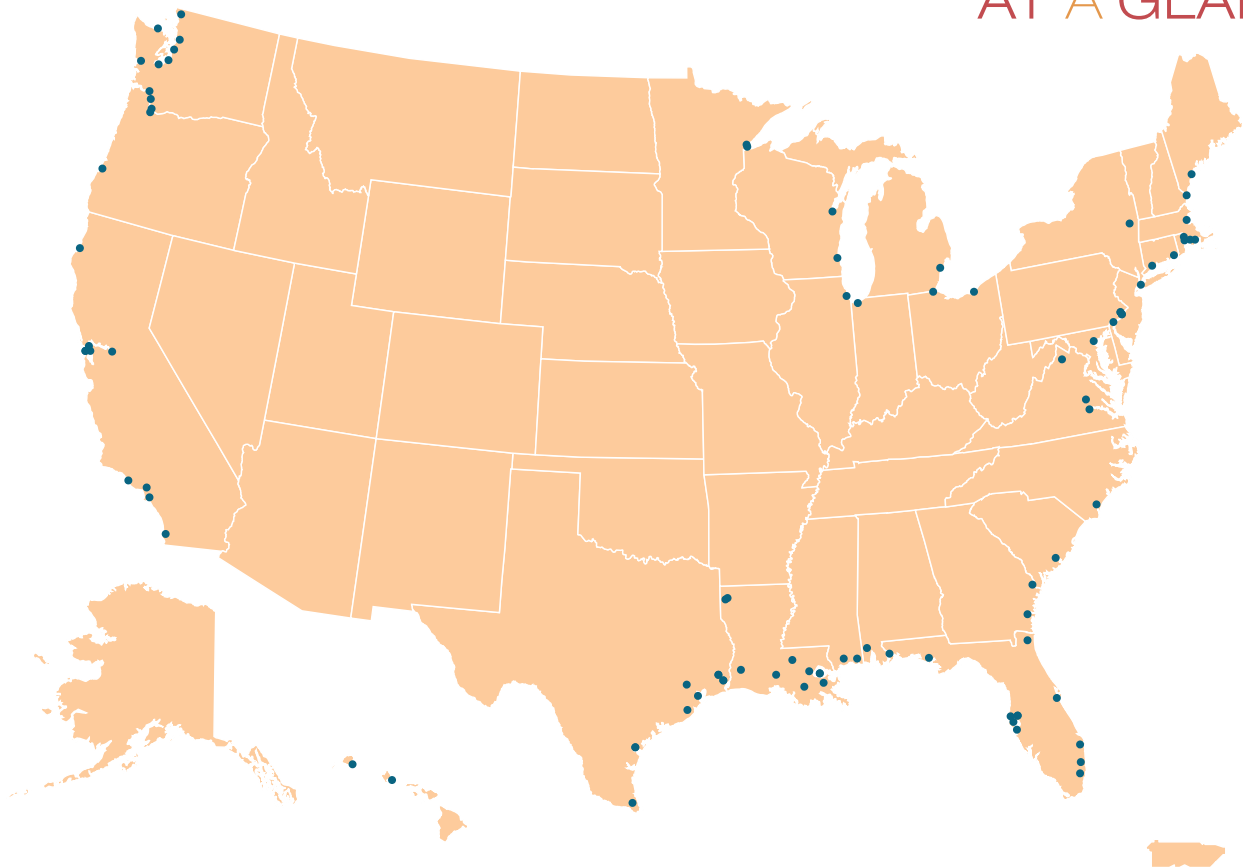




# PORTS

## AT A GLANCE<sup>1</sup>



2005: 360 public and private ports; map shows large, deep water, public port authorities

1999: 422,578 employees

2006: 507,448 employees  
▲ 20%

1997: \$5.3 billion in revenue

2002: \$6.2 billion  
▲ 16%

# Latest Environmental Statistics

Because of the relative lack of sector-level data on the environmental performance of ports, this chapter relies in part on survey information that the American Association of Port Authorities (AAPA) collected in 2005 and 2007 from its U.S. members, the country's 86 largest port authorities. Thirty-eight ports completed the 2007 survey, representing a 44% response rate.<sup>2</sup> They represented 19 of the top 30 U.S. container ports in 2006, and 20 of the top 30 U.S. ports for total trade tonnage in 2005.<sup>3</sup> Although these large public ports are only one component of the U.S. port industry, they handle the majority of U.S. overseas freight. Understanding their performance is key to understanding the environmental performance of the entire sector. The chapter also highlights commitments ports are making, individually and collectively, to better understand and improve their environmental performance.

