Municipal Stormwater
Source Control Report for Portland Harbor
City of Portland Outfalls Project

December 2013
Amended February 2014
January 17, 2014

Alex Liverman
Oregon Department of Environmental Quality
Northwest Region
2020 SW 4th Avenue, #400
Portland, OR 97201-4987

Subject: Transmittal of Municipal Stormwater Source Control Report and Notice of Completion - Intergovernmental Agreement for Remedial Investigation and Source Control Measures (DEQ No. LQVC-NWR-03-10)

Dear Ms. Liverman:

Enclosed are two copies of the Municipal Stormwater Source Control Report for Portland Harbor (Municipal Report). The Municipal Report describes our citywide stormwater source control programs, how those programs are being implemented in the Portland Harbor, and the City’s role in an interagency effort to identify and control contaminant sources to the municipal stormwater conveyance systems located in the harbor. As we have discussed, this Municipal Report is a component of the Oregon Department of Environmental Quality’s (DEQ) forthcoming summary report of upland source control in Portland Harbor. It also provides the general context for the Closure Report for the City of Portland Outfalls Project included as Appendix A. The Closure Report summarizes the results of the Intergovernmental Agreement (IGA) for Remedial Investigation and Source Control Measures for the City of Portland Outfalls Project.

This letter is also the City’s Notice of Completion for Intergovernmental Agreement DEQ No. LQVC-NWR-03-10, between the City of Portland and DEQ dated August 13, 2003. In 2003, the City and DEQ developed the joint objectives for the IGA and a Scope of Work to identify the specific elements of the collaborative work that the City would perform. This work was necessary to minimize the potential for upland site discharges to City outfalls to recontaminate inriver sediment following future sediment remediation in Portland Harbor. In accordance with the terms of the IGA, the City is pleased to notify DEQ that it has completed work under this agreement, and requests a Source Control Decision, written Notice of Completion and final invoice of oversight costs owed under the IGA from DEQ for the Outfalls Project. The IGA provides 60 days for DEQ to issue a letter acknowledging satisfactory completion of activities in accordance with the agreement. If you anticipate needing an extended schedule for review, please inform the City of the proposed date for issuance of the notice. Once the Notice of Completion has been issued and the City has paid the final oversight costs, this IGA will be terminated.

Investigating and controlling contaminant sources to the municipal storm system required a different kind of approach than that typically utilized by DEQ at upland properties, because City regulatory authority alone would not have been sufficient for achieving source control at all identified sources, such as those where onsite investigation or remedial action was warranted. For more than a decade, the City and DEQ have worked together to identify sources of
contamination to the City outfalls located in Portland Harbor and to refer sources to an appropriate City, state, or federal program for the implementation of source controls under those respective authorities. Completing the IGA involved many interim steps, including the following key components:

- Development and approval of the *Programmatic Source Control Remedial Investigation Work Plan for the City of Portland Outfalls Project* to establish an approach for evaluating each outfall basin;
- Determining the potential for each basin to contain sources of contaminants that may have adverse impacts on river sediment, via contaminant discharges to the municipal stormwater conveyance system;
- Conducting source investigations where warranted to identify specific contaminant sources and referring sources to an appropriate program for control;
- Documenting investigation activities and findings in technical reports to DEQ; and
- Consulting with DEQ and the U.S. Environmental Protection Agency on the format and level of content for the Closure Report.

The Closure Report summarizes the City's satisfaction of IGA requirements, and presents Outfall Basin Completion Summaries for each outfall basin, that demonstrate how IGA objectives have been met for each of the 39 City outfalls located in the Portland Harbor Study Area. In partnership with DEQ, the City completed the remedial investigation of City outfall basins in Portland Harbor, verified that all significant current sources have been identified and are in an appropriate program to implement source control measures where needed, and concludes that future discharges from City outfalls are unlikely to represent a significant source of contaminants to the river.

Though the City has completed the specific work required under the IGA, the City’s regulatory and non-regulatory stormwater source control programs in the harbor will continue. The City appreciates the productive collaborative relationships with DEQ that this IGA has fostered, and anticipates an ongoing partnership on issues of mutual concern in Portland Harbor.

Sincerely,

Linda Scheffler
Water Resources Program Manager
Superfund Program

cc: Rich Muza / EPA
    Kristine Koch / EPA
    Keith Johnson / DEQ (w/out attachment)
    Kim Cox / City of Portland
    Nanci Klinger / Office of the City Attorney

Enc.
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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>BDS</td>
<td>Bureau of Development Services</td>
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<td>BES</td>
<td>Bureau of Environmental Services</td>
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<tr>
<td>BMP</td>
<td>Best Management Practice</td>
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<tr>
<td>CBWTP</td>
<td>Columbia Boulevard Wastewater Treatment Plant</td>
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<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<td>City</td>
<td>City of Portland</td>
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<td>Closure Report</td>
<td>Closure Report for City of Portland Outfalls Project</td>
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<tr>
<td>CSO</td>
<td>combined sewer overflow</td>
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<td>DEQ</td>
<td>Oregon Department of Environmental Quality</td>
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<td>ECSI</td>
<td>Environmental Cleanup Site Information</td>
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<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<td>IGA</td>
<td>Intergovernmental Agreement</td>
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<td>ISA</td>
<td>Initial Study Area</td>
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<td>JSCS</td>
<td>Joint Source Control Strategy</td>
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<td>LWG</td>
<td>Lower Willamette Group</td>
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<tr>
<td>MOA</td>
<td>Memorandum of Agreement</td>
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<td>MOU</td>
<td>Memorandum of Understanding</td>
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<tr>
<td>Municipal Report</td>
<td>Municipal Stormwater Source Control Report for Portland Harbor</td>
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<tr>
<td>MS4</td>
<td>Municipal Separate Storm Sewer System</td>
</tr>
<tr>
<td>ND</td>
<td>not detected</td>
</tr>
<tr>
<td>NEC</td>
<td>No Exposure Certification</td>
</tr>
<tr>
<td>NJ</td>
<td>tentatively identified and estimated</td>
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<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
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<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
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<tr>
<td>Outfalls Project</td>
<td>City of Portland Outfalls Project</td>
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<tr>
<td>PBOT</td>
<td>Bureau of Transportation</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>PCB</td>
<td>polychlorinated biphenyl</td>
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<td>Portland Development Commission</td>
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<tr>
<td>Port</td>
<td>Port of Portland</td>
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<tr>
<td>RI</td>
<td>remedial investigation</td>
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<tr>
<td>RI/FS</td>
<td>remedial investigation / feasibility study</td>
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<tr>
<td>RM</td>
<td>river mile</td>
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<tr>
<td>SCE</td>
<td>source control evaluation</td>
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<tr>
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<td>source control measure</td>
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<tr>
<td>SLV</td>
<td>screening level value</td>
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<tr>
<td>Study Area</td>
<td>Portland Harbor Study Area</td>
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<tr>
<td>SWCM</td>
<td>stormwater control mechanism</td>
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<tr>
<td>SWMM</td>
<td>Stormwater Management Manual</td>
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<tr>
<td>SWMP</td>
<td>Stormwater Management Plan</td>
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<tr>
<td>SWPCP</td>
<td>stormwater pollution control plan</td>
</tr>
<tr>
<td>TMDL</td>
<td>total maximum daily load</td>
</tr>
<tr>
<td>TSS</td>
<td>total suspended solids</td>
</tr>
<tr>
<td>µg/L</td>
<td>micrograms per liter (i.e., parts per billion)</td>
</tr>
<tr>
<td>WPCL</td>
<td>Water Pollution Control Laboratory</td>
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SECTION 1. Introduction

The City of Portland (City) developed this Municipal Stormwater Source Control Report for Portland Harbor (Municipal Report) to meet two objectives. The first objective is to support the Oregon Department of Environmental Quality’s (DEQ) forthcoming report that will summarize how source control is being achieved in Portland Harbor. This Municipal Report describes the City stormwater source control programs being implemented citywide and in the harbor. The second objective is to provide context for the attached Closure Report for the City of Portland Outfalls Project (Closure Report) documenting the City’s completion of an intergovernmental agreement (IGA) with DEQ for remedial investigation and source control in the municipal stormwater conveyance systems in Portland Harbor.

Investigating and controlling sources to the municipal storm system required a different approach than typically has been used for remedial investigation of upland properties. Because some identified sources required onsite remedial investigation or action, City regulatory authority alone would not have been sufficient for achieving source control at all identified sources. Therefore, under the IGA with DEQ and in close coordination with the U.S. Environmental Protection Agency (EPA), the City and its agency partners collaborated on a Portland Harbor source investigation (the City of Portland Outfalls Project [Outfalls Project]) to identify contaminant sources to the 39 City outfalls in Portland Harbor, and to ensure that all identified sources were referred to an appropriate source control program. This report explains the City’s general approach to source investigation and control in the municipal stormwater conveyance system and identifies the various City programs that improve stormwater quality in the harbor. Appended to this report is the Closure Report (see Appendix A).

Information presented in the Closure Report represents the culmination of more than a decade of coordinated, targeted work investigating sources to the municipal stormwater conveyance systems in the harbor and identifying mechanisms to ensure their long-term control. During the course of the investigation, the City prepared and submitted more than 50 technical reports to DEQ that document findings of the outfall remedial investigations and the source control referrals. Given the magnitude of the work completed and the availability of previous reports that present the technical details of the Outfalls
Project, the City worked with DEQ and EPA to formulate a format and level of content for this final report. The Closure Report in Appendix A summarizes how the City has met the IGA requirements and includes individual “Outfall Basin Completion Summaries” to demonstrate how IGA objectives have been achieved for each outfall.

As a result of the Outfalls Project, contaminant sources were identified and controlled by the dischargers, existing programs were modified to manage stormwater from sites with legacy contamination, new or revised regulations were created when needed, and interagency collaboration on stormwater quality concerns was improved. The City has completed the Outfalls Project, and the City’s programs that improve stormwater quality in the harbor will continue. Ongoing implementation of stormwater quality initiatives by the City, DEQ, and EPA will be essential to ensuring that each agency’s respective regulatory and programmatic functions continue to reduce contaminant discharges to the Willamette River via the municipal stormwater conveyance system, and minimize the potential risk of sediment recontamination after inriver remediation has been completed.

1.1 Purpose of Document

This Municipal Report presents how the City has completed its targeted Portland Harbor source investigation (the Outfalls Project) under an IGA with DEQ and how the City will continue to work with DEQ and other partners on the long-term implementation of source control programs. This report describes:

- The City’s general approach to source investigation and control in the municipal stormwater conveyance system.
- The City’s various stormwater source control programs and regulations that provide current and future protection of Portland Harbor and water resources citywide.

The Municipal Report is intended to supplement DEQ’s final report to EPA on Portland Harbor upland source control and to provide background information for the Closure Report included as Appendix A.

The purpose of the Closure Report is to support a DEQ Source Control Decision and Notice of Completion for the Outfalls Project. The Closure Report includes:

- A summary of City completion of the IGA Scope of Work.
- The rationale for concluding that source investigation is complete in every City outfall basin within Portland Harbor.
1.2 Report Organization

The remainder of this report is organized as follows:

- **Section 2: Background** — Summarizes the regulatory context and setting for City stormwater source investigation and control in Portland Harbor
- **Section 3: Outfall Basin Source Investigation** — Describes the objectives, approach, and findings of the Outfalls Project
- **Section 4: City Source Control Programs for Stormwater** — Describes the nature of stormwater source controls that are implemented through various City programs and code requirements
- **Section 5: Conclusions** — Summarizes the completion of the Outfalls Project and the City’s current and future role in Portland Harbor stormwater source control
- **Section 6: References**
- **Appendix A: Closure Report for the City of Portland Outfalls Project** — Summarizes the satisfaction of IGA requirements and presents how IGA objectives were met for each City outfall basin
- **Appendix B: Portland Harbor Land Use Map Development** — Describes the methodology used for creating the land use map used in the report
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SECTION 2. Background

2.1 Regulatory Overview

2.1.1 Federal and State Roles

A 1997 study initiated by EPA and DEQ (EPA, 1998) identified elevated levels of hazardous substances in shallow, nearshore sediments throughout Portland Harbor. On December 1, 2000, EPA placed the Portland Harbor site (see Figure 2-1) on the National Priorities List under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which established the Superfund program. The roles of the lead agencies involved with the investigation, cleanup, and source control of this site were defined by a Memorandum of Understanding (MOU) entered among DEQ, EPA, other agencies, and Tribes effective February 8, 2001. DEQ is designated as the lead agency for implementing environmental investigation and source control at upland facilities in the harbor under state cleanup authorities. EPA is designated as the lead agency for implementing environmental investigation and cleanup of in-water sediments in the Portland Harbor using CERCLA authorities. In 2001, EPA and members of the Lower Willamette Group (LWG) entered into an Administrative Order on Consent to conduct a remedial investigation/feasibility study (RI/FS) for in-water sediment below the mean high water mark in Portland Harbor (EPA, 2001).

