A Century of Engineering Challenges at the San Pedro Bay Ports of Long Beach and Los Angeles — America's No. 1 Gateway for International Trade

The Southern California San Pedro Bay ports of Long Beach and Los Angeles form the nation's premier gateway for international trade, and, throughout the history of the adjacent ports, each has provided fertile ground for engineering accomplishments. Many unique challenges, from subsidence to containerization to sustainability, have been ably met by a legion of innovative engineers.

Los Angeles is the busiest container seaport in North America. Long Beach has also held the No. 1 spot and is currently second busiest. Combined, the San Pedro Bay Port Complex is the eighth busiest container gateway in the world.

And, like the American Society of Civil Engineers (ASCE), both have recently celebrated their Centennial — the Port of Los Angeles in 2007 and the Port of Long Beach in 2011. For the first time, ASCE included seaports in its *2013 Report Card on America's Infrastructure*, and, according to the American Association of Port Authorities (AAPA), "The inclusion of seaports in this infrastructure analysis is recognition of the importance of ports, and the connections to them, and to our nation's transportation system."

The first vessels to call at the ports carried lumber from Northern California to supply the housing boom in Southern California as the population rapidly grew. Bulk lumber shipments are still important, but these days, containerized cargo dominates the harbor. More than 40 percent of all inbound containerized waterborne cargo enters the U.S. through the San Pedro Bay Ports, and between them the ports move more than 14 million TEUs (twenty-foot equivalent container units) annually, valued at \$355 billion. The ports also handle more than a million cruise passengers, half a million automobiles and more than half of California's crude oil imports. The port complex is a driving force in the economic well-being of Southern California and the United States. The ports help to support hundreds of thousands of Southern California jobs and millions of jobs nationwide.

Both ports are self-supporting departments of the cities they serve — Los Angeles and Long Beach — and do not use tax revenues to operate. The governing body for each port is a five-member Board of Harbor Commissioners, whose members are appointed by the respective mayors and confirmed by the respective city councils. The ports derive their revenues from leases and cargo fees. In a nutshell, they are landlord ports, leasing property to tenants who are the companies that operate the terminals and move cargo off and on ships. Port tenants have been, and are today, active partners in terminal infrastructure improvements. As leases are renewed, tenants are signing green leases committing to top environmental standards. Shipping lines that call at the ports work continually to upgrade their ships and equipment to the latest shipping and environmental standards.

The Port of Los Angeles is roughly 20 miles south of downtown Los Angeles. It encompasses 7,500 acres of land and water (4,300 land acres and 3,200 water acres) along 43 miles of waterfront. It has 25 cargo terminals with 270 berths, including passenger, container, breakbulk, dry and liquid bulk, automobile and warehouse facilities. The Port

also is home to the World Cruise Center (also requiring new infrastructure to welcome bigger and bigger passenger vessels through the years), Ports O'Call Village, 16 marinas with 3,796 recreational boat slips, the Vincent Thomas Bridge connecting the Port to Terminal Island and other recreational, cultural, dining and shopping facilities. Two historic U.S. Naval ships, the SS Lane Victory and the USS Iowa, are open for public tours.



The World Cruise Center in the Port of Los Angeles serves about 500,000 cruise passengers each year.

The Port of Long Beach is located at the mouth of the Los Angeles River, adjacent to downtown Long Beach. The Port includes 3,200 acres of land and 35 miles of waterfront, 20 cargo terminals and 80 berths. The Port of Long Beach also handles all kinds of cargo, including containerized, breakbulk, dry and liquid bulk and automobiles. A \$1.1 billion replacement project is underway for the aging Gerald Desmond Bridge that connects Terminal Island to downtown Long Beach and the Long Beach I-710 Freeway. While a variety of hospitality facilities are neighbors to the Port, including the iconic Queen Mary, which arrived in Long Beach in 1967 to be permanently docked as a hotel and tourist attraction, the Long Beach Cruise Terminal (housed in the geodesic dome that was built to display Howard Hughes Flying Boat, the Spruce Goose), the Aquarium of the Pacific and Shoreline Village for entertainment, shopping and dining, they now operate under other city departments. Industry customers have named the Port of Long Beach "Best Seaport in North America" 16 of the past 18 years in the annual Cargonews Asia magazine poll.