## Profile

More than 360 commercial ports serve the United States with approximately 3,200 cargo and passenger handling facilities employing more than 507,000 people, contributing an estimated \$1.3 trillion to the Gross Domestic Product, and generating an estimated \$21.4 billion in U.S. Customs revenue.<sup>4</sup>

The Ports sector includes public and private marine facilities along sea coasts, on estuaries and rivers, and around the Great Lakes. Ports develop and maintain shoreside facilities for intermodal transfer of cargo between ships and other modes of transportation, such as barges, trucks, railroads, and pipelines. They may also operate other facilities, such as airports, world trade centers, and recreational facilities.

U.S. ports and waterways handle more than 2 billion tons of domestic and import/export cargo annually.<sup>5</sup> Ports handle 78% of all U.S. foreign trade by weight and 44% by value.<sup>6</sup> Forty-nine U.S. ports also have passenger cruise terminals, from which more than 9 million passengers embarked in 2006.<sup>7</sup>

U.S. ports are expected to experience unprecedented growth in overseas trade and continuing growth in the cruise industry. Forecasts call for a doubling in the volume of containerized cargo and in the number of cruise passengers between 2005 and 2020.<sup>8</sup>

## Energy Use

Energy use at ports consists mainly of electricity for facility operations and fuel for vehicles and cargo-handling equipment. The most common fuel used is petroleum-based diesel, although ports are beginning to use other fuels. To

reduce air emissions, some ports have switched to electric-powered cargo handling equipment, while others are using propane, liquefied natural gas (LNG), or biodiesel blends in vehicles and equipment. A few ports, including Juneau, AK, Long Beach and Los Angeles, CA, and Seattle, WA, have installed shoreside power (or "cold ironing") at some of their terminals so that oceangoing vessels can connect to the landside electric grid while at the dock rather than running their auxiliary diesel engines. The Port of Seattle has cold ironing infrastructures in place for the two berths. The Port of Oakland, CA, has successfully tested a mobile power unit that produces electricity onsite for ships at dock using LNG.<sup>9</sup> A 2004 study for the Port of Long Beach estimated that shoreside power would reduce nitrogen oxide (NO<sub>x</sub>) emissions by 99% and particulate matter (PM) emissions by up to 97% per vessel, while a vessel is hotelling.<sup>10</sup>

Ports have some potential for fuel switching, especially if they have direct control over the diesel-powered vehicles and equipment onsite. However, even "landlord" ports, whose tenants own and operate the majority of vehicles and equipment, can influence fuel use through voluntary programs or means such as lease specifications or preferential fees when new leases are being negotiated or old leases are being renegotiated.<sup>11</sup>

## Air Emissions

Ports have a diversity of activities and a multitude of emissions sources; there are currently no sector-level estimates of port air emissions. However, EPA is working with AAPA to encourage individual ports to prepare emissions inventories, develop and implement emission reduction strategies, and measure progress against the baseline.<sup>12</sup> EPA also is working with ports and other stakeholders to develop modeling tools for port-related

### Increasing Use of Biodiesel

Compared to burning standard diesel, the use of biodiesel results in reductions in direct emissions of carbon monoxide (CO), PM, sulfates, volatile organic compounds (VOCs), and greenhouse gases (GHGs). In 2006, the Port of Seattle, WA, and SSA Marine, the port's largest maritime customer, switched their maintenance vehicles and container-handling equipment from standard diesel fuel to biodiesel. Another terminal operator, APL, also switched to biodiesel. Both terminal operators use B20, a blend of 20% biodiesel and 80% ultra-low-sulfur (ULSF) diesel. The port uses B99 (99% biodiesel) in its maintenance equipment. During cold periods, the port and SSA switch to lower blends of biodiesel (B50 and ULSF, respectively) to cope with gelling problems.<sup>13</sup> Together, the port and SSA use about 1 million gallons of fuel per year in the vehicles now powered by biodiesel.<sup>14</sup> Annual emissions reductions from this switch are estimated to be 2.1 tons of CO, 1.5 tons of VOCs, 0.3 ton of PM, and nearly 1,300 tons of GHGs.<sup>15</sup>

