port of Los Angeles 2004c). However, a sufficient level of analysis has been completed to date to indicate that the Port does have the potential capacity to meet the intermodal demand that has been identified between now and 2020.
References

Printed References


Port of Los Angeles. 2003a. Port of Los Angeles Facilities Guide. 425 South Palos Verdes Street, P.O. Box 151. San Pedro, CA 90733-0151.


Personal Communications


## Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda Corridor</td>
<td>A 20-mile rail expressway that runs from the Ports of Los Angeles and Long Beach to downtown Los Angeles, primarily along and adjacent to Alameda Street.</td>
</tr>
<tr>
<td>Backlands</td>
<td>Container storage areas.</td>
</tr>
<tr>
<td>Badger Bridge</td>
<td>Rail Bridge that connects Terminal Island to the mainland</td>
</tr>
<tr>
<td>BNSF Watson Yard</td>
<td>BNSF rail yard in Wilmington near PCH (between Sanford and Eubank avenues).</td>
</tr>
<tr>
<td>Bobtail</td>
<td>Truck cab without a trailer.</td>
</tr>
<tr>
<td>Centralized Traffic Control (CTC)</td>
<td>A system of railroad operation by which the movement of trains over routes and through blocks on a designated section of track is directed by signals controlled from a designated point without requiring the use of train orders and without the superiority of trains.</td>
</tr>
<tr>
<td>Chassis</td>
<td>Another word for an open trailer frame to which containers can be attached.</td>
</tr>
<tr>
<td>CP Mole</td>
<td>Control Point on Terminal Island for the Port and Port of Long Beach Terminal Island piers (200–400, S, T, W).</td>
</tr>
<tr>
<td>CP West Thenard</td>
<td>Control Point at Thenard Tower (0.75 mile north of PCH and Alameda).</td>
</tr>
<tr>
<td>Dolores Yard</td>
<td>UP transfer yard located adjacent to the Alameda Corridor north of I-405, west of Alameda Street.</td>
</tr>
<tr>
<td>Double-stacked Car (DS-car)</td>
<td>Articulated railcar (typically 5-unit) that carries containers stacked two high. Equivalent to 310 feet of track.</td>
</tr>
<tr>
<td>East LA</td>
<td>UP’s main yard in the City of Commerce (I-710 at I-5).</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Hoot Shift</td>
<td>Work shift that occurs between the night shift and the day shift.</td>
</tr>
<tr>
<td>Intermodal container transfer facility (ICTF)</td>
<td>A rail yard used to transfer containers between ships and trains or trucks and trains.</td>
</tr>
<tr>
<td>Intermodal Transport</td>
<td>Containerized cargo moved via two different modes of transportation (e.g., ship, truck, rail, and barge).</td>
</tr>
<tr>
<td>Light engine moves</td>
<td>Train engine moves due to fueling, maintenance, or crew change requirements.</td>
</tr>
<tr>
<td>Manuel Yard</td>
<td>UP rail yard south of UP ICTF.</td>
</tr>
<tr>
<td>Mode</td>
<td>Type of transportation (i.e., rail, ship, and truck).</td>
</tr>
<tr>
<td>MPC Model</td>
<td>Maximum Practical Capacity Model developed by DMJM+Harris. The MPC Model is a tool that directly considers rail operations, including switching, loading and unloading trains, and departing trains.</td>
</tr>
<tr>
<td>National Market</td>
<td>Area more than 550 miles from the Port, usually served by rail.</td>
</tr>
<tr>
<td>Near-dock ICTF</td>
<td>An ICTF that is in nearby, but requires travel on public streets to/from berths.</td>
</tr>
<tr>
<td>Non-intermodal</td>
<td>This includes automobiles, slab steel, bulk, and any cargo not transported in containers.</td>
</tr>
<tr>
<td>Off-dock ICTF</td>
<td>An ICTF that is removed from the port, such as the downtown/East Los Angeles yards.</td>
</tr>
<tr>
<td>On-dock ICTF</td>
<td>An ICTF that is adjacent or very near berths.</td>
</tr>
<tr>
<td>Parking Spot</td>
<td>Staging area for trucks.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Pier 400 ICTF</td>
<td>This is the newest on-dock ICTF at the Port. The yard is currently operated by APM Terminals (Maersk-Sealand), and receives rail service from BNSF.</td>
</tr>
<tr>
<td>Pier A Yard</td>
<td>Main rail yard for PHL.</td>
</tr>
<tr>
<td>Regional Market</td>
<td>Area 550 miles from the Port, usually served by truck transit.</td>
</tr>
<tr>
<td>Stevedoring</td>
<td>The process of loading/unloading ships.</td>
</tr>
<tr>
<td>Storage track</td>
<td>Track on which trains are stored.</td>
</tr>
<tr>
<td>Throughput</td>
<td>The amount of cargo transferred in and out of a port.</td>
</tr>
<tr>
<td>Total Intermodal Demand</td>
<td>Total volume of cargo that is expected to be loaded onto trains at either on- or off-dock rail yards.</td>
</tr>
<tr>
<td>Tractor</td>
<td>Truck cab without a trailer/chassis.</td>
</tr>
<tr>
<td>Train Move</td>
<td>Any move made by an empty or full train into or out of a terminal or rail yard.</td>
</tr>
<tr>
<td>Twenty-foot equivalent unit (TEU)</td>
<td>The standard measure of container volume. Originally, all containers were 20 feet in length, now most are 40 or 50 feet.</td>
</tr>
<tr>
<td>Unit Train</td>
<td>Coupled railcars varying in length between 115 and 140 railcars.</td>
</tr>
<tr>
<td>UP ICTF</td>
<td>UP near-doc ICTF (0.5 mile east of Alameda and Sepulveda).</td>
</tr>
<tr>
<td>West Basin-East</td>
<td>Proposed new on-dock ICTF to serve TraPac. Same as West Basin-East ICTF.</td>
</tr>
<tr>
<td>Working track</td>
<td>Track that is actively used in rail service to run trains.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Yard switcher moves</td>
<td>Railcar movement within/between the Port/Port of Long Beach to provide &quot;empties,&quot; make deliveries, or build trains.</td>
</tr>
</tbody>
</table>