A number of industries have thrived at the ports, but international trade has grown consistently through the decades. Shipyards were vital port tenants during much of the ports' history, especially during World War II when wartime shipbuilding employed nearly 100,000 workers in various shipyards. But over the years, demand dwindled and most operations moved to other ports and other countries. San Pedro Bay also grew to become home to the nation's largest commercial fishing fleet with 15 canneries operating on Terminal Island. However, all are now closed. There was also a Ford Motor Co. assembly plant and Procter & Gamble operated a manufacturing facility. In 1919 the Navy established Long Beach as the home port for the Pacific Fleet. Then in 1940, the Navy paid \$1 to acquire 100 acres of land on Terminal Island from the City of Long Beach to establish a new naval station and shipyard. It opened in 1943 and was a major employer for the region for many years. As part of the U.S. military's base consolidation program in the 1990s, the Long Beach Naval Facility was shuttered and the land returned to the Port of Long Beach for development.

From its earliest days, the Port and its tenants all needed electricity. Southern California Edison powered much of that need with steam-generating units on what was then called Rattlesnake Island, later to be renamed Terminal Island. The first units were completed in 1913, and a new one was built in 1924 in only 303 days.

The first European to discover San Pedro Bay was Spanish explorer Juan Rodriguez Cabrillo in 1542, but for centuries the bay had been a central part of the livelihood of the Native American peoples who populated the area. Cabrillo heralded the progression of conquerors — Spanish, Mexican, then American — who forever changed the culture and the landscape to welcome trade and build modern cities. But the tidal flats and marshes of San Pedro Bay would remain pristine for more than 200 years, while Europe focused on colonizing America's East Coast. Sailing up the coast, Cabrillo would have seen a ragged border of land, tall sand dunes and wide wetlands flanked by towering bluffs. The bay itself was dotted with rocky islands and white surf.

Mud Flats to Deep, Safe Water

The two ports are side by side. The Port of Los Angeles is located on the San Pedro/Wilmington waterfront, both formerly independent cities with port operations, annexed by Los Angeles in 1909. The first merchandise cargo landed at the Wilmington wharf in 1858. The Port of Long Beach is to the east. Long Beach got its start with the purchase of 800 acres of sloughs and salt marshes at the mouth of the Los Angeles River, an area that later became the Port's Inner Harbor. Terminal Island, formerly just mud flats, is now a major activity center for both ports and is the center of the ports complex. Both Long Beach and San Pedro were incorporated as cities 125 years ago in 1888.

The first challenge was to dredge channels to the sea through hundreds of acres of mud flats to access new docks, where passengers and trade goods could be offloaded, and turning basins so the bigger vessels could come and go with ease. The Cerritos Channel was completed, connecting the two ports, and in 1909 the sand bar between the ocean and the San Gabriel River washed out at high tide, making the ocean entrance to the newly dredged Inner Harbor a reality.

In the early development of the ports, there were continual shifts in control of the harbors, with sale and resale of the land that in the beginning was mostly the property of the railroads that had been delivering passengers and some cargo to the area as early as the mid-1800s. Both were popular areas for vacationers and recreational beachgoers.

In 1897, following a bitter challenge, the federal government selected San Pedro over Santa Monica to develop a deep-water port and construct a breakwater to make that possible. Many thousands of cargo, military and passenger ships would come to rely on the nearly 9-mile-long, 60-foot-deep wall of rock to keep the mighty ocean waters calm while they docked (much to the dismay of modern-day surfers who want the waves back and some environmentalists who believe returning the wave action would cleanse pollution from the bay). Openings in the breakwall were left for ships to go between the open ocean and what would become the Outer Harbor for each port. The Los Angeles opening in the breakwater is Angel's Gate, and the Long Beach opening is Queen's Gate.