## Increasing Use of Solar Power

The Port of New York and New Jersey East Coast Warehouse Facility at Elizabeth Port Authority Marine Terminal has been equipped with more than 5,000 flexible solar panels, covering about 37% of its roof and designed to produce more than 810,000 kilowatts (kW) of electricity. The Ports of Oakland and Los Angeles, CA, both recently committed to deploying solar power systems onsite to supply electricity for their operations. In December 2007, the Port of Los Angeles agreed to construct a 10-megawatt solar photovoltaic system as part of the mitigation package for a major expansion of one of the port's container terminals. The port expects the system to offset nearly 17,000 metric tons of GHG emissions annually.<sup>16</sup> In November 2007, the Port of Oakland arranged for deployment of a new 756-kW solar photovoltaic power system on its property, which it expects to generate more than 1 million kW hours of electricity annually. The port expects the system to reduce its GHG emissions by 850 metric tons per year.<sup>17</sup>

air emissions. Many of the nation's ports are located in areas that do not meet EPA National Ambient Air Quality Standards for ozone (eight-hour standard) and PM<sub>2.5</sub>.<sup>18</sup>

## Diesel Emissions

The primary sources of air emissions from the Ports sector are diesel engines, which are used in ships, trucks, trains, cargo-handling equipment, and harbor craft. Diesel emissions include PM, NO<sub>x</sub>, sulfur oxides (SO<sub>x</sub>), hazardous air pollutants, and GHGs. As shown in Table 1, more ports are taking steps to quantify and reduce air emissions.

**TABLE 1**  
**Emission Reduction Strategies**  
**Reported by Ports**

	2005	2007
Have an emissions inventory	23%	42%
Have an emissions control or reduction strategy	25%	37%
Are using low-emission fuels	29%	47%
Have implemented program for diesel retrofits or replacements	NA	34%
Are using alternative energy sources	NA	26%

Source: American Association of Port Authorities

As shown in the table, some ports are reducing emissions from existing diesel engines through engine replacements or retrofits. To assist with this effort, EPA worked with AAPA and other stakeholders to create Clean Ports USA. Launched in 2004 as part of EPA's National Clean Diesel

## Ports With Emissions Inventories<sup>19</sup>

Anacortes (WA)  
 Baltimore (MD)  
 Coos Bay (OR)  
 Corpus Christi (TX)  
 Everett (WA)  
 Houston (TX)\*  
 Lake Michigan Ports  
 Long Beach (CA)\*  
 Los Angeles (CA)\*  
 Lower Mississippi River Ports (LA)  
 New York/New Jersey (NY/NJ)\*  
 Oakland (CA)\*  
 Olympia (WA)  
 Philadelphia and Delaware River Ports (PA, DE)  
 Port Angeles (WA)  
 Portland (OR)  
 San Diego (CA)  
 Savannah (GA)\*  
 Seattle (WA)\*  
 South Carolina State Port Authority (SC)\*  
 South Louisiana (LA)  
 Tacoma (WA)\*  
 Tampa (FL)  
 Virginia Port Authority (VA)\*

Note: \* = top 10 U.S. container ports in 2006

Source: U.S. Environmental Protection Agency

Campaign, this incentive-based program is designed to reduce diesel emissions from existing vehicles and equipment at ports. Clean Ports USA has funded 11 port-related projects with \$1.9 million in federal dollars and \$2.5 million in matching funds provided by partners.<sup>20</sup> Ports, EPA, and other stakeholders also are collaborating through five regional partnerships that are encouraging voluntary diesel emissions reductions.

Ports are reducing diesel emissions from trucks by implementing operational changes that reduce waiting times and the number of truck trips. One such change is the establishment of common pools for the chassis that are used to haul intermodal containers. Most chassis are owned and maintained by individual terminal operators or shipping lines, which typically do not allow them to be used with another carrier's containers. Requiring drivers to switch chassis can add up to one hour per trip, increasing fuel use and air pollution. Chassis pools reduce the number of truck movements and the amount of idling, resulting in lower emissions and greater productivity. In 2004, the Virginia Port Authority established a chassis pool at the Port of Virginia, which became the first U.S. port to achieve 100% participation from the port's shipping lines.<sup>21</sup> In the Port of New York and New Jersey, the Maher Container Terminal at the Elizabeth Port Authority Marine Terminal utilizes a 31-acre chassis pool yard. Ports also are