Historically and currently, there are many pathways by which upland contamination may have reached the river, such as overwater spills, bank erosion, stormwater, groundwater, and industrial wastewater discharges. For the upland areas in Portland Harbor, the MOU specified that DEQ and EPA jointly develop a source control strategy that defines the process...
for identifying and controlling sources of contamination that could have adverse effects on the river. DEQ and EPA issued the Portland Harbor Joint Source Control Strategy (JSCS) in 2005, which established a framework for ensuring that sources and potential migration pathways to the river are evaluated and addressed (DEQ and EPA, 2005). The objective of the JSCS is to complete upland source control in the harbor so that inriver cleanup can proceed without threat of recontamination from upland areas.

Because stormwater has been identified in other Superfund sites as contributing to sediment recontamination after a sediment remediation project has been completed, DEQ is evaluating upland stormwater discharges to determine whether they pose reasonably likely future migration pathways for site contaminants to be transported to the river. DEQ issued its Guidance for Evaluating the Stormwater Pathway at Upland Sites (DEQ, 2009) to provide more detailed information to DEQ Cleanup Program project managers and upland sites on investigating and controlling contaminant discharges via the stormwater pathway. The DEQ Cleanup Program enters into agreements with individual owners of sites with known or suspected contamination, to determine whether remedial actions or source controls are warranted at the site.

### 2.1.2 City Stormwater Source Control

The City is a member of the LWG, and has the challenge of balancing many roles in Portland Harbor. The City Council designated the Bureau of Environmental Services (BES) as its lead agency for Portland Harbor. In this role, BES works within the LWG, with other City bureaus and programs, and with DEQ and EPA to help meet Portland Harbor objectives and to be an ongoing steward of the Willamette River.

The City works in multiple capacities to achieve Portland Harbor stormwater source control objectives, including as a:

- **Regulator** — working with private property owners to implement stormwater quality and pollution prevention programs under City, state, and federal guidelines.

- **Provider of public conveyance services** — working to ensure that contaminant discharges to City conveyance systems are identified and dischargers enter into City or state programs to control or eliminate those discharges.

- **Property owner** — implementing stormwater source controls as needed at City-owned properties in the harbor.

City stormwater source control programs predate the listing of Portland Harbor as a Superfund site. However, Portland Harbor includes unique upland conditions, such as older industrial areas with legacy site contaminants that were not necessarily being identified or adequately controlled by current site owners.
and operators. For this reason, the City determined that the following were needed: (1) a specific Portland Harbor source investigation to ensure that all major sources to the City’s stormwater conveyance systems in the harbor were identified and referred to appropriate state or City programs for control; and (2) evaluation of City and state stormwater source control programs to identify areas where program modifications were warranted to ensure long-term protection of river sediment and water quality. In partnership with DEQ, the City developed the Outfalls Project to meet these needs (see Section 2.1.3).

It should be noted that while many City programs are implemented citywide and throughout the Portland Harbor drainage area, others are limited only to the drainage area served by City conveyance systems (which represents about 50 percent of the upland area in the harbor). Section 4 describes the municipal stormwater source control programs and program coverage within the harbor.

Within the harbor, there are also properties owned by the City. The City identifies and implements stormwater best management practices as needed to control potential contaminant exposures to stormwater. Some of these sites were contaminated by historical industrial operations before acquisition by the City. Under separate agreements with the DEQ Cleanup Program, the City completes remedial investigations and if needed, remedial actions, to ensure that City properties do not pose adverse risks to human health and the environment and are not likely to cause recontamination of inriver sediment.

Details of investigations and decisions at these sites are not included in this report because they are covered under separate agreements with DEQ.1

### 2.1.3 City and DEQ Partnership

Following the completion of the initial Portland Harbor sediment study in 1997, the City began evaluating the sediment data to assess whether City stormwater conveyance systems in the harbor may be providing pathways to the river for contaminants from upland sites. The City entered into a voluntary cleanup agreement with DEQ to conduct a preliminary assessment of the City’s stormwater outfalls within the Portland Harbor Study Area (Study Area) (DEQ, 2000). The City and DEQ recognized that the regulatory authorities of both agencies would need to be implemented in order to identify and control contaminant sources to the river. Therefore, the City and the DEQ Cleanup Program began working together to develop a unique cooperative approach to source investigation and control for the Outfalls Project. Section 3 summarizes the specific work (e.g., preliminary assessments and pilot studies) conducted by the City on the Outfalls Project, before the formal IGA with DEQ.

In 2003, the City and DEQ entered into the Outfalls Project IGA to provide the framework for ongoing cooperative work to investigate and control potential

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1 City properties that are in the DEQ Cleanup Program and that discharge to City outfalls in the harbor are identified in the Completion Summaries in Appendix A.
upland sources of contaminants to the City stormwater conveyance system that could adversely affect sediment and surface water quality in Portland Harbor (DEQ, 2003). The IGA established mutual objectives for jointly conducting a remedial investigation and implementing source control measures within the system drainage area. The goals of the IGA were to use respective authorities to:

1. Identify all potentially significant sources of contaminants to the City stormwater conveyance systems in the harbor.

2. Ensure that all identified sources are in a program to implement source controls, where needed, to minimize or prevent the potential for sediment recontamination from those sources.

Under the agreement, the City provided technical support to DEQ on site discovery, site information from the BES Industrial Stormwater Program, source investigation findings, and feedback on stormwater pathway evaluations being conducted at DEQ Cleanup Program sites discharging to City storm systems. DEQ used information collected by the City to identify sites for DEQ Cleanup Program consideration and to inform site work plans and data evaluations. The City and DEQ also evaluated existing stormwater source control programs and modified programs to meet long-term Portland Harbor objectives. More information on the City’s general approach implemented to meet the IGA objectives is provided in Section 3. Section 4 includes a discussion of the adaptive management process the City is applying in the harbor. The Closure Report is provided in Appendix A.

In addition to the IGA for the outfalls investigation, the City and DEQ entered into a separate IGA in 2004 to provide funding for a new Portland Harbor Stormwater Source Control Coordinator position in the DEQ Cleanup Program (DEQ, 2004). The coordinator is assigned to work on cross-program stormwater issues with the DEQ Water Quality and Hazardous Waste Programs and the City, and to provide programmatic and site-specific regulatory assistance related to stormwater source control in the harbor.

### 2.2 Setting

#### 2.2.1 Location

The Willamette River drains the entire basin that lies between the Cascade Range and the Coast Range in western Oregon. Portland Harbor is at the downstream end of this large watershed, just upstream from the confluence of the Willamette River with the Columbia River. The Study Area is the stretch of the Willamette located between River Miles (RM) 1.9 and 11.8, or roughly between the southern end of Sauvie Island and the Broadway Bridge (see Figure 2-2). The Willamette River basin upstream of Portland is approximately 11,500 square miles, whereas the current Portland Harbor drainage area is approximately 18 square miles.
Figure 2-2 includes the 2013 hydrologic boundary (i.e., “hydroboundary”), which delineates the land area adjacent to the Study Area that is served by stormwater conveyance systems that discharge to the Willamette River.2

2.2.2 Physical Characteristics

Historically, the Willamette River in the Portland area comprised an extensive and interconnected system of active channels, open slack waters, emergent wetlands, riparian forest, and adjacent upland forests. During the past 150 years, the Portland Harbor reach of the river has been redirected, straightened, filled, and deepened by dredging. Most of the riverbank has been filled, stabilized, and/or engineered for industrial or port operations with riprap, bulkheads, and overwater piers and docks. The river flow varies dramatically with the seasons, with low late summer dry-season levels and high rainy season and spring snow melt levels; during low flow conditions, periodic flow reversals within Portland Harbor also occur as a result of tidal effects. The Willamette River flows into the Columbia River and the Multnomah Channel.3 River stage and velocity within the Study Area are influenced by hydrologic conditions in the Willamette and Columbia rivers, including effects from dam operations on both waterways.

The width and depth of the river affect flow velocities and determine in part where sediment is eroded and deposited. Sediments moving down the river from upstream tend to accumulate in some areas and scour from others. Areas within the main channel tend to be more prone to natural disturbances (e.g., high seasonal flows) than sediments in off-channel areas, such as coves and the Swan Island Lagoon. Hydrodynamic and sediment transport characteristics vary within the Study Area as a function of multiple factors, such as the channel width and depth, degree of tidal influence, off-channel features, and other localized influences, such as propwash from shipping activities. Potential effects of stormwater discharges to the river also will vary depending on the nature of the localized area where stormwater discharge occurs.

2.2.3 Stormwater

The term “outfall” is used in this report to describe a piped point of discharge to the Willamette River from a conveyance system. Outfalls in Portland Harbor convey stormwater, wastewater, and/or combined sewage (i.e., a mix of stormwater and sanitary sewage) to the river from upland properties. There are 39 City outfalls in the Study Area, 36 of which currently discharge stormwater.4 More than 400 non-City outfalls also are located within the Study Area. These conveyance systems are operated by other public entities (e.g., the Oregon

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2 The hydroboundary is subject to change when modifications to existing stormwater conveyance systems or drainage are made and when new systems are constructed during property development.

3 Under certain conditions more than half the river flow is directed into the M. Channel.

4 The remaining three outfalls either have no flow at all (i.e., all historical connections to it have been sealed) or only function as a combined sewer overflow discharge point (see Section 2.3.2).
Department of Transportation [ODOT] and the Port of Portland [Port]) and private entities. Some outfalls convey stormwater from multiple parties (i.e., shared systems), while others are dedicated to a single entity. City and non-City outfalls are shown in Figure 2-2. The Outfalls Project addresses only City outfalls, which are described in more detail in Section 2.3.

Given the size of the Willamette River drainage basin relative to the Portland Harbor drainage area, stormwater discharging to Portland Harbor represents a small fraction of the river flow leaving the harbor. At DEQ’s request, BES conducted an analysis of the contribution of stormwater flows to the river from the Study Area compared to the total flow in the Willamette River. Based on this analysis, the average annual runoff volume from the harbor is 0.06 percent of the total Willamette River flow; the contribution varies, depending on seasonal conditions and rain patterns, but Portland Harbor stormwater flows are 0.1 percent or less of the river flow at any given time (BES, 2006a).

2.2.4 Historical Development Overview

Understanding the history of industrial development and locations of industrial activities in Portland Harbor provides insight to the current potential sources of contaminants to the river via stormwater discharges. Many historical industrial activities resulted in contaminated soil and/or groundwater that still may be potential sources to the river, even if current land use does not appear to pose risk of contaminant releases.

The Study Area remained largely undeveloped through the late 1800s. Early industrial and commercial development along the river began in scattered areas, such as downtown Portland, St. Johns, Linnton, and Macadam (LWG, 2007). Industrial activities typically were located within narrow strips along the riverfront, while pockets of residential development existed in areas upgradient of the industrial areas, such as in the St. Johns and Linnton neighborhoods. Most of these waterfront industrial sites constructed private conveyance systems that discharged directly to the river.

At the beginning of the 20th century, businesses began to relocate from downtown to the current industrial areas of the harbor, especially the waterfront, as commercial development in the downtown area prevented further industrial expansion. Commercial and industrial land use in Portland Harbor accelerated in the 1920s and again during World War II, which reinvigorated industry following the Great Depression. During the war years, a considerable number of Liberty ships, minesweepers, and T-2 tankers were built at military shipyards located in Portland Harbor. A number of these shipyards also were involved in ship repair. Following the war, some of the shipbuilding facilities closed, but a few remained and were repurposed for scrapping the military’s surplus and obsolete vessels. The years following the war also saw an increase in industrial development, which continued to spread throughout the Study Area. In addition to shipbuilding and repair, historical industrial land uses in Portland Harbor included lumber and steel mills, foundries, fuel facilities, rail yards, and
manufacturing facilities (LWG, 2007).