Angel's Gate Lighthouse sits sentry at Angel's Gate, looking eastward as a ship prepares to exit Los Angeles Harbor.

Completed in three sections, work began on this herculean project in 1899 when engineers brought the first load of quarried rock from Catalina Island to begin construction of the Federal Breakwater.

The first section at San Pedro was completed in 1911, and with the removal of the great sand bar that blocked the harbor entrance and the creation of a channel deep enough for seagoing ships, San Pedro — later annexed to Los Angeles, became a competitive port.

Then the Federal River and Harbor Act authorized construction of a 3.5-mile breakwater extension, and construction began in 1932 with completion in 1937. Construction began on the 2.5-mile eastern leg of the breakwater in 1941. Work was halted in 1943 due to World War II, but resumed in 1946 with final completion in 1949.

Deep water access for bigger, oceangoing ships became a priority for both ports.

Nature lent a helping hand in the early days in San Pedro. The breakwater shunted water away from Rattlesnake Island (now Terminal Island) and forced it around the western curve of Dead Man's Island, and the seesaw of four tides per day created a scouring effect and gradually deepened the Main Channel. (Having done its work, in 1928, a contract was awarded by the War Department to remove historic Dead Man's Island from the harbor as it was considered an "impediment to progress.")

In 1983, the Port of Los Angeles completed dredging to a depth of 45 feet, the first major deepening of the Port in 55 years, and has just recently completed a \$370 million Channel Deepening Project, that will ensure 53-foot-deep access to the Port's container berths.

The discovery of oil in Signal Hill in 1921 and in Long Beach Harbor in 1936 not only created a development boom for both the city and the Port of Long Beach, but also had an interesting impact on deep water.

Development fueled by oil revenues took a dramatic turn in 1945 when it was discovered that some of the land that Port was built on was sinking. So much oil was pumped from the ground so rapidly, that the land slowly began sinking, or subsiding, under its own weight. Entire structures were lowered below sea level.

Expansion of the Port and the valuable oil field was put on hold while engineers searched for a solution. Long Beach gained notoriety as "America's Sinking City." The Southern California Edison plant at the epicenter of the subsidence never shut down for repairs, even though it dropped more than 25 feet. Other sites didn't fare as well. Streets and rail lines had to be rebuilt, buildings had to be shored up, and a system of dikes was put in place to control flooding at high tide. An engineer hired by the Harbor Department recommended a strategy that had been used successfully



in Mexico City. Under a project called "The Big Squirt," beginning in 1960, seawater was injected deep into the soil strata to stop the subsidence. It also allowed for vital oil production to be continued. More than 10 billion barrels of water was injected into the oil fields and, ironically, the water re-pressurization forced millions of barrels of oil out of the ground that might not otherwise have been recovered.

From the 1930s to the 1950s, oil was pumped so rapidly from beneath the Long Beach Harbor that the ground sank. Engineers by the 1960 were able to stop the sinking and stability the ground and harbor bottom.

For the Port of Long Beach, subsidence had a silver lining – it dropped the ocean floor, creating some of the nation's deepest channels. Just recently, the Port, in partnership with the Army Corps of Engineers, completed dredging to deepen its main channel to a depth of 76 feet and create larger, safer turning basins for tankers. Most of the Port's terminals now have 50-foot-deep water at all berths.