### San Pedro Bay Ports Clean Air Action Plan

In November 2006, the Ports of Los Angeles and Long Beach, CA, adopted a comprehensive strategy to reduce air emissions from freight transportation in a region that has some of the worst air quality in the nation. Their goal is to reduce emissions of PM, SO<sub>x</sub>, and NO<sub>x</sub> (a precursor to smog) from port-related operations by 45% or more within five years.<sup>22</sup> By the fifth year, the ports plan to achieve annual emission reductions of 1,200 tons of PM, 12,000 tons of NO<sub>x</sub>, and 8,900 tons of SO<sub>x</sub>.<sup>23</sup> Under the plan, the ports will:

- Phase out the oldest (and therefore dirtiest) trucks servicing the ports,
- Equip all major terminals with shoreside electricity for vessels at berth,
- Require ships to use low-sulfur fuels and reduce speeds when entering or leaving the harbor region, and
- Replace or retrofit all switching locomotives and cargo-handling equipment to meet EPA's toughest emissions standards for new equipment.

The ports are actively implementing the plan. For example, all diesel-powered Class 1 switcher and helper locomotives entering the Port of Los Angeles have been using ULSF diesel fuel since the beginning of 2007.<sup>24</sup> The plan built upon previous efforts by the ports. For example, between 2001 and 2005, the Port of Los Angeles reduced emissions of PM, SO<sub>x</sub>, and NO<sub>x</sub> by 17% to 27% on a per-container basis.<sup>25</sup>

### South Carolina State Ports Authority (SCSPA)

Even though the southeastern coast of the United States is currently in attainment with federal air quality standards, SCSPA developed a voluntary air quality program to minimize air emissions from existing terminals and a new container terminal it is building. The port committed to activities such as conducting an emissions inventory of existing facilities, funding a PM monitoring station, and including clean air guidelines in construction bid documents.<sup>26</sup> SCSPA also switched to ULSF diesel in September 2007, three years ahead of federal requirements.<sup>27</sup> Emissions reductions over those three years will be an estimated 1,100 pounds of NO<sub>x</sub> and 30 pounds of SO<sub>x</sub>.<sup>28</sup>

### Northwest Ports Clean Air Strategy

The Northwest Ports Clean Air Strategy is a joint effort of the Ports of Seattle and Tacoma, WA, and Vancouver Fraser Port Authority (British Columbia) to reduce maritime and port-related emissions that affect air quality and contribute to climate change. A key goal is to stay in attainment of ambient air quality standards. The strategy establishes measurable short- and long-term performance measures for trucks, rail, water vessels, oceangoing vessels, and cargo-handling equipment.<sup>29</sup>

developing retrofit and replacement programs for drayage trucks to reduce emissions.

Oceangoing vessels, which burn bunker fuel while at sea and run auxiliary diesel engines in port, are a major source of emissions at ports. The International Convention for the Prevention of Pollution from Ships (also known as MARPOL) governs vessels' environmental performance. In October 2007, AAPA's members agreed to support the U.S. government proposal to the International Maritime Organization (IMO) to amend MARPOL Annex VI and establish more stringent air emission standards for oceangoing vessels.<sup>30</sup>

## Greenhouse Gases

There are no sector-level estimates of GHG emissions from ports, but many ports are estimating GHGs when conducting emissions inventories. For example, the Ports of Seattle, Tacoma, and Everett, WA, jointly estimated GHG emissions of 397,033 tons of carbon dioxide (CO<sub>2</sub>) equivalent in 2005, with overall Puget Sound maritime emissions of 1.9 million tons of CO<sub>2</sub> equivalent.<sup>31</sup> The Port of San Diego, CA, a relatively small port, estimated GHG emissions of 128,000 tons of CO<sub>2</sub> equivalent in 2006.<sup>32</sup>

Increasingly, shippers are expecting organizations in the transportation supply chain to measure, report, and improve their environmental performance. For example, through EPA's SmartWay Transport Partnership, companies commit to shipping higher percentages of freight with truck and rail carriers that are SmartWay partners. In turn, participating carriers agree to estimate their emissions and

reduce them over time. EPA is working with the freight industry to expand the program and develop tools that will help companies measure and reduce GHG and criteria air pollutant emissions from their entire transportation supply chain (including ports).