By 1985, most industries were gone from the west downtown area, except for several located on waterfront properties and the Hoyt Street Railyard. On the east side, heavy industrial operations continued along the riverfront downstream of downtown, starting from about the Steel Bridge. Light industrial activities were more widespread on the east side and interspersed with other land uses.

2.2.5 Current Land Use

Land use is an important consideration for stormwater source investigation and control because different land uses generally have different potential pollutant exposures and release mechanisms that may affect stormwater quality. For example, developed industrial areas with outdoor operations likely represent a higher risk of contaminant release to stormwater than commercial and residential areas where chemical products and materials are not handled in large quantities.

Current land use within the Study Area is a mix of heavy and light industrial, commercial, major transportation (i.e., highways and freeways), residential, and open space. Industrial land uses have been a focus of stormwater investigation in the harbor because other studies have shown that contaminant loading from industrial land uses typically is higher for many chemicals than other land uses, such as residential, commercial, and open space (Anchor and Integral, 2007). During the course of the Outfalls Project, the City evaluated current and historical land uses within specific drainage areas to inform where targeted investigations may be needed to identify current contaminant sources.

City zoning regulates general land use patterns for development in the City and can be used as a surrogate for evaluating land use. Figure 2-3 is a map of current land uses within the Study Area (refer to Appendix B for additional information about the map). Figure 2-3 provides a useful depiction of land use patterns, but it is not necessarily accurate for all individual properties because actual land use in some areas may not match zoning (e.g., undeveloped properties and non-conforming uses). Table 2-1 summarizes land use acreages within the Study Area and within the portion of the Study Area drained by City outfalls.

The predominant land use/zoning classifications in the Study Area are parks and open space (58 percent of total drainage area) and industrial (31 percent of total drainage – including light and heavy industrial), as shown in Table 2-1. The remaining land use categories combined comprise approximately 11 percent of the Study Area.5

---

5 Note that the General Employment zoning is included in the non-industrial percentage because in the harbor, this zoning often is used to allow a transition from industrial to other land uses. For example, the Triangle Park site was zoned industrial, but was changed to General Employment when the University of Portland purchased it for expansion of its campus.
Table 2-1. Land Use Totals within the Portland Harbor Hydroboundary (2013 Conditions)

<table>
<thead>
<tr>
<th>Acres Per Land Use Classification</th>
<th>Heavy Industrial</th>
<th>Light Industrial</th>
<th>General Employment(^1)</th>
<th>Major Transportation(^2)</th>
<th>Commercial</th>
<th>Residential</th>
<th>Parks and Open Space</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total for Each Land Use within Hydroboundary</strong>(^3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres</td>
<td>2,767</td>
<td>636</td>
<td>266</td>
<td>303</td>
<td>66</td>
<td>719</td>
<td>6,535</td>
<td>11,292</td>
</tr>
<tr>
<td>% of Total</td>
<td>25%</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
<td>&lt;1%</td>
<td>6%</td>
<td>58%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total for Drainage through City Outfalls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres</td>
<td>795</td>
<td>498</td>
<td>137</td>
<td>128</td>
<td>58</td>
<td>488</td>
<td>3,693</td>
<td>5,797</td>
</tr>
<tr>
<td>% of Total City Drainage</td>
<td>14%</td>
<td>9%</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>8%</td>
<td>64%</td>
<td>100%</td>
</tr>
<tr>
<td>% of PH Land Use Category</td>
<td>29%</td>
<td>78%</td>
<td>52%</td>
<td>42%</td>
<td>88%</td>
<td>68%</td>
<td>57%</td>
<td>51%</td>
</tr>
<tr>
<td><strong>Total for Drainage through Non-City Outfalls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres</td>
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<td>129</td>
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<td>8</td>
<td>231</td>
<td>2,842</td>
<td>5,495</td>
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<tr>
<td>% of PH Land Use Category</td>
<td>71%</td>
<td>22%</td>
<td>48%</td>
<td>58%</td>
<td>12%</td>
<td>32%</td>
<td>43%</td>
<td>49%</td>
</tr>
</tbody>
</table>

PH = Portland Harbor

\(^1\) General employment is a Portland zoning category that allows a range of employment opportunities, but emphasizes industrial and industrial-support uses (see Appendix B).

\(^2\) Acreage for this land use category includes both developed and undeveloped Oregon Department of Transportation (ODOT) drainage areas.

\(^3\) Hydroboundary acreage does not include the surface area of the river.

The City’s stormwater outfalls drain about 50 percent of the total area within the hydroboundary. Parks and open space comprise approximately 64 percent of the acreage drained by City outfalls. There are a couple of key differences between the hydroboundary land use acreages drained by City outfalls versus areas drained by non-City outfalls:

- The majority of heavy industrial drainage is in the non-City drainage area because much of the heavy industrial development is along the shoreline where properties discharge directly to the river.
- The majority of the light industrial land is in the City drainage areas.
- City stormwater systems serve the majority of commercial, residential, and parks and open space areas within the hydroboundary.
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2.2.6 Road and Rail Corridors

The Study Area includes state roads, City roads, private roads, and railroad corridors. Some roads are impervious (i.e., improved with pavement) while others are pervious (e.g., gravel or dirt). The term “right-of-way” refers to an area between taxable properties where a right has been granted to establish a public transportation corridor. City roads, state roads, and some rail corridors are located within these rights-of-way. In some cases, there are areas where rights-of-way have been granted and planned, but never exercised (e.g., residential platting in what is now Forest Park included rights-of-way). Most rights-of-way are much wider than the developed roadway or railroad within them. Often rights-of-way include a mix of paved and unpaved surfaces (e.g., paved road surface and unpaved shoulders or areas between the curbs and the adjacent properties). Stormwater discharge from rights-of-way typically is generated from the impervious portions. Stormwater from roadways in some residential areas is routed through green infrastructure that provides treatment (e.g., engineered swales) and in other less developed areas, such as Linnton and Forest Park, road runoff drains to roadside ditches that allow for some stormwater infiltration and a portion of the suspended solids to settle.

Table 2-2 and Figure 2-4 depict the impervious areas within the Study Area, including City and state roads, and buildings and impervious surfaces on individual properties.

Within the Study Area, there is a relatively low prevalence of paved City roads (i.e., 2 percent of the total area). Typically, commercial and residential areas have more roads than do industrial areas because there are more individual tax lots within a given area (i.e., properties are smaller). However, as summarized in Table 2-1, these land uses comprise a small proportion (<7 percent) of the Study Area, and there is a large amount of open space (58 percent) where few paved roads are present. Many of the tax lots in the industrial areas are larger to

<table>
<thead>
<tr>
<th>Table 2-2. Portland Harbor Impervious Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Total Impervious Area</td>
</tr>
<tr>
<td>City Paved Road</td>
</tr>
<tr>
<td>State Paved Road</td>
</tr>
<tr>
<td>Private Pavement</td>
</tr>
<tr>
<td>Buildings</td>
</tr>
</tbody>
</table>

1Total upland portion of Study Area is 11,292 acres.
2Total area within City basins is 5,797 acres.
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accommodate industrial activities, so fewer roads are needed to access individual sites. In addition, a number of industrial properties use rail and shipping to move materials and goods, and many properties are served by state roads (e.g., Highway 30).

2.3 City Drainage in the Harbor

2.3.1 Stormwater System

As summarized in Table 2-1, City stormwater outfalls drain approximately half of the Portland Harbor upland area. Thirty-six City outfalls in the Study Area convey stormwater to the river from the municipal system. Three additional City outfalls are present, but no longer discharge stormwater to the river; all connections to Outfall 23 have been sealed; and Outfalls 24 and 46 now function only during infrequent overflows from the City’s combined sewer system (see Section 2.3.2). City outfalls are located in each of the nine general geographic regions of the Study Area described in Table 2-3.

To facilitate the remedial investigation of the City outfalls, the City delineated the drainage area for each outfall using conveyance system maps, facility records, and topography. These drainage areas are referred to as “outfall basins.” City outfall basins convey drainage from City stormwater lines and connecting stormwater lines constructed by other parties (e.g., ODOT lines and lines constructed on private property). Actual basin drainage areas are subject to change as development and redevelopment occur. In addition, it should be noted that the City used a conservative approach when delineating basins for the

<table>
<thead>
<tr>
<th>General Location</th>
<th>Study Area Region</th>
<th>Reach (RM)</th>
<th>City OF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream</td>
<td>Pearl District Area</td>
<td>10.3 - 11.8</td>
<td>10A, 11, 13, 14, 15</td>
<td>Encompasses area at the north end of downtown where current land use near river is shifting from industrial to residential/commercial.</td>
</tr>
<tr>
<td></td>
<td>Guilds Lake Industrial Area</td>
<td>8.0 - 10.3</td>
<td>16, 17, 18, 19, 19A</td>
<td>This industrial area was mostly created by the filling of Guilds Lake in the 1920s. Area extends roughly from NW Nicolai to NW Kittredge.</td>
</tr>
<tr>
<td>West Side</td>
<td>Willbridge/ Doane Lake Area</td>
<td>6.0 - 8.0</td>
<td>22, 22B, 22C</td>
<td>This industrial area includes the Willbridge bulk oil and chemical distribution terminals and the former Doane Lake complex that subsequently became the location for chemical, steel, and gas manufacturing; battery and metals recycling; and multiple landfills.</td>
</tr>
<tr>
<td>Downstream</td>
<td>Linnton Area</td>
<td>3.0 - 6.0</td>
<td>22D, 23*, 24*</td>
<td>Encompasses the historical town of Linnton with a mix of shoreline industrial development and residential/commercial development along Highway 30. Area extends roughly from the St. Johns Bridge to the Multnomah Channel.</td>
</tr>
</tbody>
</table>
source investigation. To ensure that potential source areas were not overlooked, delineations for some basins include areas where stormwater likely infiltrates rather than discharges to the City conveyance system (e.g., gravel portions of rail yards and substations). For these reasons, outfall basin delineations presented in this report are approximate in some locations.

Table 2-4 summarizes the physical characteristics of the 39 City outfalls present within the Study Area, and Figure 2-5 presents the 36 City stormwater drainage basins. Outfalls 23, 24, and 46 do not have stormwater drainage basins affiliated with the outfalls because stormwater from the historical affiliated drainage basins has been diverted to the City’s wastewater treatment plant (see Section 2.3.2).
<table>
<thead>
<tr>
<th>Outfall ID</th>
<th>River Mile</th>
<th>Outfall Size</th>
<th>Basin Acreage</th>
<th>Heavy Industrial</th>
<th>Light Industrial</th>
<th>General Employment</th>
<th>Commercial</th>
<th>Residential</th>
<th>Parks and Open Space</th>
<th>Major Transportation</th>
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<tbody>
<tr>
<td><strong>West Side</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OF 10A</td>
<td>11.6</td>
<td>30&quot;</td>
<td>2.9</td>
<td>--</td>
<td>--</td>
<td>0.5</td>
<td>1.2</td>
<td>1.2</td>
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<td>--</td>
</tr>
<tr>
<td>OF 11</td>
<td>11.4</td>
<td>78&quot;</td>
<td>948.8</td>
<td>--</td>
<td>--</td>
<td>56.4</td>
<td>38.1</td>
<td>344.4</td>
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<td>2.0</td>
<td>--</td>
<td>0.3</td>
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<td>--</td>
<td>--</td>
<td>0.1&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>4.8</td>
<td>--</td>
<td>7.6</td>
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<td>--</td>
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<td>--</td>
<td>--</td>
<td>--</td>
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<td>70.6</td>
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<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>4.4</td>
</tr>
<tr>
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<td>76.0</td>
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<td>--</td>
<td>1.6</td>
<td>36.6</td>
<td>1368.0</td>
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<td>--</td>
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<td>2.7</td>
<td>269.1</td>
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<td>29.4</td>
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<td>--</td>
<td>--</td>
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<td>--</td>
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<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>East Side</strong></td>
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<td></td>
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</tbody>
</table>
### Table 2-4. City Outfall Physical Characteristics