Developing the Infrastructure

Anyone who's seen the high-tech, sophisticated operations at the ports' modern terminals would find it hard to believe how they were run in the beginning. In those early days, men used megaphones to shout directions to ships coming in. Alerted to the calls, men along the shore — later called "longshoremen" — rushed to the vessels to off-load the cargo from the ships, assisted by nets, ropes and pulleys. This difficult and often dangerous work many times kept even small ships in port for a week or more, with cargo hauled away on mule-drawn carts. In the 1930s and 1940s, advances in technology started to give the ports the tools they needed to improve efficiency and move more goods. The construction of modern docks, then the addition of clear-span cargo sheds to handle breakbulk cargo (items moved on pallets, like bagged grain or fruit), spurred productivity and fueled Port growth during this period.

A seminal technological innovation ushered in a new era in the ports' history: containerization. It was invented by trucking company entrepreneur Malcom McClean who revolutionized cargo handling with standardized steel cargo boxes that could be used interchangeably on ships, trucks and trains. Before containerization, teams of longshoremen could handle only about 10 tons of cargo a day. After containerization, crews moved a steady stream of cargo containers, each weighing as much as 25 tons.

Containerization allowed much more trade to move around the world at very low cost. To maximize productivity and keep pace with growth, smaller, slower ships were replaced by ever larger, faster vessels that called at a few ports equipped with the latest, biggest machines — such as the ports of Los Angeles and Long Beach.

Containerization had required the conversion of terminals and the construction of new terminals to handle steel boxes.

Introduced on the U.S. East Coast in 1956, containers eventually began arriving in San Pedro Bay (The Matson shipping company brought it to Los Angeles in 1958 and McLean's Sea-Land Services to Long Beach in 1962.)

The 1960s also saw the beginning of another era at the ports — the focus on international trade. The first trade mission was in 1961, opening the floodgates for cargo from Japan, then other imports from South Korea, Hong Kong, Taiwan and finally China. The Pacific Ocean became the key waterway for U.S. trade with the world and Southern California found itself the epicenter of global trade. A new wave of imports from Asia began after the normalization of trade with China in 1979 and today China is far and away the ports' largest trading partner for both imports and exports.

In the 1970s, as more and more cargo came to the docks in containers, the ports equipped their terminals with giant cranes to expedite the loading process. Bigger and bigger "post Panamax" ship-to-shore gantry cranes (numbering 88 in Long Beach and 85 in Los Angeles) now rise 300 feet above the decks when the loading boom is lifted.

During the development and growth of the trade and shipping industry, world-class transportation infrastructure grew around the ports, giving shipping companies efficient, safe and environmentally friendly ways to move cargo. Bridges became essential partners to the navigation channels that served the hubs, and railroads became more crucial to the goods-movement industry that quickly grew and expanded after World War II between 1948 and the early 2000s. Two new bridges, one railway and a major freeway were constructed, all contributing to the success of the ports.

Terminals

Long Beach Terminals

The Port of Long Beach officially opened with the dedication of Municipal Pier One in 1911. It was reconstructed in 1928 and renamed Municipal Wharf, and construction began on Piers A and B. When Pier A debuted in 1930, it was the first pier to extend into the Pacific Ocean, and several of its berths were built to accommodate larger ships. It had a transit shed, complete with railroad tracks on the wharf and dockage for several steamers at once. The first of nine clear-span transit sheds was completed in 1946 at Pier F, establishing Long Beach as "America's most modern port."

Once subsidence was halted, construction was completed on Piers J and F in 1965, adding 310 acres of landfill to Long Beach. The project required 3.35 million tons of rock and 30 million cubic yards of hydraulic fill. The landfill expansion was the world's largest at that time.

In 1971, the port completed a \$7.6 million expansion on Pier J and developed a 55-acre combination container and automobile terminal. The facility became Toyota's distribution center for Southern California and the Western U.S.

With construction of the trans-Alaskan pipeline in 1977, Long Beach's ARCO terminal on Terminal Island became a leading gateway for North Slope Oil, and later for oil from elsewhere in the world.

In 1979, the port completed a \$20 million modernization of Pier E where breakbulk terminals became multipurpose cargo facilities that could handle containers, roll-on/roll-off cargo, like automobiles, as well as other bulk cargo.