SmartWay already includes some drayage carriers, which are truck companies that deliver freight to and from port facilities. Seeking more ways to improve the environmental performance of drayage fleets, which typically consist of older trucks, SmartWay is working with ports such as the Virginia Port Authority to offer low-cost loans to drayage carriers for cleaner and more fuel-efficient trucks.<sup>33</sup>

## Water Use and Discharges

Located on coasts and inland waterways, ports are caretakers for coastal resources. Public ports regularly develop wetland sites; create, restore, and enhance habitat; and monitor water quality. The transport of invasive species in ships' ballast water and oil spills from ships or landside facilities can significantly affect local water quality and wildlife. Dredging of channels and harbors can affect water quality, although dredging permits require mitigation plans.

## Stormwater

Stormwater can pick up pollutants from paved surfaces before entering waterways. Most port facilities for cargo handling include large expanses of paved surface, which,







### Reducing Discharges With Permeable Asphalt

In 2006, the Port of Portland, OR, installed 35 acres of porous asphalt at one of its auto-import facilities. Unlike traditional asphalt, porous asphalt allows stormwater to soak into the underlying soil. The porous asphalt, along with a system of swales and natural vegetation to handle runoff from heavy rain, treats all stormwater onsite. The port saved \$250,000 and nearly a year of time for obtaining an NPDES permit. The port also receives a discount on the city's storm sewer fee and will have lower maintenance costs over time.<sup>34</sup>

along with the possibility of spills of bulk or liquid freight, makes stormwater management very important. Most stormwater discharges from ports are considered point sources and require a National Pollutant Discharge Elimination System (NPDES) permit. Many NPDES permits require preparation of a Stormwater Pollution Prevention Plan. In the 2007 AAPA survey, 68% of the ports responding indicated that they have such a plan; 61% indicated that they advise tenants periodically on stormwater compliance responsibilities.

### Restoration of Aquatic Habitat

Ports often restore coastal habitat as mitigation for development activities and in broader stewardship efforts.

#### Restoring Fish Habitat

Most of the east side of Puget Sound is hardened with riprap and bulkheads. Restoration of more natural shoreline habitats is critical to the recovery of Puget Sound salmon. In part to mitigate the impacts of a new pier, the Port of Everett, WA, used a new method for pebble/sand beach construction to restore 1,100 feet of shoreline habitat in front of a rock bulkhead supporting a BNSF railroad line. Biological monitoring has already shown a high level of activity by juvenile salmon and forage fish along the restored shore.<sup>35</sup>

### Invasive Species

Ships take on or discharge ballast water to accommodate changes to their displacement and trim as they load or unload cargo or take on or consume fuel.<sup>36</sup> As vessels transit the globe, they collect and discharge water many miles apart, and in the process can introduce nonindigenous species. These species are considered

“invasive” if they are capable of exploiting their new environment and causing economic or environmental harm. Ships discharge an estimated 80 million tons of ballast water into U.S. waters each year.<sup>37</sup>

To combat the spread of invasive species, ships are required to take steps such as exchanging ballast water while at sea. However, management methods still need to be improved. EPA and AAPA are working with the U.S. Coast Guard, IMO, and others to promote effective policies and technologies for ballast water management and treatment. For example, the Duluth Seaway Port Authority, MN, hosts the world’s first freshwater test facility for ballast water treatment technology. The facility, completed in June 2007, is part of the Great Ships Initiative, a cooperative research effort to which nine U.S. and Canadian ports have provided monetary or in-kind support.<sup>38</sup>

## Waste Generation and Management

### Dredged Material

Because of the natural process of sedimentation, periodic dredging of channels and shipping berths is necessary to ensure that vessels can continue to reach ports. Existing channels and berths must also be deepened and widened for U.S. ports to accommodate the largest container ships coming into use. Few U.S. ports have the channel depth of up to 55 feet that these vessels require.<sup>39</sup>

Although the U.S. Army Corps of Engineers is responsible for dredging navigation channels, ports and their tenants dredge 100 million cubic yards annually from vessel berths and private terminals.<sup>40</sup> Ports must dispose properly of both clean and contaminated dredge material, and are increasingly seeking beneficial reuses of this material.<sup>41</sup>

#### **Beneficially Using Dredged Material**

The Port of Fourchon, LA, is using dredged material to rebuild a natural forest ridge reduced by coastal erosion. Such forest ridges serve as buffers between the Gulf of Mexico and the coastal marsh habitats for fish, shellfish, and other wildlife. Working with volunteers and several private and governmental entities, the port has created 60 acres of forest habitat and 60 acres of salt marsh.<sup>42</sup>