<table>
<thead>
<tr>
<th>Outfall ID</th>
<th>River Mile</th>
<th>Outfall Size</th>
<th>Basin Acreage</th>
<th>Heavy Industrial</th>
<th>Light Industrial</th>
<th>General Employment</th>
<th>Commercial</th>
<th>Residential</th>
<th>Parks and Open Space</th>
<th>Major Transportation</th>
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</thead>
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<td>5.7</td>
<td>30&quot;</td>
<td>24.5</td>
<td>0.01</td>
<td>--</td>
<td>15.5</td>
<td>--</td>
<td>4.7</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>OF 52A</td>
<td>5.6</td>
<td>36&quot;</td>
<td>26.1</td>
<td>2.1</td>
<td>12.5</td>
<td>4.7</td>
<td>0.4</td>
<td>4.2</td>
<td>2.2</td>
<td>--</td>
</tr>
<tr>
<td>OF 52C</td>
<td>4.4</td>
<td>36&quot;</td>
<td>21.6</td>
<td>--</td>
<td>21.4</td>
<td>0.2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>OF 52D</td>
<td>3.9</td>
<td>24&quot;</td>
<td>23.9</td>
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<td>--</td>
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<td>--</td>
</tr>
<tr>
<td>OF 53</td>
<td>5.2</td>
<td>48&quot;</td>
<td>21.2</td>
<td>--</td>
<td>--</td>
<td>1.1</td>
<td>0.8</td>
<td>19.3</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>OF 53A</td>
<td>2.7</td>
<td>48&quot;</td>
<td>72.6</td>
<td>72.6</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.05</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*Major Transportation acreage in the basin likely is less than this value or none. When land use occurs in multiple vertical dimensions (e.g., State highways elevated over separate land use beneath), the land use map assigns a value to the top layer, but not the underlying land use. This can result in minor inaccuracies in calculated acreages.*
2.3.2 Combined Sewer Control

In addition to separated stormwater and sanitary sewer conveyance systems, the City’s conveyance systems in the harbor include combined sewers, primarily in certain residential and commercial areas, that carry a mix of stormwater and sanitary sewage. Eight outfalls currently have the potential to discharge a combination of stormwater and sanitary sewage during what is called a combined sewer overflow (CSO). CSOs can occur when the capacity of the combined sewer system is exceeded during heavy rain events. When they occur, CSO discharges on average include approximately 80 percent stormwater and 20 percent sanitary wastewater.

In the late 1940s, the City began to construct large interceptor pipes to reduce the amount of combined sewer flow reaching waterways by routing wastewater to the Columbia Boulevard Wastewater Treatment Plant (CBWTP), which started operating in 1952. Additional work involved constructing new separated stormwater and sanitary systems in areas traditionally served by a combined system, primarily in the industrial areas between the river and the residential and commercial developments that typically are located farther from the river.

Starting in the early 1990s under DEQ oversight, the City began implementing a 20-year CSO Abatement Program that included measures to significantly reduce overflows to the Willamette River (BES, 2012a). The objective of the CSO Abatement Program for the Willamette was to reduce the average number of CSO events (i.e., “control” CSO outfalls) to no more than four per winter and one every three summers.

The City initiated the CSO Abatement Program with the Cornerstone Projects, which were designed to reduce the volume of stormwater entering the combined sewer system. In neighborhoods on the east side of the Willamette River, the City worked with residents to redirect stormwater flow from roof drains away from the combined sewer system and into yards where stormwater can infiltrate. On the west side, the City completed the Tanner Creek Stream Diversion Project to reroute underground stream flow from Tanner Creek away from the combined system and directly to the Willamette River. All of the CSO outfalls downstream of RM 9.8 were controlled before the Portland Harbor was listed as a Superfund site; this was about one half of the CSO outfalls in the Study Area.

CSO projects included major infrastructure improvements on the west and east sides of the Study Area. In 2006, the City completed the West Side Big Pipe – a large tunnel that controls CSO outfalls on the west side of the Willamette River by conveying combined sewage to a new pump station on Swan Island and on to the CBWTP. By 2011, a similar tunnel on the east side, the East Side Big Pipe, was also in operation to control CSO outfalls on the east side of the river. The City completed the CSO Abatement Program in 2011. All CSO outfalls are now controlled.

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6 A video summarizing the City CSO Abatement Program is available for online viewing at: [http://www.portlandoregon.gov/bes/article/402830](http://www.portlandoregon.gov/bes/article/402830)
Before completion of the new West Side and East Side Big Pipes (i.e., tunnels), CSO outfalls within the harbor were subject to overflows from combined sewer drainage areas affiliated with each outfall. Now the CSO outfalls in the harbor where overflows are most likely to occur (i.e., up to four CSO events per winter) are subject to overflows from the tunnels, which contain combined sewer flow from broader drainage areas. In other words, these CSO outfalls now function as relief points for periodic heavy rainfall events that cause backups in the west side or east side tunnels, and combined sewage from the basin only overflows when the tunnel overflows (see Figure 2-6).

Figure 2-7 provides an overview of the major facilities in the City’s combined sewer system and the CSO outfalls in the harbor (BES, 2011a). Table 2-5 summarizes the City outfalls in the harbor that were controlled under the 20-year CSO Abatement Program.

In addition to the reductions of stormwater discharges to the harbor from CSO events, the CSO Abatement Program resulted in the diversion of approximately 600 acres of formerly separated stormwater drainage, including about 165 industrial acres, from the river to the CBWTP. Current stormwater drainage through City outfalls is depicted in Figure 2-5. Figure 2-8 displays the spatial extent of CSO controls in Portland Harbor, as well as the specific areas where the City diverted separated stormwater to the CBWTP.
### Table 2-5.
Portland Harbor Outfalls Controlled as Part of the City’s 20-Year CSO Abatement Program

<table>
<thead>
<tr>
<th>Outfall ID</th>
<th>River Mile</th>
<th>Control Date</th>
<th>CSO Potential?</th>
<th>Control Method</th>
<th>Control Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>11.4</td>
<td>2006</td>
<td>No</td>
<td>Tanner Creek and West Side Facilities</td>
<td>Sealed</td>
</tr>
<tr>
<td>13</td>
<td>11.1</td>
<td>2006</td>
<td>No</td>
<td>West Side Facilities</td>
<td>Sealed</td>
</tr>
<tr>
<td>15</td>
<td>10.4</td>
<td>2006</td>
<td>Yes</td>
<td>Tanner Creek and West Side Facilities</td>
<td>3-Year Summer, 4-per Winter</td>
</tr>
<tr>
<td>17</td>
<td>9.8</td>
<td>2011</td>
<td>Yes</td>
<td>West Side Facilities; Balch Consolidation Conduit</td>
<td>10-Year Summer/Emergency</td>
</tr>
<tr>
<td>23</td>
<td>5.2</td>
<td>1992</td>
<td>No</td>
<td>System Improvements</td>
<td>Sealed</td>
</tr>
<tr>
<td>24</td>
<td>4.3</td>
<td>2000</td>
<td>Yes</td>
<td>Partial separation and pump station improvements</td>
<td>3-Year Summer</td>
</tr>
<tr>
<td>43</td>
<td>11.4</td>
<td>2011</td>
<td>Yes</td>
<td>East Side Facilities</td>
<td>3-Year Summer, 4-per Winter</td>
</tr>
<tr>
<td>44A</td>
<td>11.2</td>
<td>2011</td>
<td>No</td>
<td>East Side Facilities</td>
<td>Sealed</td>
</tr>
<tr>
<td>46</td>
<td>10.5</td>
<td>2006</td>
<td>Yes</td>
<td>Cornerstone Projects and East Side Facilities</td>
<td>3-Year Summer, 4-per Winter</td>
</tr>
<tr>
<td>47</td>
<td>9.9</td>
<td>2006</td>
<td>Yes</td>
<td>West Side Facilities</td>
<td>3-Year Summer, 4-per Winter</td>
</tr>
<tr>
<td>48</td>
<td>7.3</td>
<td>1996</td>
<td>No</td>
<td>Cornerstone Projects and System Improvements</td>
<td>Sealed</td>
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<tr>
<td>49</td>
<td>6.5</td>
<td>1995</td>
<td>No</td>
<td>Cornerstone Projects and System Improvements</td>
<td>Sealed</td>
</tr>
<tr>
<td>50</td>
<td>5.9</td>
<td>1995</td>
<td>No</td>
<td>Cornerstone Projects and System Improvements</td>
<td>Sealed</td>
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<tr>
<td>52</td>
<td>5.7</td>
<td>1995</td>
<td>Yes</td>
<td>Cornerstone Projects and System Improvements</td>
<td>3-Year Summer</td>
</tr>
<tr>
<td>53</td>
<td>5.2</td>
<td>1995</td>
<td>Yes</td>
<td>Cornerstone Projects and System Improvements</td>
<td>3-Year Summer</td>
</tr>
</tbody>
</table>
FIGURE 2-8

MAP NOTES: Date: December 2013, Data Sources: BES

NOTE: Land use/zoning data compiled for this map did not include all CSO control areas outside the hydroboundary.

LEGEND

- Approximate Controlled CSO Area
- Approximate Diverted
- Separated Stormwater Area
- River Mile (RM)
- Portland Harbor Hydroboundary

Land Use/Zoning

- Heavy Industrial
- Light Industrial
- General Employment
- Commercial
- Residential
- Parks and Open Space
- Major Transportation
SECTION 3. Outfall Basin Source Investigation

The City determined that an evaluation of contaminant sources in City basins was needed because of the unusual conditions in Portland Harbor, where historical industrial activities may have resulted in legacy contamination at upland areas with current pathways to the river. The Portland Harbor Remedial Investigation (LWG, 2011) concluded that “historical releases from upland or overwater activities likely contributed to the majority of the observed chemical distribution in sediments within the Study Area.” Some of these historical releases at upland sites may continue to be current sources if there is legacy contamination onsite. Because current site owners and operators may not have anticipated potential adverse impacts to site stormwater from legacy releases, the City developed and completed a Portland Harbor source control program (the Outfalls Project) to ensure that sources to City basins were identified and referred to appropriate programs for control. The Outfalls Project investigation is described in more detail below.

3.1 Pre-IGA Source Investigation Activities

The City began evaluating potential sources to City outfall basins in Portland Harbor in early 2000 in recognition of the sediment contamination observed in the harbor. Steps taken before the development of the Outfalls Project IGA with DEQ included conducting outfall preliminary assessments, development and completion of a Pilot Project, and collection of inriver sediment data near City outfalls. Data collected during early investigation of sources to the stormwater conveyance system informed the development of the IGA and the approach for future investigations in City outfall basins. These activities are described in more detail below.

3.1.1 Preliminary Assessment

In 2000, the City completed a preliminary assessment of outfall basins located within the Portland Harbor Initial Study Area (ISA), a roughly 6-mile stretch from RM 3.5 to RM 9.2.
The objective of the preliminary basin assessments was to compile available background information about each of the approximately 20 City outfalls in the ISA to determine where further source investigation may be warranted. Data included physical information about the outfalls, a comparison of nearby sediment data to DEQ preliminary “baseline” values for individual contaminants (DEQ, 1999), and summaries of upland site information within each basin (e.g., current and historical facility lists, stormwater permit data, spill and hazardous material records, etc.). The City submitted the basin information to DEQ in two reports – one for the east shore outfalls and one for the west shore outfalls (BES, 2000a and 2000b).

3.1.2 Pilot Project

After the completion of the preliminary basin assessments, DEQ and the City developed a collaborative pilot project approach for the outfall basin investigations. The Pilot Project objective was to formulate a process for:

- Evaluating the impacts of upland contaminants discharged to the City stormwater outfalls on Willamette River sediment quality.
- Identifying upland sources of contaminants within the outfall basins.
- Guiding source control efforts.