The Port of Long Beach's Pier J, in the foreground, was last expanded in 1993 and now mainly serves the COSCO and CMA CGM shipping lines.

In the 1990s, the Port of Long Beach continued to grow steadily with the expansion of Pier J, and in the early 2000s, the redevelopment of Pier T, recently vacated by the departure of the long-time Navy station and shipyard at the Terminal Island site. The successful redevelopment of these former federal lands gave new productive use as a major center for international trade and jobs and Pier T became a model for the military base reuse process.

Another new terminal is on the way, with the Middle Harbor Redevelopment Project, which is combining two aging terminals, Piers E and F, into one super terminal. It broke ground in 2011 and is due for completion in 2019. The 304-acre terminal, which will include 54 acres of newly created land, will be among the cleanest and most technologically advanced container terminals in the world, cutting pollution by 50 percent and more than doubling container capacity to 3.3 million containers annually.

By 2014, the Port will have installed shore-to-ship power connections at all of its container terminals to meet the California Air Resources Board mandate for ships to turn off their engines at berth. The Port completed the world's first shore-to-ship connection for oil tankers at Berth T-121 ARCO/BP Terminal in 2009.



Workers at the Pier C Matson/SSA terminal in the Port of Long Beach plug a container ship into shore power to eliminate air pollution.

Los Angeles Terminals

At the Port of Los Angeles, the last reinforced concrete pile for Municipal Dock No. 1 in the Outer Harbor was driven in 1914. And at the time of its completion it was proclaimed the most substantial wharf in the world.

The Port of Los Angeles has eight existing container terminals that have been developed in various stages over the past couple of decades. The 162-acre container terminal operated by Evergreen America Corp. and the 185-acre container terminal operated by Yusen Terminals Inc. on Terminal Island comprise two of the busiest container terminals at the Port. When both shipping lines expressed the desire for dedicated on-dock rail service, the Port initiated the design and construction of the \$15 million Terminal Island Container Transfer Facility (TICTF), which opened in 1997 to expedite on-dock rail transfer capability. The 262-acre Pier 300 container terminal operated by Eagle Marine Services Ltd. for APL Limited opened in 1997, and became the Port's first container terminal with an on-dock rail yard.



The Port of Los Angeles' 292-acre APL Terminal/Global Gateway South Container Terminal is one of the Port's eight container terminals.

When the Pier 400 Terminal opened in 2002, it was the largest proprietary terminal in the world. The 484-acre complex, now occupied by APM Terminals and CUT Terminal, is truly "an engineering marvel," made entirely from dredged material.

The Berth 100 West Basin Container terminal at the Port of Los Angeles was the world's first container terminal to use Alternative Maritime PowerTM (AMPTM). China Shipping, the Port's customer to commit to AMPTM technology, opened the terminal in 2004, with its first AMPTM vessel call by *Xin Yang Zhou*.

In 2013, the Port of Los Angeles and U.S. Army Corps of Engineers marked the completion of the Main Channel Deepening Project, a major milestone in the Port's ongoing efforts to assure its global competitiveness, continued growth, and job creation. The 10-year project to deepen the Port's main navigational channel and turning basins to minus 53 feet allows the Port of Los Angeles to continue to accommodate bigger, more modern vessels from around the world.

Due to be completed in 2015, the Port of Los Angeles has two major projects under construction that advance modernization of the marine container terminal operated by longtime tenant, TraPac, Inc. The facilities project includes new buildings and state-of-the-art truck entrance and exit gates at TraPac's rear Berths 136-139, in addition to backland and other infrastructure improvements at Berths 145-147. The related large-scale South Wilmington Grade Separation project involves building an elevated 4,100-foot roadway that links Harry Bridges Boulevard, Pier A

Street and Fries Avenue to TraPac's new entrance and separates truck from rail operations for safer and more efficient flow of traffic.