### Brownfields

Although ports will be able to accommodate some of the expected increase in trade volume by improving the efficiency of current operations, they sometimes need to build new facilities. Many ports seeking to expand existing facilities have revitalized nearby “brownfields,” which are unused or underused industrial sites. In doing so, the ports must first address any environmental contamination. For example, the Port Authority of New York and New Jersey is remediating and developing a contaminated site on Staten Island, NY, in connection with the intermodal rail facility supporting the New York Container Terminal. Fifteen of the 38 ports that responded to AAPA’s 2007 survey had participated in brownfields redevelopment in the past 5 years, contributing to redevelopment of more than 3,200 acres of brownfields.<sup>43</sup>

### Disposal and Recycling

Ports handle a variety of materials and wastes, both generated onsite and from vessels. Since inception in 2005, the Port of Corpus Christi Authority, TX, recycling program has recycled 327,055 lbs. of materials, including 96,470 lbs. in 2007. The program includes recycling paper, plastic, cardboard, metal, batteries, tires, oil, oil and fuel filters, antifreeze, and capacitors. Cruise ships return to port with recyclable materials such as metal cans, glass, and batteries. They also offload hazardous wastes while at dock, such as waste generated during photo processing, dry cleaning, and ship maintenance. There are no estimates of the total volumes of solid and hazardous wastes brought into U.S. ports by cruise ships, although EPA is developing a “Cruise Ship Discharge Assessment Report” to address solid and hazardous waste.<sup>44</sup>



## Hazardous Waste Management

Port facilities generate various hazardous wastes. Vessel refurbishing and maintenance operations generate spent solvents and caustics, and paints and paint sludge. Examples of other marine facility wastes that may be hazardous include vehicle maintenance fluids, near-empty paint cans, and paint-stripping residue.<sup>45</sup> In AAPA's 2007 survey, 17 of 38 ports (45% of respondents) indicated that they generate enough hazardous waste to require tracking and reporting.<sup>46</sup>

## Additional Environmental Management Activities

### Environmental Management Systems

An environmental management system (EMS) is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency. The Ports EMS Assistance Project, which EPA helped AAPA launch, has guided 13 ports in developing EMSs over 4 years.<sup>47</sup> The Ports of Boston, MA, Corpus Christi and Houston, TX, and Los Angeles, CA, have each received third-party ISO 14001 certification, and other ports are working toward this recognition.<sup>48</sup> In AAPA's survey, the percentage of ports with an EMS in place or under development increased from 29% in 2005 to 47% in 2007. The number of ports publishing an annual environmental review or report also increased from 4% in 2005 to 29% in 2007.<sup>49</sup> AAPA also assisted EPA in development of *An EMS Primer for Ports: Advancing Port Sustainability*.<sup>50</sup>

### Voluntary Sustainability Partnership

Green Marine is a new, voluntary sustainability initiative designed to help the marine transportation industry between the Gulf of St. Lawrence and the Great Lakes minimize its environmental footprint without compromising economic viability. The initiative, officially announced in October 2007, includes U.S. and Canadian carriers and ports. Priority issue areas include air emissions, discharges to water, and invasive species. The partnership has published an action plan and will enlist a third party to evaluate and report on the conformance of the program's corporate members.<sup>51</sup>



## Sustainability

Some ports are building on the systems-based management approach of EMSs to address broader aspects of sustainability. AAPA is working to develop a sustainability framework. AAPA members approved a sustainability resolution and principles in October 2007. The resolution states, "Sustainability involves the simultaneous pursuit of economic prosperity, environmental quality and social responsibility," and AAPA "embraces the concept of sustainability as a standard business practice for ports and the Association."<sup>52</sup>

## Community Involvement

Because of their size, location, and high profile, ports increasingly recognize the importance of effectively communicating with surrounding communities about the environmental aspects of port operations.

### Environmental Outreach

The Port of Portland, OR, has created a position within its Community Affairs Department specifically for environmental outreach and communication. The port also provided its staff with "Community Integration Guidelines," an extensive menu of outreach approaches and tools to use when engaging the public. Several of these tools have been used effectively during the decisionmaking process for cleanup of contaminated sediment at the port's Terminal 4. For example, the port has hosted five open houses corresponding to different phases of the project, and it arranged for stakeholders to visit two confined disposal facilities in the Puget Sound area. The port's outreach efforts have reached more than 300 stakeholders and identified specific areas of citizen concern that the port might otherwise have overlooked.<sup>53</sup>