Outfall Basins 18 and M-1 (see Figure 2-5) were selected for the two-phased Pilot Project (CH2M HILL, 2002). Phase 1 entailed collecting inriver sediment samples in the immediate vicinity of the two outfalls and updating the basin assessments with new or revised information (CH2M HILL, 2003a, 2003b, and 2004a). The purpose of Phase 1 was to determine whether these outfalls were likely conduits for current sources of contaminants to river sediment and to identify which contaminants warranted further investigation in Phase 2. Phase 2 of the Pilot Project was designed to identify current sources of the contaminants identified in Phase 1 and to develop a collaborative approach between the City and DEQ for controlling identified sources. Phase 2 included collection and analysis of inline solids (i.e., sediments accumulated within City storm lines from upland drainage areas), observations of dry-weather flow in the conveyance systems, and comprehensive facility inspections within Basins 18 and M-1 (CH2M HILL, 2005).

The results of the Pilot Project were used as a model to streamline the collaborative source investigation and control processes in the remaining basins in the harbor.

---

7 “Dry-weather flow” is defined as non-stormwater flows from various sources including, but not limited to, diverted stream flow, groundwater infiltration, approved or permitted discharges (e.g., remediated groundwater, structure dewatering, non-contact cooling water), etc.
3.1.3 Outfall Sediment Sampling

After completing inriver sediment sampling near Outfalls 18 and M-1 under the Pilot Project, the City collected inriver sediment data (see Figure 3-1) from the remaining City stormwater outfalls in the ISA (CH2M HILL, 2004b). The City used these data to prioritize outfall basins for additional source investigation (see Section 3.3).

3.2 IGA Objectives and General Approach

In 2003, the City and DEQ entered into an IGA that established the framework for collaboration on source investigation and control in City outfall basins (DEQ, 2003). The Outfalls Project IGA constitutes the agreement between DEQ and the City to conduct a collaborative remedial investigation (RI) in City outfall basins and to identify and require implementation of source control measures (SCM) as needed under their respective authorities. The primary joint DEQ and City objectives of the outfalls RI/SCMs were to:

- Identify contaminant sources and pathways for each outfall.
- Determine if source control measures are needed within the basin (i.e., at upland sites or in the City system).
- Confirm that all identified sources are in the appropriate program to implement necessary controls.
- Evaluate the potential for upland sources to the City outfalls to be a significant future contaminant migration pathway to river sediment.
- Evaluate City and state stormwater programs to determine if modifications are needed to ensure long-term protection of sediment quality from upland sources.

The three main components of the City’s general approach to the basin RI/SCMs were:

1. Identifying basins where unknown contaminant sources may be present, and collecting analytical data and information from other programs to confirm whether sources were present and to determine actual source locations.
2. Coordinating with the DEQ Cleanup Program on known contaminated sites in City basins to ensure that all potential contaminant pathways from the sites to the basins are evaluated and controlled at the source.

Historically, DEQ did not always require sites in the Cleanup Program to consider stormwater during upland site remedial investigations. In addition to stormwater, contaminant pathways can include contaminated groundwater infiltration into or along City conveyance systems and offsite tracking of contaminated erodible soil to City rights-of-way.

3. Determining appropriate control programs so that all identified sources are controlled and source controls are implemented at the source.
   ○ Major sources (i.e., those with suspected high concentrations of contaminants migrating offsite and where remedial investigation and/or action may be needed) were referred to the DEQ Cleanup Program.
   ○ Sources with low to moderate contaminant concentrations were referred to other state or City stormwater quality programs to ensure that sites make necessary operational changes to control pollutant discharges.

As the Study Area expanded from the ISA (RM 3.5 to RM 9.2) to the current Study Area (RM 1.9 to RM 11.8), the BES Portland Harbor Source Control Program broadened its work under the IGA to incorporate the additional outfalls and drainage areas into its source investigation.

The City evaluated the potential for City roads to be a source, but determined that stormwater discharges were not likely to have a significant adverse effect on inriver sediment for the following reasons:

- Vehicular use of roadways is not associated with most of the major risk drivers in the river (e.g., contaminants such as polychlorinated biphenyls [PCB] and pesticides typically are not deposited by cars on roadways).

- Residential areas (e.g., St. Johns) have the highest density of City paved roads, and stormwater treatment already had been added in most of these areas as part of the CSO Abatement Program system improvements and other City programs (see Section 4).

- Because of the large industrial tax lots within the harbor and the large percentage of parks and open space (see Figure 2), City roads comprise only a small percentage (4 percent) of the total area within City outfall basins (see Table 2-2 and Figure 2-4).

- Other City and state programs are addressing potential contaminant discharges from roadways (e.g., City street and associated stormwater system maintenance activities, DEQ permits that control offsite tracking of contaminants from industrial sites to roadways, etc.).

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8 The City constructed stormwater treatment facilities in Basins 48, 49, and 50 as part of the CSO Abatement Program. See Appendix A for specific information about these facilities.
Basin investigations also typically did not extend into the combined sewer drainage areas (i.e., the areas outside of the separated storm systems). This is because land use in these areas within the harbor is largely residential and commercial, and additional controls were implemented under the CSO Abatement Program to minimize discharges to the river from the combined system (see Section 2.3.2).

In short, to obtain the best potential for contaminant reduction, the City focused source investigation efforts on the outfall basins and sources within the basins that had the highest concentrations of contaminants. To direct source investigation resources to these areas, the City implemented a general land use approach, along with an evaluation of inriver sediment data and information compiled about potential source areas within the basins, to identify outfall basins where further data collection was warranted (see Section 3.3).

### 3.3 Outfall Basin Evaluation

The City developed the *Programmatic Source Control Remedial Investigation Work Plan for the City of Portland Outfalls Project* to describe the approach used to determine upland sources of contamination to the municipal stormwater conveyance system (CH2M HILL, 2004b). In accordance with that plan, the City implemented an iterative approach to completing the RI/SCM process for each basin.

An Outfall Basin Completion Summary for each outfall is included in the Closure Report provided in Appendix A. Each summary:

- Provides general background information specific to the basin.
- Synthesizes the source investigation approach implemented in the basin, with references to relevant technical reports.
- Presents a weight-of-evidence evaluation to support the conclusion that additional City source investigation is not needed.
- Identifies the control mechanisms (implemented or planned) for the sources located within the basin that address current and future contaminant discharges to the basin.

Basin evaluation steps completed by the City included (1) prioritizing basins for source investigation, (2) identifying potential sources and pathways within basins to shape investigation activities, (3) collecting data to identify sources, (4) determining the appropriate programs for controlling sources, and (5) verifying that additional source investigation in the basin was not warranted. These steps are described in more detail below.
3.3.1 Prioritization of Basin Source Investigations

The City prioritized basins for initial source investigation to ensure that the outfall basins with the highest likelihood of containing uncontrolled sources were investigated early enough to allow time for implementing source controls (CH2M HILL, 2004b). These areas were identified by evaluating sediment data collected by the City near the outfalls, harbor-wide sediment data compiled by the LWG, and known upland conditions (e.g., land use and potential sources to the basin and river in the vicinity of the outfall). Basins identified for early initial investigation were those where inriver sediment concentrations, land use, and/or upland site information indicated that the basin may be a significant pathway to the river for contaminants from upland areas. The City assigned a lower initial investigation priority to basins where adjacent inriver sediment contamination was not present and where basin land use did not indicate a likelihood of sources with high contaminant concentrations. These priorities determined the order of evaluation. Each City basin was evaluated as part of the Outfalls Project.

Basin source investigations typically included a broader range of contaminants than those identified through sediment data evaluation because the City wanted to verify that other significant sources were not present. In some cases, additional analytical data also were useful in identifying specific contaminant source areas and pathways to the conveyance system. As new data collected in the City conveyance systems (e.g., by LWG) and at upland sites within the basins became available, the City adjusted basin investigation priorities and source tracing contaminants.

In 2010, the City conducted an interim assessment of further source tracing needs. The City developed the Stormwater Evaluation Report to present the statistical analysis of basin stormwater data used to determine specific contaminants and basins where additional source tracing was warranted (BES, 2010b). This analysis placed each basin in one of three interim categories:

1. **Further source tracing not planned.** Applied to basins where basin data, land use, and a review of potential sources indicate that the basin does not contain significant sources.

2. **Further source tracing not recommended at this time.** Applied to basins where data indicate sources, but sources were believed to have been identified and investigations at suspected sources were underway or planned.

3. **Further source tracing may be needed.** Applied to basins where data suggest sources, but no sources had been identified.

For basins in the second category, the City continued to review data being collected at upland sources to confirm that sources of contaminants observed in the basin had been identified and to verify that additional City source tracing
in the basin was not needed. For basins in the third category, the City initiated additional source investigations to fill data gaps.

3.3.2 Identification of Potential Sources and Pathways

The second step in the outfall basin evaluations was to identify potential sources and pathways to the City conveyance system for contaminants that had been observed in river sediment. This information then was used to design subsequent source investigations in the basin. The City also evaluated potential sources and pathways to the river from properties in the vicinity of the outfalls to develop a conceptual site model of contaminant sources and pathways for each basin (e.g., in some cases, contaminants observed in river sediment near the outfall appear to be from sources that are not located within the City basin).

To identify potential sources within the basins, the City reviewed City and DEQ records to identify specific upland properties that may be discharging pollutants to the basins. Potential sources to each basin included:

- Sites in the DEQ Environmental Cleanup Site Information (ECSI) Database (i.e., sites with known or potential contamination from hazardous substances).
- Sites with National Pollutant Discharge Elimination System (NPDES) stormwater permits issued by the DEQ Water Quality Program to sites with industrial exposures.
- Sites with a history of contaminant releases.
- Sites without an NPDES permit that had been identified by the BES Industrial Stormwater Program to have industrial operations that may result in contaminant exposures to stormwater.

There are several possible pathways for contaminants from upland sites to migrate to City stormwater conveyance systems. Potential contaminant migration pathways to the river via the City system include:

- Stormwater and non-stormwater\(^9\) discharge via piped connections to the basin.
- Overland runoff of site stormwater to offsite inlets (i.e., catch basins in the right-of-way or on adjacent property) that are connected to the basin.
- Preferential infiltration of contaminated site groundwater into City storm lines or migration along the storm line bedding.
- Offsite tracking of contaminated site erodible soil to areas where it can migrate to basin inlets (see Figure 3-2).

\(^9\) Non-stormwater discharges include all other permitted (e.g., approved discharges, such as non-contact cooling water) and non-permitted (e.g., spills and illicit discharges) flows.
Air deposition of site contaminants (i.e., fugitive dusts) to offsite impervious surfaces where contaminants can be mobilized by stormwater runoff.

The City used preliminary information on potential sources and pathways to identify potential contaminants and sampling locations for the outfall basins (see Section 3.3.3). To identify potential preferential groundwater pathways to City basins, the City evaluated potential intersections between known groundwater plumes (i.e., mapped areas of contamination) at upland sites and City storm sewer systems in the harbor (GSI, 2006). The City provided this information to DEQ for consideration during evaluations of upland site sources and pathways to the river.

### 3.3.3 Data Collection

Types of analytical data collected from the City conveyance system and from potential upland sources, to identify specific contaminant sources to the basins, included samples to characterize stormwater, inline solids, erodible soil, and dry-weather flow. The BES Field Operations Program invented a new passive suspended sediment sampling device (see Figure 3-3) to use in smaller pipes where standard sediment traps did not fit and in larger pipes with shallower stormwater flow depths (BES, 2013). The City also used data that were collected from the City conveyance system by other parties, such as the LWG, Port, and DEQ Cleanup Program sites. The Completion Summaries presented in Appendix A include tables of specific investigations in each basin.

For each basin, the City evaluated the basin to determine whether data collection was needed to identify sources (i.e., inriver sediment data or other information indicated the basin was a potential pathway for upland contaminant discharges to the river). If so, the City designed a sampling plan to meet the specific basin investigation objectives. City source investigations focused on the areas where current sources were most likely to be present and on early identification of the major sources (i.e., sources with high concentrations of contaminants in stormwater discharges). Source control implementation at these sources results in large reductions in contaminant loading to the municipal stormwater system.