Aerial view of the Port of Los Angeles Breakbulk Terminal and pleasure boat marinas.

In order to maintain and improve its world-class infrastructure, the Port of Los Angeles is in the midst of a five-year, \$1.3 billion Capital Improvement Program to modernize and upgrade terminals, to increase rail capacity and improve roadways in and around the Port.

Bridges

Getting on and off Terminal Island, at the heart of the port complex, has long been an engineering and driving challenge. In Long Beach, a fixed trestle bridge for trains provided an early answer. But it blocked the waterway into the newly relocated Craig Shipyard (the Port's first tenant) and soon-to-be Municipal Pier, so the trestle bridge was replaced in 1908 with a drawbridge. But during World War II, sailors and shipyard workers needed to travel on and off the island, so the Navy created a floating, segmented pontoon bridge that could open for ships to pass or fit together for cars to cross. It was notorious for traffic backups and in general was a safety hazard. A number of drivers went into the water. To accommodate the growing number of vehicles traveling from Terminal Island to Long Beach, the "temporary" pontoon bridge was replaced in 1968 by the new, 5,134-foot-long Gerald Desmond Bridge, a steel arch bridge, built at a cost of \$19 million. Fast forward to present time, the Desmond Bridge is being replace. The original was not designed to handle the current traffic and showing its age. In 2013, the Port of Long Beach broke ground for a \$1.1 billion, state-of-the-art replacement. The new span will be wider, safer and more efficient. It will offer 205 feet of vertical clearance above water level, so larger, greener ships can pass through to the Port's Back Channel. The new support towers will soar more than 500 feet in the air, making them the tallest manmade structures in Long Beach. The new bridge will feature bicycle and pedestrian pathways and scenic outlook stations with spectacular views of the water level.



Opened in 1968, the Gerald Desmond Bridge connects downtown Long Beach to Terminal Island.

The Commodore Schuyler F. Heim Bridge on Terminal Island was completed in 1948. It allows State Route 47 to pass over the Cerritos Channel and is the largest vertical lift bridge on the West Coast. Its center section can be

elevated to 175 feet above the water in just over two minutes. Replacement of this bridge by Caltrans is currently underway.

Building of the Vincent Thomas Bridge began in 1961, connecting San Pedro to Terminal Island. Dedicated in 1963, the four-lane, 1,500-foot-long, \$21.4 million bridge is the third-largest suspension bridge in California. In recent years, decorative lighting was added to frame the bridge, making it a nighttime coastal landmark.



The Vincent Thomas Bridge, which connects San Pedro to Terminal Island, is an iconic structure day or night. It opened in 1963.

<u>Railways</u>

Railroads have been an integral part of the development of the ports from the very beginning. The 23-mile-long Los Angeles and San Pedro Railroad formally opened in 1869. The Southern Pacific and Santa Fe Railway had started offering service to Long Beach, and tourists were arriving by train to what was, by the 1880s, a fast-growing seaside resort and vacation destination. The Pacific Electric Railway reached the Outer Harbor in San Pedro in 1905, connecting the town to downtown Los Angeles. It operated until 1959, and, in 2003, the PUC approved a plan to reintroduce Pacific Electric type trolleys in San Pedro.

On-dock rail yards are now a key feature of any container terminal and have a dramatic effect on terminal efficiency. These rail yards offer the terminal operator the added benefit and flexibility of loading cargo directly onto trains within the terminal, eliminating truck traffic and reducing polluting emissions. The Port of Los Angeles has built four on-dock rail yards within the last decade and a half that provide direct rail access to seven of their eight container terminals with plans in the work for the eighth, with a goal of on-dock rail for 35 percent of their total throughput.

Five of the six container terminals at the Port of Long Beach are equipped with on-dock rail, and, in early 2013, the Port broke ground for a Green Port Gateway project that will enhance capacity for on-dock rail and realign rail intersections to reduce congestion and speed trains through the Port.