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10 The term “inline solids” refers to solids samples collected from a conveyance system. Inline solids analyzed by the City for the source investigation included samples of residual sediment accumulated in storm lines and catch basins, as well as suspended solids moving through the system via stormwater and collected in “sediment traps.”
The iterative “up-the-pipe” approach used by the City typically entailed collecting data from the downstream end of the conveyance system (i.e., representative of the whole drainage basin before discharge from the outfall) for a broad range of contaminants to determine if another investigation round was needed. The City compared contaminant concentrations to the screening level values provided in the Portland Harbor JSCS, to the ranges of concentrations in samples collected at industrial sites in Portland Harbor (DEQ, 2009), and to data collected at sites within the basin to ascertain whether unknown sources may be present in the basin. If additional investigation was warranted, then the City identified sampling locations farther up-the-pipe in specific branches of the storm system and near suspected sources. Where necessary to expedite potential referral to DEQ, the City sampled discharges to the basin from individual upland sites.

The City also used data collected by sites, for various regulatory requirements, in the basin evaluations. Specifically, site investigations conducted under DEQ Cleanup Program oversight often included a combination of stormwater, inline solids, groundwater, and soil data to characterize potential offsite migration pathways for site contaminants. The City also used the stormwater monitoring data collected by sites with NPDES stormwater permits for the DEQ Water Quality Program. In addition, DEQ collected stormwater solids data from a number of industrial sites in City basins, as part of DEQ site discovery activities in the harbor.

The conveyance system and upland site data, in conjunction with land use and historical information, formed the basis of the City’s conceptual models of contaminant sources and pathways for each basin. The Completion Summaries in Appendix A summarize data collection activities, sources, and pathways in each basin. Three examples of the City’s data collection approach are provided in Table 3-1.

In some basins, the City collected additional data after source controls were implemented at identified sources. These data were used to verify that additional source tracing was not warranted and to determine whether the implemented controls were likely reducing contaminant loading to the City storm system (i.e., effectiveness monitoring). Under DEQ Cleanup Program oversight, sites evaluate the effectiveness of stormwater source controls that are put into place to verify that additional controls are not warranted.
The City conducted source investigations in basin drainage areas that were subsequently diverted to the City’s combined sewer system (i.e., areas within Basins 17, 43, 44A, 46, and 47). These investigations had a dual purpose. The first was to identify major sources to the river that warranted control before the CSO diversions were completed in 2006 and 2011 (see Table 2-5). The second was to identify any potential sources that were likely to violate applicable City wastewater discharge limits and prohibitions, after the storm systems were diverted to the wastewater treatment plant.
3.3.4 Referral for Source Control

When the City identified a previously unknown contaminant source within a basin, the City and DEQ then determined which City or state program would be the most appropriate for implementing source controls. The general approach used was to refer major sources (i.e., those where contaminant concentrations were much higher than the JSCS screening levels) to the DEQ Cleanup Program. These sources were where data and historical records indicated that contaminant releases may have occurred and remedial actions may be needed to address potential risks to human health and the environment. In some cases, the City’s Portland Brownfield Program also could provide investigation funding assistance. Sources with lower contaminant concentrations that were not likely to require remedial investigation or action, and that were more likely to achieve source control through more minor operational changes and controls, were referred to other state or City programs. Examples of other programs include the DEQ Water Quality Program for issuance or enforcement of NPDES stormwater permits (administered by the City), the BES Industrial Stormwater Program for technical assistance or for issuance of stormwater control mechanisms under City Code, and DEQ’s Hazardous Waste Technical Assistance Program.

During the course of source identification and referral, the City and DEQ also evaluated their respective programs and authorities to determine whether modifications were needed to address identified sources. Section 4 includes further discussion of this adaptive management approach and descriptions of City source control programs at work in the harbor.

3.3.5 Case Studies

The Outfall Basin Completion Summaries in Appendix A conclude more than 10 years of source investigation and source control coordination work completed by the City in the stormwater basins. To demonstrate how the City implemented the Outfalls Project investigation and source control referral approach, simplified summaries of two of these basins (Basins 44 and 53A) are presented below. In these basins:

- The BES Portland Harbor Program conducted multi-phased source investigations and referred identified potential sources to City and state programs for further investigation and control (BES, 2011b and 2012c).

- Several sites collected data, under DEQ Cleanup Program oversight, to identify onsite source areas to the municipal stormwater system and to implement stormwater source controls.

- The BES Industrial Stormwater Program conducted facility inspections and provided technical assistance to industrial sites within the basins (see Section 4 for a description of this program).
The City collected additional stormwater data, following the completion of most site source controls, to confirm that further source tracing was not warranted and to evaluate whether contaminant concentrations (e.g., PCBs) in basin stormwater had decreased (BES, 2011b, 2012c, and 2012d). These data, along with data being collected by the DEQ Cleanup Program sites in the basins, indicate that source control implementation resulted in decreased contaminant loading to the municipal storm system.

Detailed descriptions of both basins are included in Appendix A. Figure 3-4 summarizes the source investigations and referrals completed in each basin.

### 3.4 Basin Findings

During the course of the Portland Harbor basin investigations, the City developed more than 50 reports documenting specific basin investigation findings. A summary of the reports relevant to each basin is provided in each individual Completion Summary included in Appendix A.

General basin source evaluation findings (i.e., the determination of whether sources that warrant control are present) fall into three categories:

1. No significant sources are present in the basin and the basin represents an insignificant or incomplete contaminant pathway to the river.
2. Sources to the basin are present and source identification is complete.
3. Additional source identification is needed or may be needed in the basin.

One basin (Basin 52D) remains in the third category because the basin source investigation is being completed by a private party, under a work plan approved by the DEQ Cleanup Program, and the investigation is still underway. Additional investigation of this basin by the City is not warranted (see Appendix A). The remaining City outfall basins in the harbor are divided equally between the first two categories. Figure 3-5 displays the City basin evaluation findings. Section 4 describes the City stormwater source control programs that are being implemented in Portland Harbor and in City outfall basins.
WILLAMETTE RIVER

STEP 1
Investigation results indicate PCBs source(s), and possibly chlordane source. (2008-2009)

STEP 2
Refer site to Industrial Stormwater Program for inspection/stormwater technical assistance. (2009)

STEP 3
Follow-up investigation for chlordane. No current major sources. (2010)

STEP 4
Source control effectiveness monitoring by City and upland site. Dramatic decrease in PCB concentrations in stormwater. Additional source tracing not needed. (2011-2012)

STEP 2
Refer site to DEQ Cleanup Program. Site investigation confirmed PCBs sources. Controls implemented. (2006-present)

STEP 3
Follow-up investigation for PCBs sources upgradient of substation. No current major sources. (2010)

STEP 4
City collects additional stormwater data to confirm more source tracing is not needed and controls are reducing pollutant loads. (2010)

WR-401
WR-353
WR-352
WR-350
WR-306
OF44
RM 11.2
RM 11.3

01 5 0 3 0 0
Feet

TOTAL PCBs in BASIN STORMWATER

BASIN 44

Pre-Source Control: 0.08 - 1.93 ug/L
Post-Source Control: ND - 0.08 ug/L

BASIN 53A

Pre-Source Control: 0.03 - 0.05 ug/L
Post-Source Control: 0.003 NJ ug/L

NOTES:

NJ = Tentatively identified and estimated. Total PCB congener values are based on a single congener detection, which is unlikely to occur.
ug/L = Micrograms per liter.


City Outfall Basin Investigation Case Studies

FIGURE 3-4
LEGEND

Basin Source Evaluation Findings
- No Significant Sources in Basin and Insignificant or Incomplete Pathway
- Sources in the Basin are Present and Source Identification in Basin is Complete*
- Additional Source Identification Needed or May be Needed in Basin

All Other Features:
- River Mile (RM)
- Portland Harbor Hydroboundary

NOTE:
*Current significant sources are not present within Basins 52C and 53. Investigations conducted within these basins suggest that contaminants from sources in the vicinity are being tracked offsite to areas drained by these outfalls.
SECTION 4. City Stormwater Source Control Programs

City programs contribute to stormwater quality improvements in the Study Area and stormwater source control takes many forms. Some source controls are designed to keep pollutants out of stormwater, such as removing potential contaminant exposures to rainfall via technical assistance to industries and public education programs. Other “structural” controls remove pollutants from stormwater before the stormwater reaches a receiving water or divert stormwater that may include contaminants away from receiving waters (e.g., to infiltration facilities or offsite disposal). Examples of structural controls include water quality swales, sedimentation ponds or vaults, and green streets.

During development of the IGA, DEQ and the City recognized that program modifications may be needed to meet Portland Harbor upland source control objectives and to minimize the potential for recontamination of river sediment from stormwater discharges. This section provides an overview of City stormwater source control programs in the harbor, and the adaptive management approach the City has been implementing to ensure that City programs evolve to meet future stormwater source control needs.

4.1 Overview of Stormwater Controls

The City historically has prohibited the discharge of contaminants to the City’s conveyance system. Early efforts to control discharges were in the form of discharge prohibitions in City Code. For example, an ordinance adopted in 1943 prohibited discharge of “any flammable liquid” into any public sewer.11 Subsequent code revisions in 1960 prohibited specific discharges that could be hazardous to humans and restricted the discharge of commercial and industrial wastes to public sewers.12 These provisions formed the basis of what eventually became the City’s pollution prevention programs, which are described in more detail in Section 4.2.

11 Portland City Code § 14-1432(l) (1943).
In 1990, EPA initiated Phase 1 of the NPDES Stormwater Program, which required permit coverage for stormwater discharges from medium and large Municipal Separate Storm Sewer Systems (MS4) located in incorporated places or counties with populations of 100,000 or more. In Oregon, EPA delegates administration and enforcement of NPDES regulations to DEQ. The City collected stormwater data from the municipal stormwater conveyance system starting in 1991 to evaluate issues of concern with specific land uses, and subsequently submitted its Stormwater Management Plan (SWMP) to DEQ in 1993. DEQ issued its first 5-year NPDES MS4 permit to the City and its co-permittees in 1995. At that time, the Portland City Council passed a resolution that designated BES as the lead for the City’s implementation of the stormwater program.

In preparation for the initial MS4 permit, the City implemented a program to monitor and control pollutants in stormwater runoff from industrial facilities. The City adopted City Code Chapter 17.39 in 1994 to further regulate discharges to the City’s stormwater sewer system, and entered into a Memorandum of Agreement (MOA) with DEQ to administer general NPDES industrial stormwater permits issued by DEQ to industrial sites discharging to the City’s storm sewer system (DEQ, 1994). DEQ and the City expanded the MOA in 1999 to include administration of all NPDES stormwater permits issued to individual industrial sites within the City. These agreements with DEQ resulted in closer coordination between the BES MS4 Stormwater Program and the industrial dischargers to the City’s stormwater system.

The MS4 Program’s 1993 SWMP identified BMPs for new stormwater pollution control techniques in a variety of categories (e.g., Operation and Maintenance, Public Education, and Industrial Controls) and existing management practices that had ongoing stormwater source control benefits (e.g., street sweeping, revegetation programs, etc.). The MS4 Program works within BES and with other City bureaus to achieve BMP goals and meet program objectives. During the early years of the MS4 permit, BES also piloted different types of structural BMPs in the City storm system and on City properties to improve stormwater quality and to inform subsequent revisions to City Code that incorporate stormwater controls into City-wide development standards. Annual reports summarizing the MS4 Program activities from 1995 to the present are available online. This program forms the backbone of the City’s stormwater source control in the harbor, and is described in more detail in Section 4.2.

Following the listing of the harbor, the City initiated a targeted investigation of contaminant sources to the municipal stormwater conveyance system in Portland

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13 Co-permittees for the first permit cycle were Multnomah County, Port, ODOT, Multnomah Drainage District #1, Peninsula Drainage District #1, and Peninsula Drainage District #2. The Port is the only co-permittee on the current MS4 permit.