In 1986, International Transportation Service at Pier G in Long Beach became the first container terminal in Southern California to open an on-dock rail facility for double-stacked container trains.

The Intermodal Container Transfer Facility (ICTF), operated by Union Pacific Railroad, is a near-dock rail yard located approximately five miles from the ports. The \$55 million ICTF opened in 1986 as a multi-user facility serving numerous shipping lines. It has greatly enhanced transcontinental train service, as well as the relay of marine cargo containers between the two Southern California ports and major rail yards near downtown Los Angeles. A similar facility, proposed by BNSF Railroad, is in the planning stages.

One of the most successful rail projects in recent years is the Alameda Corridor. The 20-mile train thoroughfare, which stretches 20 miles from the ports to the transcontinental rail yards in Los Angeles, opened in 2012, providing an efficient link from dock to downtown Los Angeles-area rail yards and back again. One of the largest infrastructure projects in Southern California at the time, the building of the corridor lasted five years and cost \$2.4 billion.

The railway includes a 10-mile section of trench, 33 feet deep and 50 feet wide, which buffers surrounding residential neighborhoods from the sound and vibration of dozens of trains a day. By reducing the need for the trucks that move cargo from the docks to the local rail yard, the Corridor also improves air quality. It also removed more than 200 street crossings, which helps reduce traffic congestion and cuts pollution from idling cars.

<u>Roadways</u>

In 2007, the Port of Long Beach completed construction of the Ocean Blvd/Terminal Island Freeway Interchange which eased the flow of traffic for commuters and for truckers. Plans are under consideration for improvements to the Long Beach I-710 Freeway to accommodate expected increases in port traffic.

Green and Sustainable

In their first century of service, port developers made great strides in overcoming daunting challenges. Then, in one of their boldest and most important moves, they "went green." The Port of Long Beach adopted its landmark Green Port Policy in 2005 to improve air and water quality, clean the soil and undersea sediments and protect wildlife habitat, creating a sustainable Port for the benefit of future generations.

Then in 2006, the San Pedro Bay Ports joined forces to write and implement the groundbreaking San Pedro Bay Ports Clean Air Action Plan (CAAP). It was created with the cooperation of the U.S. Environmental Protection Agency, the California Air Resources Board and the South Coast Air Quality Management District, to dramatically cut air pollution from all port sources: ships, trains, trucks, harbor craft, and cargo-handling equipment. The plan was updated in 2010. The ports also collaborated on a Water Resources Action Plan (WRAP) to identify and target sources of water and sediment pollution in the bay. The challenge was to reduce port-related environmental impacts while maintaining the economic benefits of international trade in the community. The plans, completed in 2009, provided a framework, defining an aggressive ethic of environmental protection and sustainability in every aspect of the operations.

The ports have amassed an impressive record of environmental accomplishments with more on the horizon: green leases, making a commitment to use the best environmental practices available; a Technology Advancement Program that has funded 26 demonstration projects to date including hybrid tugboats and zero-emissions trucks; a 2008 Clean Trucks Program that has reduced truck-related diesel pollution by 90 percent by replacing old, dirty rigs; the ports' switching railroad, Pacific Harbor Line, completely transforming its fleet, swapping out all 20 of its old locomotives for new clean-diesel engines; Union Pacific and BNSF Railroads, the two long-haul railroads, continuing to add new clean equipment and invest in on-dock rail capacity; all new structures at the ports meeting top green construction standards; dredging materials being recycled into new terminals; demolished construction materials such as asphalt and concrete being recycled; voluntary compliance by shipping lines to use low sulfur fuels and slow ship speeds; near the ports; and efforts to give incentives to the shipping lines to bring their cleanest, new ships to the Southern California ports to reduce emissions.

The largest remaining source of pollution at the ports is exhaust from ships. In order to reduce emissions from ships at berth, the ports are spending hundreds of millions of dollars to allow vessels to "plug in" to clean electricity at berth and dramatically cut air pollution in time for state shore power deadlines in January 2014. The shore power regulation came about thanks to the pioneering commitment by the ports as part of the CAAP. Several existing terminals are already equipped, and all container shipping docks will include hook-ups.

The Future

The San Pedro Bay ports are again entering a new era, shaped by powerful trends that will bring challenges and opportunities. With billions of dollars in capital improvements underway, the ports are poised not only to maintain their status as the premier gateway for trans-Pacific trade, but also grow their contribution to the global and U.S. economies while leading the way in green and sustainable operations.

A new generation of ever larger and more efficient vessels is entering the Pacific fleet. Not that long ago, container ships that carried 8,000 TEUs were the biggest ships. Now ships up to 14,000 TEUs have called at the ports. The capital improvements that are underway will continue to accommodate them. The Southern California region also continues to offer superior logistics with extensive on-dock rail and cross-country rail connections, an unrivaled network of warehouses and distribution facilities and an experienced labor force.



The MSC Altair departs the Port's Pier T terminal. The Altair is one of the new generation of mega ships, and can carry more than 13,000 container units.

Other U.S. and international seaports are vying for trade now coming through Southern California, underscoring the need to stay competitive. The widening of the Panama Canal holds great potential for more trade between the West Coast and South America, and a growing middle-class in Asia bodes well for American exports to that continent. We are staying ahead of the curve by investing in state-of-the-art facilities and actively promoting imports and exports through our region.

Staying competitive in the global economy will require both ports to aggressively pursue expansion of their infrastructure. But to do so, both ports remain true to their commitments to build and grow sustainably by preserving and enhancing the environment, involving and supporting the local community and the area's enviable lifestyle. Engineers will continue to play a major role in building sustainable infrastructure, coming up with innovative solutions to enable the continuing, fascinating growth of the San Pedro Bay ports.

References for this Article

To learn more about the history of the San Pedro Bay Ports, go online to www.polb.com or www.portoflosangeles.org. In addition to the extensive current and historic information on the websites, books referenced for this article include: *Port of Long Beach - Celebrating a Centennial* (2011), *Port of Los Angeles - An Illustrated History from 1850 to 1945* (2007) and *Long Beach - The Golden Shore* (1988). Communications staff from both ports provided invaluable information and assistance.

About the Author

Douglas J. Sereno, P.E., ENV-SP, joined the Port of Long Beach in 2002 and has been Director of the Program Management Division since 2007. He oversees the Port's 10-year \$4.5 billion capital improvement program, which includes landmark projects such as the \$1.1 billion Gerald Desmond Bridge Replacement Project, the \$1.2 billion Middle Harbor Redevelopment Project, the \$470 million Pier G Redevelopment and the Port's \$100 million Ship-to-Shore Power projects.

Doug holds both bachelor's and master's degrees in civil engineering from Brigham Young University; he is a Registered Engineer in the State of California and is credentialed as an Envision Sustainability Professional by the Institute for Sustainable Infrastructure (ISI).

An active member of ASCE, he is involved in sustainable infrastructure initiatives with ACSE's Coasts, Oceans, Ports and Rivers Institute (COPRI) as the chairman of its Sustainability Committee and secretary of the ASCE-LA Chapter's Sustainability Committee. ASCE recently appointed him to the Committee on Sustainability and he is serving on its Sustainable Infrastructure Certification subcommittee that is developing an international certification standard for Sustainable Infrastructure Professionals and its subcommittee to develop an international Sustainable Infrastructure Standard. He is also a member as a member of the ASCE-ISI Strategic Communications Committee and ISI Envision Infrastructure Rating System Leadership Credits Committee.

Doug was the initial chair of the Port's Sustainability Task Force and is a founding member of the Joint West Coast Ports Technical Committee for the Development of Sustainable Design and Construction Guidelines. He is also an active member of the Water Environment Federation and the U.S. Green Building Council, LA Chapter.