15 DEQ retained oversight on some permits issued to government agencies.

16 http://www.portlandoregon.gov/bes/37485
Harbor and refer those sources to appropriate programs for control (see Section 3). By 2005, DEQ and EPA had developed the Portland Harbor JSCS (DEQ and EPA, 2005) and the DEQ Cleanup Program had begun to routinely incorporate stormwater into upland site investigations and remediation. Key milestones in the joint City and DEQ collaboration on Portland Harbor stormwater source control are displayed in Figure 4-1.
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4.2 Current Stormwater Control Programs

4.2.1 BES MS4 Program

DEQ reissued the MS4 permit to the City in January 2011. In April 2011, the City submitted a revised SWMP to DEQ to describe the BMPs the City planned to implement throughout the permit term, to reduce the discharge of pollutants from the municipal stormwater system to the maximum extent practicable (BES, 2011c). The MS4 Program relies on a number of BES, Portland Bureau of Transportation (PBOT), Portland Bureau of Development Services (BDS), and other partner initiatives to accomplish the stormwater BMP objectives. The eight BMP categories in the SWMP are as follows:

1. Operations and Maintenance (i.e., for streets, sewers, and City facilities)
2. Industrial/Commercial Controls
3. Illicit Discharges Controls
4. New Development Standards
5. Structural Controls
6. Natural Systems
7. Public Involvement
8. Program Management

Brief summaries of some of the City programs that help to meet these objectives are provided below. Detailed descriptions of annual accomplishments in each BMP category are included in annual MS4 reports to DEQ.

4.2.1.1 Operations and Maintenance

The City implements operations and maintenance practices for the City storm sewer system, City rights-of-way, and City facilities to reduce the discharge of pollutants from the MS4.

- For the storm system, the BES Stormwater Operations and Maintenance group works with PBOT to inspect, maintain, and clean system components. This includes pipes, ditches, catch basins, inlets, culverts, public stormwater management facilities, and other infrastructures.

- For City streets, PBOT conducts routine street sweeping (see Figure 4-2) and implements work practices to limit pollutant discharges, such as spill and erosion control during street maintenance activities.
• For City facilities, each bureau manages City assets to minimize potential adverse stormwater effects. Examples include operation and maintenance of the stormwater treatment facilities at the BES Water Pollution Control Laboratory (WPCL), and integrated pest management in City parks to minimize fertilizer and pesticide use.

4.2.1.2 Industrial/Commercial Controls

The City regulates industrial and commercial facilities to reduce and control the discharge of pollutants to the MS4. The BES Pollution Prevention Services Group, of which the Industrial Stormwater Program is an integral part, implements several programs that work with individual facilities to address potential pollution concerns. Under an agreement with DEQ, BES administers NPDES industrial stormwater permits (1200-A, 1200-Z, and 1200-COLS)17 and No Exposure Certifications (NEC) issued to facilities within the City (DEQ, 2010). Under this IGA, BES reviews Stormwater Pollution Control Plans (SWPCP) prepared by facilities to meet permit requirements, reviews monitoring data collected by permittees, conducts facility inspections, provides technical assistance on BMPs needed at the sites to control pollutant discharges in stormwater runoff, and refers non-compliant industries to DEQ for enforcement. BES also identifies facilities that are covered by the NPDES program but warrant issuance of an NEC instead of a permit because of the lack of industrial exposures to stormwater. BES confirms that NEC conditions are met and conducts periodic inspections to verify that facility operations continue to qualify for the NEC.

Another aspect of the BES Industrial Stormwater Program is to inspect unpermitted industrial and commercial facilities to determine whether they are required to obtain an NPDES stormwater permit and to provide technical assistance and outreach to identify pollution prevention measures. BES identifies these facilities through field reconnaissance, environmental surveys conducted by the Industrial Pretreatment Program, and pollution complaints. In some cases, the BES Industrial Stormwater Program will identify sites for which specific stormwater BMPs are needed, but which either do not qualify for NPDES program coverage because of the Standard Industrial Codes under which the facility operates, or need controls in addition to what is required under the permit. Where necessary, BES uses its authorities under City Code Chapter 17.39 to require enforceable stormwater controls, such as SWPCPs or Accidental Spill Prevention Plans. These types of controls under City Code have been referred to by the Industrial Stormwater Program as City Discharge Authorizations or Stormwater Control Mechanisms (SWCM). Under newly adopted Administrative Rules,18 the City now will issue permits to require these types of stormwater controls. SWCMs, NPDES industrial stormwater permits, and NEC coverage

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17 See http://www.deq.state.or.us/wq/stormwater/industrial.htm for more information on NPDES industrial stormwater permits issued by DEQ.

18 BES updated and finalized Administrative Rules, effective October 1, 2013, that are associated with the issuance and enforcement of City stormwater permits.
within the City’s outfall basins are displayed in the Completion Summaries provided in Appendix A.

In 2011, the City evaluated long-term stormwater data in Basin 19, where both DEQ and City stormwater source control programs apply to industrial sites, to evaluate program effectiveness (BES, 2011d). Data showed decreasing trends and that City and DEQ programs are working (see Figure 4-3); further reductions are anticipated because the 2012 NPDES industrial permits benchmarks are lower. Conclusions from this basin are applicable to other drainage areas with similar land use and source control program activity.

The Industrial Stormwater Program also evaluates non-stormwater discharges allowed under the MS4 permit (e.g., pumped groundwater discharges) to identify and require implementation of any control mechanisms required to protect the City storm system and receiving waters.

The BES Portland Brownfield Program also contributes to control of pollutant discharges from industrial and commercial properties. This program administers EPA grants to provide assistance for property owners, developers, and community members who have concerns with using potentially contaminated land. Funding is available for assisting with environmental assessment and for providing loans to pay for needed cleanup at contaminated sites.

BES also partners with other organizations to promote pollution control at the industrial or commercial source. Examples of this approach include:

- Participation in the Regional Pollution Prevention Outreach Team, a multi-agency group of environmental professionals that promotes comprehensive pollution prevention programs and sponsors the Eco-
Logical Business Program. This program certifies businesses that use environmentally responsible business practices.

- The Bureau of Planning and Sustainability’s BEST program (Businesses for an Environmentally Sustainable Tomorrow), which assists industries with green practices that conserve resources and address stormwater and solid waste concerns.

### 4.2.1.3 Illicit Discharges Controls

The City identifies, investigates, controls, and, to the extent practicable, eliminates illicit discharges to the MS4. Illicit discharges can include illicit connections (i.e., piped connections that allow unacceptable non-stormwater discharges to enter the conveyance system), illegal dumping, and spills. BES implements an Illicit Discharge Elimination Program to identify outfall basins where illicit connections may be present. This program conducts inspections and dry-weather sampling at City outfalls and investigates referrals from other work groups (e.g., Industrial Stormwater) where illicit connections are suspected. City Code and administrative rules provide enforcement authority to rectify illicit connections.

BES also implements a Spill Response Program to provide immediate response to spills and pollution complaints that may adversely impact City conveyance systems. The program maintains a 24-hour hotline, investigates spill reports and complaints, and works with other City staff and external agency partners to complete necessary response and enforcement actions.

### 4.2.1.4 New Development Standards

The City implements new development and redevelopment standards to prevent and mitigate potential pollutant discharges that can result during and after construction. By requiring the incorporation of stormwater management and erosion control provisions into property development plans, the City mitigates potential adverse effects on stormwater from new impervious surfaces, site uses that may generate pollutants of concern, and ground disturbance during construction.

New development and redevelopment projects are required to manage stormwater onsite after project completion (i.e., for the life of the project). The City’s Stormwater Management Manual (SWMM) identifies stormwater management principles and techniques that help preserve or mimic the natural hydrologic cycle and achieve water quality goals (BES, 2008). SWMM requirements apply to all development, whether public or private, and include provisions for reducing the impacts of stormwater runoff (water quantity).

20 City Code Chapter 17.39.050 Notification and Control of Illicit Connections and Discharges; City Code Chapter 17.39.110 Enforcement.

and pollution (water quality). Standards included in the SWMM are intended to make site-specific improvements to properties City-wide to protect water resources.

Key stormwater quantity and quality requirements of the SWMM include:

- Infiltration of as much post-development stormwater runoff as practicable.
- Removal of at least 70 percent of total suspended solids (TSS) from 90 percent of the average annual runoff.
- Removal of pollutants of concern for receiving waters that have established total maximum daily loads (TMDL) or are on DEQ’s 303(d) list of impaired waters.
- Additional source controls for sites with characteristics and uses that may generate specific pollutants of concern or pollutant levels that cannot be addressed solely with implementation of standard pollution reduction facilities.

BES also conducts a Maintenance Inspection Program to verify that stormwater management facilities constructed to meet SWMM requirements are properly installed, operated, and maintained. This program reviews Operation and Maintenance Plans submitted to meet SWMM requirements and provides technical assistance to site owners and operators as needed.

The Completion Summaries in Appendix A display properties where development or redevelopment has occurred under the SWMM and properties where stormwater management facilities are in operation.

Another tool for reducing construction-related stormwater impacts is the City’s Erosion and Sediment Control Manual (BDS et al., 2008). BDS administers and enforces City Code Title 10: Erosion and Sediment Control Regulations for private development. The public works bureaus (BES, PBOT, Water, and Parks and Recreation) manage erosion, sediment, and pollutant control in accordance with Title 10 for their own public works permit projects. Title 10:

- Applies to any ground-disturbing activity, regardless of site size.
- Allows no visible or measurable offsite discharge at any time during construction.
- Requires compliance with the Erosion and Sediment Control Manual.
- Requires the same standards for private construction sites and public works permit projects.

BDS operates a hotline and Web site for receiving erosion-related complaints, and works with BES to investigate and implement an appropriate response.
City public works bureaus also acquire construction-related NPDES stormwater permits (1200-C) from DEQ for each project site larger than 1 acre. Given the number of construction projects undertaken by PBOT and the Bureau of Parks and Recreation, those bureaus hold agency program permits (1200-CA) that cover all development-related activity.

### 4.2.1.5 Structural Controls

The City structurally modifies components of the storm drainage system to reduce pollutant discharges (i.e., suspended solids) from the MS4 and provides technical assistance, grants, and incentives that result in retrofits and improvements to existing developments that discharge to the MS4. These activities include:

- Implementing retrofits of existing storm drainage systems identified through routine operations and maintenance by City bureaus. Examples include culvert improvements in Forest Park and retrofitting ditches with water quality swales.
- BES Sustainable Stormwater Ecoroof Program. This program provides technical assistance and development incentives to promote the use of ecoroofs on public and private property to manage stormwater onsite.
- BES Sustainable Stormwater Green Streets Program. This program identifies opportunities to install green infrastructure (e.g., vegetated swales, planters, rain gardens, etc.) in public rights-of-way to reduce the flow volume and solids loading to the MS4 from street runoff.
- BES Systems Planning. BES is in the process of developing a Stormwater Systems Plan that will be used to identify and prioritize projects for potential funding through the BES capital improvement process. The plan will evaluate various levels of service provided by the stormwater system, such as capacity, condition, and water quality.

### 4.2.1.6 Natural Systems

The City protects and restores natural areas and vegetation in numerous ways to help preserve the natural resources and functions that prevent pollutants from entering into and discharging from the MS4. Efforts include overall watershed-level planning, regulatory measures, tree-planting incentives, and land acquisition and protection. Examples of relevant program areas include:

- Implementation of the Portland Watershed Management Plan (BES, 2006b). This plan includes the Willamette watershed, and describes the approach the City uses to evaluate watershed conditions and to

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22 A video about the Ecoroof Program is located at http://www.portlandoregon.gov/bes/article/465250.

implement projects to improve watershed health. Development of subwatershed improvement strategies is expected to begin in the Portland Harbor area that will recommend specific actions to help protect and improve environmental conditions in localized areas.

- BES Watershed Revegetation Program. This program improves water quality by restoring and maintaining native vegetation and reduces erosion and offsite migration of soil through biofiltration and bioengineering techniques.
- City land use plans and zoning codes that result in natural resource conservation and protection. These include environmental overlay zones that prevent or limit development within protected waterways and upland natural resource areas.
- Working with community partners to plant trees for stormwater management as part of the BES Urban Tree Canopy Program.
- Land acquisition and protection through interbureau partnerships, and partnerships with private property owners and Metro.

### 4.2.1.7 Public Involvement

The City informs the public about the causes of stormwater pollution, the effects on local waterways, and the need for pollution prevention and stormwater management. Examples of programs that support this BMP are:

- The Clean Rivers Education Program, which provides free water quality and field science training for City schools, teacher workshops, and curriculum resources.
- The Community Stewardship Grants Program, which promotes citizen involvement in watershed stewardship through funding watershed protection projects.
- Participation in the Regional Coalition for Clean Rivers and Streams, which is a group of agencies and municipalities in the metro area dedicated to educating the public about the potential impacts of stormwater runoff.

### 4.2.2 BES Portland Harbor Source Control Program

Section 3 of this report describes the Outfalls Project, which identified current and potential future contaminant sources to the City stormwater conveyance systems in the harbor and ensured that all identified sources were referred to appropriate EPA, DEQ, or City programs for control. BES created the Portland Harbor Source Control Program to develop and complete this project, under an
IGA with DEQ, because Portland Harbor warranted a more targeted in-depth investigation than other existing City programs could provide. Together, the City and DEQ completed the Outfalls Project. The Closure Report is included in Appendix A.

Under the IGA, City data collection resulted in new DEQ Cleanup Program agreements and implementation of stormwater source controls at more than a dozen sites that discharge to the MS4. In addition, the City and DEQ continue to share information on more than 50 ECSI sites in City outfall basins. There are also several sites within City drainage areas for which EPA is providing remedial investigation oversight. To help DEQ and EPA achieve source control at these sites, the City provides information from City records (e.g., plumbing and building records, spill records, Industrial Stormwater inspections) to inform site investigation activities and data evaluations. DEQ and EPA provide upland site work plans and reports to the City so the City can incorporate findings into basin data evaluations to determine whether additional source tracing is needed. The City and DEQ also collaborate on joint inspections, site discovery, and technical assistance on proposed source controls at sites of mutual interest.

In addition, the BES Portland Harbor Source Control Program provides ongoing technical support within BES and to other City agencies on projects, programs, and policies that have potential source control benefits in the harbor. Examples of this include helping to identify potential areas for green street facilities, reviewing proposed redevelopment plans at private sites in City drainage areas, and contributing to long-term watershed and conveyance system planning.

One of the joint objectives of the IGA was to evaluate City and state stormwater programs to determine if modifications were needed to ensure long-term protection of sediment quality from upland sources (see Section 3.2). The BES Portland Harbor program has been working internally with the MS4, Watershed, CSO, Pollution Prevention, and Engineering programs, as well as externally with other City bureaus (e.g., PBOT, Parks, Water, and Development Services) to make program improvements to meet harbor objectives. Implementing this adaptive management approach is described in more detail in Section 4.4, and represents one of the most critical ongoing roles of the BES Portland Harbor Source Control Program.

**4.2.3 BES CSO Abatement Program**

As described in Section 2.3.2, the BES CSO Abatement Program resulted in the diversion of approximately 600 acres of separated stormwater from the river to the CBWTP. Diverted areas included approximately 165 acres of industrial-zoned land that may have included potential current or future sources of contaminants to the river. Now that construction has been completed and wet weather infrastructure has been expanded, BES will continue to evaluate long-term system needs to determine where other modifications may be warranted, possibly resulting in additional diverted area.
4.2.4 City Remediation of Contaminated Property

Within the Study Area, there are a number of formerly contaminated industrial properties that were purchased by the City and remediated. In some cases, contaminated properties have been acquired by the Portland Development Commission (PDC) and remediated before resale to bolster economic development in target areas. One area where this occurred was the Pearl District, where PDC acquired and remediated multiple blocks that had legacy contamination from historical industrial activities (see Figure 4-4). In other cases, specific bureaus (e.g., BES and Water) acquire contaminated properties, remediate them, and redevelop them with City facilities. An example of this is the WPCL site in St. Johns (see the Basin 50 Completion Summary in Appendix A). BES acquired this site, conducted remedial investigation and soil removal activities, and ultimately redeveloped the site as a full-service environmental laboratory and as a showcase for stormwater BMPs.

4.3 Coverage of Source Control Programs in Portland Harbor

Some City programs that contribute to stormwater source control are implemented throughout the Study Area, while others apply only in areas served by City stormwater conveyance systems (see Figure 2-5). Table 4-2 summarizes the applicability in the harbor of the City programs described above.

The Completion Summaries in Appendix A display coverage for some of the programs listed above, at the outfall basin scale. To provide a sense of program coverage inside and outside of City outfall basins, Figure 4-5 shows locations of program activities within the Study Area for selected City programs with readily available spatial data.

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24 See the Basin 11 Completion Summary in Appendix A for more information.
### Table 4-1. City Stormwater Source Control Program Applicability in the Harbor

<table>
<thead>
<tr>
<th>Program Type</th>
<th>Harborwide</th>
<th>City Drainage Areas Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations and Maintenance</td>
<td>Street cleaning and maintenance BMPs</td>
<td>Storm system inspection and maintenance</td>
</tr>
<tr>
<td>Industrial/Commercial Controls</td>
<td>NPDES stormwater permit administration</td>
<td>Issuance of SWCMs/City Permits under City Code Chapter 17.39.</td>
</tr>
<tr>
<td></td>
<td>Technical assistance to Ind./Comm. Businesses on stormwater BMPs</td>
<td></td>
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<tr>
<td></td>
<td>Portland Brownfield Program</td>
<td></td>
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<tr>
<td>Illicit Discharges Controls</td>
<td>Spill Response Program</td>
<td>Illicit Discharge Elimination Program</td>
</tr>
<tr>
<td>New Development Standards</td>
<td>SWMM requirements</td>
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<tr>
<td></td>
<td>Erosion controls per City Code Title 10</td>
<td></td>
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<tr>
<td>Structural Controls</td>
<td>Green streets technical assistance</td>
<td>Stormwater system retrofits</td>
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<td></td>
<td>Ecoroof incentives</td>
<td>Stormwater system planning</td>
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<tr>
<td>Natural Systems</td>
<td>Willamette Watershed planning</td>
<td></td>
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<td></td>
<td>Land Use Plans/Zoning</td>
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<td></td>
<td>Urban Tree Canopy Program</td>
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<td>Revegetation Program</td>
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<td></td>
<td>Land Acquisition/Protection</td>
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<tr>
<td>Public Involvement</td>
<td>Clean River Education</td>
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<tr>
<td></td>
<td>Community Stewardship Grants</td>
<td></td>
</tr>
<tr>
<td>BES Portland Harbor Source Control</td>
<td>Technical Coordination between Industrial Stormwater and DEQ Cleanup Programs</td>
<td>Source investigation and source referral in City stormwater outfall basins</td>
</tr>
<tr>
<td>Program</td>
<td>Development review for harbor sites</td>
<td></td>
</tr>
<tr>
<td>BES CSO Abatement Program</td>
<td></td>
<td>Diversion of industrial stormwater drainage areas to the sanitary system</td>
</tr>
</tbody>
</table>

**Notes:**

- **BES =** Bureau of Environmental Services, City of Portland
- **BMP =** best management practice
- **CSO =** combined sewer overflow
- **DEQ =** Oregon Department of Environmental Quality
- **NPDES =** National Pollutant Discharge Elimination System
- **SWCM =** Stormwater Control Mechanism
- **SWMM =** Stormwater Management Manual

Amended February 2014
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4.4 Adaptive Management

Completion of the outfall basin RI/SCM process provided an opportunity to identify areas where City program content or implementation could be improved to better meet Portland Harbor source control objectives, especially in older industrial areas with legacy contamination. Below are examples of how adaptive management has been applied by the City for stormwater source control in Portland Harbor.

- **BES Industrial Stormwater – DEQ Cleanup Program Coordination.** The City recognized that the DEQ Cleanup Program would be evaluating the stormwater pathway at contaminated sites for which the BES Industrial Stormwater Program had valuable technical information and experience. Through the BES Portland Harbor Source Control Program, the City fostered a direct working relationship between the BES Industrial Stormwater Program and DEQ Cleanup Program to support thorough evaluations of site stormwater pathways. Coordination now includes joint facility inspections, reviewing and commenting on stormwater work plans and reports prepared for the DEQ Cleanup Program, data sharing, and provision of technical records.

- **SWMM Revision and Internal/External Coordination.** During the 2004 revision of the development standards in the SWMM, requirements were added to the Source Controls section (Chapter 4) to address sites with known or suspected contamination. As part of this effort, BES worked with BDS to flag all DEQ ECSI tax lots in the City’s development permit system to help permit reviewers identify these properties as contaminated sites during the permit review process. In addition, the City implemented a business process to contact the DEQ Cleanup Program when development or redevelopment is proposed on ECSI sites to minimize potential exacerbation of environmental conditions at the site from proposed construction activities.

- **Private Party Access to City Sewers.** The City worked with DEQ to ensure that, where warranted, ECSI sites evaluated the nature and extent of site contaminants in the municipal stormwater conveyance systems that convey site drainage. To facilitate private party access to the City’s system when access was necessary to complete investigation and remediation objectives identified by the DEQ Cleanup Program, the City developed and implemented a sewer access authorization process to facilitate private party access to City sewers. Examples of access needs include conducting cleaning in the City conveyance system if offsite migration of contaminated materials had occurred, and conducting video surveys to verify potential complete stormwater and preferential groundwater pathways from sites to City storm lines.

- **City Code Revisions.** The City updated its stormwater code (Chapter 17.39) in 2011 and 2013 to clarify stormwater discharge requirements and
limitations and to enhance the enforcement provisions. This process included updating and finalizing Administrative Rules to facilitate issuance and enforcement of City permits, effective October 1, 2013.

- **Spill Response.** The City added direct coordination with DEQ Cleanup Program managers for responding to spills and pollution complaints at DEQ ECSI sites.

- **System Mapping.** The City incorporated field findings related to stormwater conveyance systems to BES mapping staff to update geographic information system layers used by municipal and private parties. The City also worked directly with the Port and ODOT to resolve discrepancies in City system maps.

The City worked with DEQ to evaluate improvements to DEQ Cleanup and Water Quality Programs. For example, the City provided technical assistance to DEQ on the development of an approach for evaluating the stormwater pathway as part of routine Cleanup Program site assessment and investigation. DEQ presented this approach in the JSCS (DEQ and EPA, 2005) and later in more detail in the specific Cleanup Program guidance regarding the stormwater pathway (DEQ, 2009). DEQ is in the process of evaluating the existing NPDES 1200-Z industrial stormwater permit and is considering including Portland Harbor-specific modifications; BES Industrial Stormwater and Portland Harbor staff identified potential candidates for permit coverage and provided mapping and inspection support to DEQ to assist with this evaluation.

The City will continue to evaluate its programs to identify areas where additional improvements should be made. Areas identified for future work include collaborating with DEQ on a process for routine updates of DEQ ECSI tax lots in the City permit tracking system, and working with BES system planners and Willamette watershed managers to develop a process for siting capital improvement projects in areas of the harbor with the highest potential benefit (e.g., to evaluate multiple objectives, such as sediment and water quality, long-term maintenance costs, etc.). The focus will be on basins that discharge to more quiescent areas of the harbor (e.g., Swan Island Lagoon), where a higher level of control may be warranted.

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25 City Ordinance 184898 (September, 2011) and City Ordinance 186192 (August, 2013).
SECTION 5. Summary and Conclusions

This report summarizes:

- The City’s approach in Portland Harbor to source investigation and control in City outfall basins.
- The various City source control programs and regulations that are in place to reduce contaminant loading to the Willamette River via stormwater.
- The rationale for concluding that the basin RI/SCM process is complete in every City outfall basin within the Portland Harbor and that requirements of the Outfalls Project IGA have been satisfied (see Appendix A).

In partnership with DEQ, the City completed the remedial investigation of City outfall basins in Portland Harbor, verified that all significant current sources have been identified and are in an appropriate City, state, or federal program to implement source control measures where needed, and concludes that future discharges from City outfalls are unlikely to represent a significant source of contaminants to the river.

The BES Portland Harbor Program employs an adaptive management approach to modify City programs so they can better meet Portland Harbor stormwater source control objectives. As shown in Figure 5-1,\textsuperscript{26} long-term stormwater source control in the harbor will continue to rely on a myriad of City, state, and federal programs.

\textsuperscript{26} Figure obtained from Dale Norton at the Washington State Department of Ecology, and modified to reflect local conditions.
Ongoing collaboration among agencies will be essential to ensuring that these
different regulatory and non-regulatory frameworks continue to reduce overall
loading of contaminants to the harbor via the stormwater pathway.
SECTION 6. References


Prepared for the City of Portland, Bureau of Environmental Services by CH2M HILL. April 2004.


